গবেষণা সংকলন ২০২৬

RESEARCH COMPILATION 2026

গোপালগঞ্জ বিজ্ঞান ও প্রযুক্তি বিশ্ববিদ্যালয় থেকে
২০২৪-২০২৫ সালে প্রকাশিত
নির্বাচিত ৩৩০ টি গবেষণা প্রবন্ধের সারসংক্ষেপ

বিজ্ঞান ও প্রযুক্তি গবেষণা অগ্রযাত্রায় গোবিপ্রবির সাফল্য

প্রকাশনায়:

রিসার্চ সেন্টার

গোপালগঞ্জ বিজ্ঞান ও প্রযুক্তি বিশ্ববিদ্যালয়
গোপালগঞ্জ-৮১০৫, বাংলাদেশ।

গবেষণা সংকলন ২০২৬

RESEARCH COMPILATION 2026

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রিসার্চ সেন্টার
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সম্পাদনায়

এডিটর-ইন-চীফ

ড. মোঃ শামসুল আরেফিন, পরিচালক, রিসার্চ সেন্টার

এক্সিকিউটিভ এডিটরস

ড. এ.টি.এম. সাইফুল ইসলাম, সহযোগী পরিচালক, রিসার্চ সেন্টার

ড. বশির উদ্দিন, সহযোগী পরিচালক, রিসার্চ সেন্টার

ড. মোহাম্মদ আসলাম, সহযোগী পরিচালক, রিসার্চ সেন্টার

এডিটরিয়াল ম্যানেজার

জনাব মোঃ আব্দুল কাদের শাকিল, বৈজ্ঞানিক কর্মকর্তা, রিসার্চ সেন্টার

প্রকাশকাল

জানুয়ারি ২০২৬ খ্রি.

প্রকাশনায়

রিসার্চ সেন্টার
গোপালগঞ্জ বিজ্ঞান ও প্রযুক্তি বিশ্ববিদ্যালয়
গোপালগঞ্জ-৮১০৫

মুদ্রণ ও গ্রাফিক ডিজাইন

মদিনা প্রিন্টার্স এন্ড পাবলিশার্স
২৭৮/৩, এ্যলিফ্যান্ট রোড, কাঁটাবন, ঢাকা ১২০৫
ফোন: ০১৮১৮২৫৭৬৪৪

Vice Chancellor
Gopalganj Science and Technology University

Message

The initiative to publish the compilation titled "Research Compilation-2026," featuring selected research articles by the faculty members of Gopalganj Science and Technology University published in internationally recognized Scopus-indexed journals with impact factors, represents a significant milestone in our university's research activities. It bears testimony to the excellence of our teachers, the quality of research, and our commitment to international recognition.

Gopalganj Science and Technology University is rapidly establishing itself as one of the leading research-oriented universities in the country. According to the Scopus database, the number of our research publications, citations, and impact factors are continuously increasing, making them comparable to the top institutions in the nation. This compilation will further highlight the contributions of our researchers and inspire young researchers toward new innovative studies.

I hope that our researchers will continue to play an important role in national development and the advancement of science and technology in the future. I extend my heartfelt congratulations to all the teachers, officers, and staff involved in the publication of "Research Compilation-2026," and wish for the continued prosperity and success of Gopalganj Science and Technology University.

Professor Hossain Uddin Shekhar, PhD
Vice Chancellor
Gopalganj Science and Technology University
Gopalganj-8105, Bangladesh.

Pro Vice Chancellor
Gopalganj Science and Technology University

Message

The endeavor to publish "Research Compilation-2026," a collection of selected research articles by the faculty of Gopalganj Science and Technology University in internationally recognized high-impact factor Scopus-indexed journals, signifies a transformative step in our university's research arena. It stands as evidence of our educators' exceptional proficiency, the depth of our research, and our resolute determination to achieve global recognition.

Gopalganj Science and Technology University is swiftly positioning itself in the ranks of the nation's top research-based institutions. According to Scopus database insights, the consistent growth in our research publications, citation rates, and impact factors is competitive with the country's elite universities. This compilation will amplify the invaluable contributions of our researchers and encourage emerging scholars in innovative endeavors, opening new horizons on national and international levels.

I am certain that our research community will pioneer in national development, sustainable technology, and novel advancements in science moving forward. My sincere thanks and congratulations to all teachers, officers, and staff associated with the publication of "Research Compilation-2026." Best wishes for the unwavering progress and overall success of Gopalganj Science and Technology University.

Professor Dr. Md Sohel Hasan
Pro Vice Chancellor
Gopalganj Science and Technology University
Gopalganj-8105, Bangladesh.

Treasurer
Gopalganj Science and Technology University

Message

Research plays a pivotal role in the continuous advancement of a university's education, research, and innovation-oriented activities. Through research, new knowledge is created, and effective pathways are opened to address national and global challenges. In this context, the "Research Compilation-2026" of Gopalganj Science and Technology University is a timely and commendable initiative.

The research works included in this compendium reflect the dedication, perseverance, and academic excellence of the university's faculty members and researchers. By presenting research outcomes from various faculties and departments in a consolidated form, this publication is expected to significantly contribute to knowledge sharing, interdisciplinary collaboration, and future research endeavors.

I extend my sincere congratulations and gratitude to all faculty members, researchers, editors, and organizers involved in the preparation and publication of this research compendium. Their tireless efforts and cooperation have made the publication of this valuable compilation possible. I firmly believe that the "Research Compilation-2026" will further strengthen the university's research activities and will be regarded as an important reference in the academic arena.

Finally, I wish continued success to the research initiatives of Gopalganj Science and Technology University.

Professor Dr. Mohammed Nazmul Ahsan
Treasurer
Gopalganj Science and Technology University
Gopalganj-8105, Bangladesh.

Director
Research Center
Gopalganj Science and Technology University

Message

Research is the fundamental pillar of knowledge creation in a university and is intrinsically linked with education and innovation. Gopalganj Science and Technology University is committed to enhancing the quality of research, promoting interdisciplinary collaboration, and translating research outcomes into practical applications. In this context, the "Research Compilation-2026" stands as a significant and timely initiative. This compendium incorporates research works of faculty members and researchers from various faculties and departments of the university, reflecting their academic competence, dedication, and research orientation. By presenting research outcomes on a single platform, this publication is expected to play a vital role in knowledge sharing, increasing research visibility, and providing direction for future research initiatives. Furthermore, I would like to express my sincere gratitude to Professor Hossain Uddin Shekhar, PhD, honourable Vice Chancellor, for his commendable initiative in this regard.

On behalf of the Research Center, I extend my sincere appreciation and congratulations to all faculty members, researchers, editors, and supporting personnel involved in the preparation and publication of this compendium. Their tireless efforts and cooperation have made this valuable publication possible. I firmly believe that the "Research Compilation-2026" will further strengthen the research culture of the university and showcase its research excellence at both national and international levels.

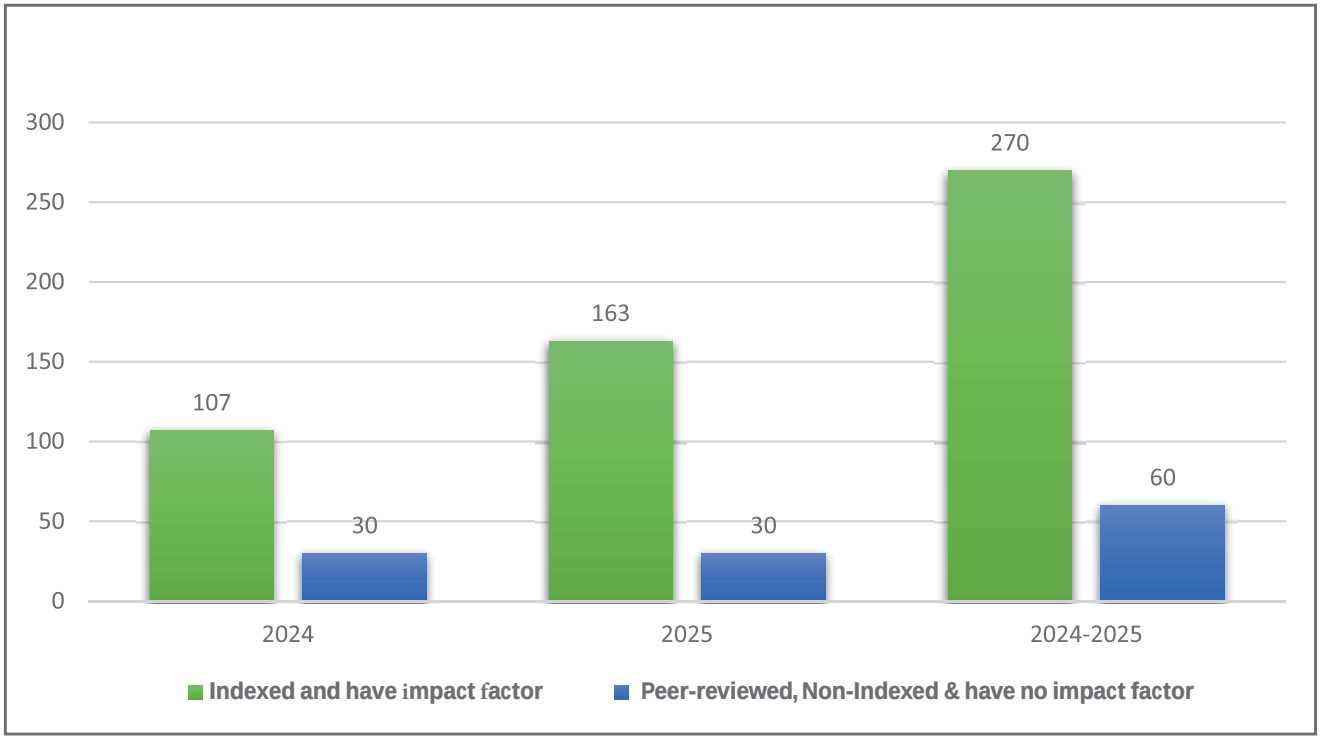
Dr. Md. Shamsul Arefin
Director
Research Center
Gopalganj Science and Technology University
Gopalganj-8105, Bangladesh.

Research Center
Gopalganj Science and Technology University

The Research Center of Gopalganj Science and Technology University serves as a central platform for promoting, coordinating, and strengthening research and innovation activities across the university. It is committed to fostering a dynamic research culture by supporting high-quality, interdisciplinary, and impact-oriented research aligned with national priorities and global challenges.

The Research Center facilitates research planning, capacity building, publication support, and collaboration among faculties, departments, and external partners. Through effective research governance and ethical practices, the Center aims to enhance research visibility, knowledge dissemination, and the practical application of research outcomes for societal and technological advancement.

Overview


Selected 330 Published Articles During 2024-2025
300
250
200
150
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107
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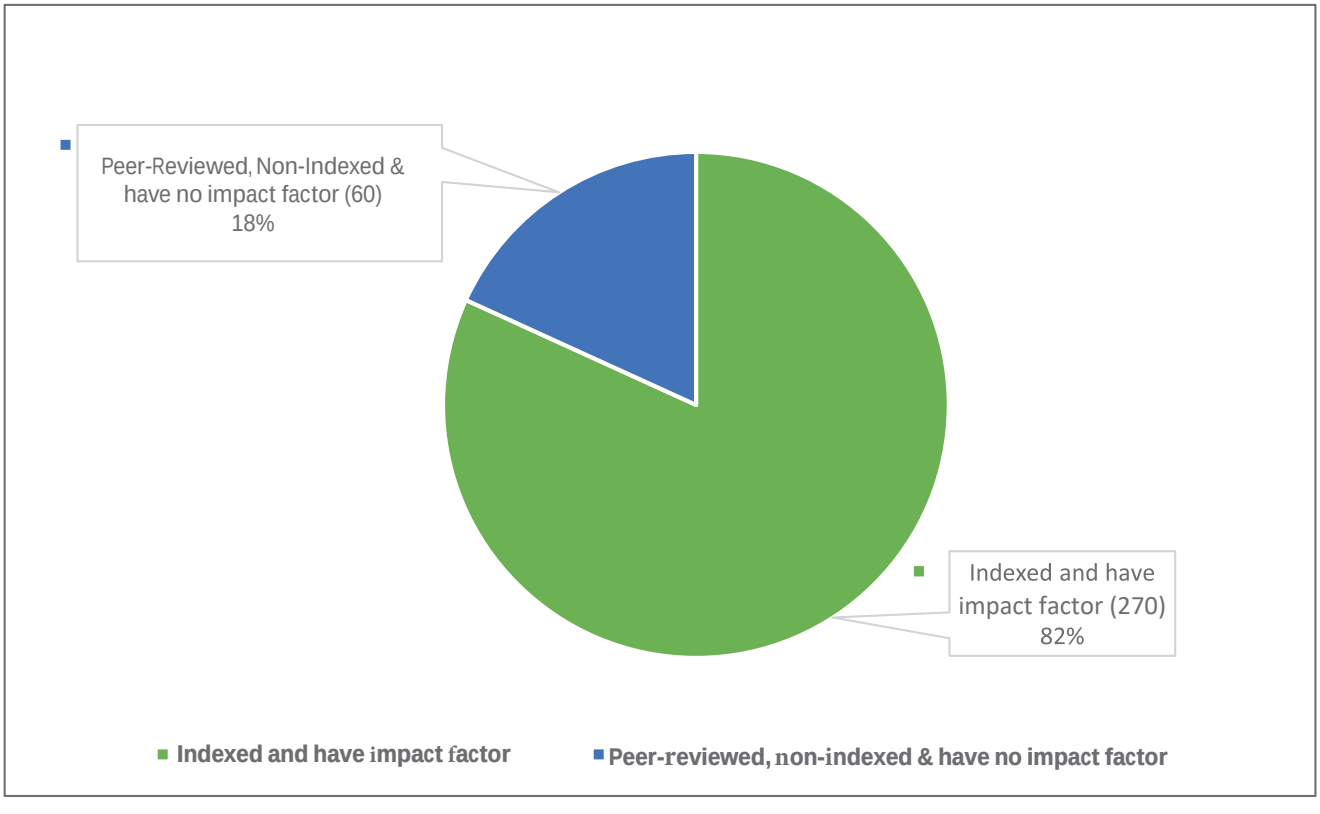
Peer-Reviewed, Non-Indexed & have no impact factor (60) 18%
Indexed and have impact factor (270) 82%
Indexed and have impact factor
Peer-reviewed, non-indexed & have no impact factor

List of Abstracts
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1	**Baowaly, M. K.,** Sarkar, B. C., Walid, M. A. A., Ahamad, M. M., Singh, B. C., Alvarado, E. S., ... & Samad, M. A. (2024). Deep transfer learning-based bird species classification using mel spectrogram images. *PLoS One*.	2.6	1
2	**Hoque, M. N**., Salma, U., **Uddin, M. J.**, Ahamad, M. M., & **Aktar, S.** (2024). Exploring transformer models in the sentiment analysis task for the under-resource Bengali language. *Natural Language Processing Journal.*	Indexed	2
3	**Ferdous, M.,** Mahmud, S., & Shimul, M. E. Z. (2025). MedNet: a lightweight attention-augmented CNN for medical image classification. *Scientific Reports.*	4.08	3
4	**Ferdous, M**., Mahmud, S., Chowdhury, T. A., Hasan, M. T., & al Harun, S. (2025). SST-HID: Scale-aware and shift-invariant teeth feature matching for human identification using OBB and SSIM. *Systems and Soft Computing.*	3.6	4
5	**Ajra, H**., Majid, M. A., & Islam, M. S. (2025). Design and Analysis of Smart Lighting System for Room Environments Using Simulation Supporting Diverse Light Bulbs. *International Journal of Advanced Computer Science & Applications.*	Indexed	5
6	**Ajra, H.,** Majid, M. A., Shohidul Islam, M., & Abdullah, D. (2025). Leaf Disease Detection in Plant Care using CNN Architecture: AlexNet and ResNet-50 Models. *International Journal on Advanced Science, Engineering & Information Technology.*	Indexed	6
7	**Ajra, H.,** Majid, M. A., & Islam, M. S. (2024). IoT-enabled smart cities towards green energy systems: a review. *International Journal of Reconfigurable and Embedded Systems.*	Indexed	7
8	**Hoque, M. N.,** & Seddiqui, M. H. (2024). Detecting cyberbullying text using the approaches with machine learning models for the low-resource Bengali language. *IAES International Journal of Artificial Intelligence (IJ-AI).*	Indexed	8
9	Faruq, M. O., Walid, M. A. A., **Baowaly, M. K**., Devnath, M. K., Ejaz, M. S., Barman, P. K., & Sattar, A. S. (2024). Shielding privacy: a technique of extenuating composition attacks in various independent data publication. *Bulletin of Electrical Engineering and Informatics.*	Indexed	9
10	**Al Asad, M. A**., **Alim, M. A**., **Khatun, M. H**., Sarker, A. C., & Rahman, M. A. (2025). Analysis of the Properties of Vacancy Mediated Methyl Ammonium Lead Iodide Perovskite: A DFT Based Study. *East European Journal of Physics.*	Indexed	10
11	Amin, R., **Khatun, M. H**., **Al Asad, M. A**., **Chakraborty, A**., Khanom, M. R., **Modak, J. K**., & **Shahjahan, M**. (2025). Structural, optical, and dielectric properties of Al–Zn co-doped SnO2 nanoparticles synthesized by co-precipitation method. *The European Physical Journal Plus.*	2.99	11
12	**Al Asad, M. A**., Ridoy, H., **Ali, M. S.,** & Maimuna, M. (2025). Electro-Optical Properties of Cesium Lead Iodide: A Computational Approach. *Iranian Journal of Materials Science & Engineering.*	Indexed	12
13	Rahman, N., Adib, S.A.J., Mia, M.M., Ali, M.H., Haque, M.D., Sultana, B., **Islam, A. T. M. S.,** Irfan, A. and Rahman, M.F. (2025). Understanding the Role of Six BSF on SnSe Thin Film Solar Cell and Efficiency Enhancement Beyond 32%. *Chemistry Select.*	2	13
14	Shimul, A. I., **Islam, A. T. M. S.**, Ghosh, A., Hossain, M. M., **Dipa, S. A**., & Ramalingam, R. J. (2025). Investigating charge transport layer flexibility for boosted performance in Lead-Free CsSnBr3-based perovskite solar cells. *Computational Materials Science.*	3.1	14

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15	Sultana, B., **Islam, A. T. M. S.**, Mamoon, I., Haque, M. D., Badi, N., Irfan, A., & Rahman, M. F. (2024). Simulating High-Efficiency, Lead-Free Inorganic-Organic Perovskite Tandem Solar Cells with over 46% Efficiency. *Chemistry Select.*	2	15
16	Rahman, M. F., Islam, M. A. I., Chowdhury, M., Farhat, L. B., Ezzine, S., & **Islam, A. T. M. S.** (2024). Efficiency improvement of CsSnI3 based heterojunction solar cells with P3HT HTL: A numerical simulation approach. *Materials Science and Engineering: B.*	4.6	16
17	**Kumar, D.**, **Islam, A. T. M. S.**, Paul, G. C., & Nuruzzaman, M. (2024). Exploring dynamic behaviors of diverse electrical soliton pulses in lossy nonlinear electrical transmission lines: Insights from analytical method and linear stability analysis technique. *The European Physical Journal Plus*.	2.99	17
18	**Rajib, A.,** Al Kafi, M. A., Najesh, M. M. H., Hasan, M. R., Miah, M. R., & Rahman, A. (2024). Performance analysis of p-MoTe2/n-MoSe2-based bifacial solar cells with p+-N: Cu2O as BSF layer by SCAPS-1D. *Physica Scripta*.	2.6	18
19	**Rajib, A**., Saha, T. C., Rahman, M. M., Sarker, H., Dhali, R., Sumon, M. S. H., & Rahman, A. (2024). Numerical evaluation of bi-facial ZnO/MoTe 2 photovoltaic solar cells with N-doped Cu 2 O as the BSF layer for enhancing V OC via device simulation. *RSC advances*.	4.6	19
20	**Biswas, P**., Sutradhar, U., Khan, M. R., Sana, S., **Islam, S.**, & Paul, S. (2025). YOLO11 for High Accuracy Real-Time Detection and Classification of Diverse E-Waste Categories: Enhancing Recycling Efficiency. *Engineering Reports.*	Indexed	20
21	**Dipa, S. A**., Pramanik, M. M., Rabbani, M., & Kadir, M. A. (2024). Effects of temperature on electrical impedance of biological tissues: ex-vivo measurements. *Journal of Electrical Bioimpedance.*	Indexed	21
22	Al Imran, I., **Dipa, S. A**., Sharif, M. S. I., Zaman, M. A., & Mahdy, A. T. (2025). Exploring the adaptability of the charge transport layers for enhanced efficiency in lead-free CH_3N-H_3SnI_3 perovskite solar cells. *Renewable Energy and Sustainable Development*.	Indexed	22
23	Billah, M. M., Shandhi, S. P., Naim, M. R., Mesbah, M. B., Eti, S. A., **Kamruzzaman, M.,** & Hoque, M. A. (2025). Effect of surface tension modification in lead ion adsorption from water using different microwave exfoliated graphene from graphite obtained by varying intercalating agent composition. *Surfaces and Interfaces.*	6.6	23
24	**Habib, M. L.**, Munshi, M. H., **Kamruzzaman, M**., Baul, T., & **Hasan, M. M.** (2025). Synthesis and Characterization of Polyvinyl Alcohol-Based Bioplastic Film Incorporated with Keratin Extracted from Duck Feathers. *Results in Materials.*	4.34	24
25	Munshi, M. H., Islam, M. D., **Hasan, M. M.**, **Nasiruddin, M.**, **Rabbi, S. M. F**., Hussain, S. A., & **Kamruzzaman, M**. (2025). Transparent and flexible MXene-chitosan nanocomposite film for effective UV and high-energy blue light shielding applications. *RSC Sustainability.*	4.9	25
26	Munshi, M. H., Islam, M. D., **Hasan, M. M.**, Hussain, S. A., & **Kamruzzaman, M.** (2025). Biodegradable MXene-Alginate Composite: A Sustainable, Transparent, and Flexible Solution for Next-Generation Ultraviolet Shielding. *ACS Applied Engineering Materials.*	3.5	26
27	Munshi, M. H., Saha, R., **Kamruzzaman, M**., Akter, M., Al Rakib Shikder, A., & Repon, M. R. (2025). Recent Advancements in Biomaterial Applications: A Review. *International Journal of Environmental Research.*	2.8	27
28	**Mottakin, M**., Su'ait, M. S., Selvanathan, V., Ibrahim, M. A., Abdullah, H., & Akhtaruzzaman, M. (2024). Integrating multiphasic CuSx/FeSx nanostructured electrocatalyst for enhanced oxygen and hydrogen evolution reactions in saline water splitting. *Journal of Alloys and Compounds*.	6.61	28
29	**Mottakin, M**., Su'ait, M. S., Selvanathan, V., Chelvanathan, P., Ibrahim, M. A., & Akhtaruzzaman, M. (2025). Effect of sulfidation on ethaline-assisted electrodeposited iron sulfide-based electrocatalyst for efficient saline water splitting. *International Journal of Hydrogen Energy.*	8.3	29

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31	**Mottakin, M**., Su'ait, M. S., Chelvanathan, P., Ibrahim, M. A., Ludin, N. A., Abdullah, H., Almohamadi, H., & Akhtaruzzaman, M. (2024). Facile electrodeposited sandwich-like CuSx/MnSx electrocatalyst for efficient hydrogen evolution in seawater splitting. *Journal of Solid State Chemistry.*	3.55	31
32	**Mottakin, M**., Su'Ait, M. S., Chelvanathan, P., Islam, M. A., Shahiduzzaman, M., Ibrahim, M. A., Muhammad, G., & Akhtaruzzaman, M. (2024). Correlation between defect properties and the performance of eco-friendly CsSnI3-based perovskite solar cells. *Semiconductor Science and Technology.*	2.17	32
33	Mobarak, M. B., Sikder, M. D. F., Muntaha, K. S., Islam, S., **Rabbi, S. M. F**., & Chowdhury, F. (2025). Plant extract-mediated green-synthesized CuO nanoparticles for environmental and microbial remediation: a review covering basic understandings to mechanistic study. *Nanoscale Advances.*	4.7	33
34	Zahan, I., **Khan, M. M**., Rana, M. S., **Sahabuddin, M.**, Rasik, M. R., & Uddin, M. B. (2024). Effect of selective preservatives on shelf-life of guava juice extracted using pectinase enzyme. *Heliyon.*	3.8	34
35	**Khan, M. M**., Rana, S., Rana, J., **Jony, M. E.**, Arifin, S., Jubayer, F., & Alim, A. (2024). Effects of Coconut Flour and Milk Powder Supplementation on the Physicochemical Properties of Peanut Butter. *Journal of Food Processing: Techniques and Technology.*	Indexed	35
36	Sweet, S.R., Khaled, B.M., Al Naeem, M.A., Rana, M.S., Sina, A.A., Shahriar, A., Shetu, T.N., **Khan, M.M**., **Jony, M.E**., Rahman, M. and Hossain, M.M. (2025). Sustainable shelf-life extension of Musa acuminata using starch-based coatings infused with pomelo peel essential oil. *Applied Food Research.*	6.2	36
37	Rana, M. S., Khaled, B. M., **Khan, M. M**., **Jony, M. E**., Ahmed, J., Kundu, G. K., & Sondhi, R. (2025). Effect of Foam-Mat Drying Methods on Quality Attributes of Green Chili Powder. *Journal of Food Quality.*	2.9	37
38	Alim, M. A., Das, A. K., Al-Asad, M. A., Prince, M. A. S., Islam, M. T., Zaman, R., & **Khan, M. M**. (2025). Effect of NaCl pretreatment and frying conditions on the physico-chemical and sensory properties of potato peel chips. *Food and Humanity.*	Indexed	38
39	**Hossain, M. I.** (2025). Finding an affordable place to live: Socio-economic challenges of middle-income communities in Khulna, Bangladesh. *ISVS e-journal.*	Indexed	39
40	**Tisha, T. T.** (2024). Regeneration of Distressed Communities in Settlements Around Brownfields: Insights from Khulna, Bangladesh. *ISVS e-journal.*	Indexed	40
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41	Chang, F., Yan, M., Luo, H., Hong, W., Feng, Y., Liu, F., ... & **Ray, S. C.** (2025). Study on the microscopic characteristics of successive droplet clusters impacting on the wall. *Experimental Thermal and Fluid Science*.	3.3	41
42	Biswas, A., **Ray, S. C**., & Aktary, R. (2025). Numerical investigation of the effect of porous blockage on fluid velocity and pressure using OpenFOAM. *Physics of Fluids*.	4.3	42
43	**Ray, S. C.**, Naito, S., Andersson, M., Nishida, K., & Ogata, Y. (2024). Characterization of diesel spray with novel high-speed laser absorption scattering technique under diesel engine-like condition. *International Journal of Heat and Mass Transfer*.	5.8	43
44	**Islam, S**., Ali, M. Y., & Reza-E-Rabbi, S. (2024). Comparative simulation of nonlinear radiative nano casson and maxwell fluids with periodic magnetic force and sensitivity analysis. *Heliyon*.	3.8	44

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46	**Islam, M. S**., Khatun, M. S., & Biswas, M. H. A. (2024). Mathematical modelling of using renewable energy in the power sectors for the sustainable environment. *Mathematical Modelling and Numerical Simulation with Applications*.	Indexed	46
47	**Islam, M. S.,** Biswas, S. K., Sheikh, N., Khatun, M. S., & Yeasmin, S. (2025). A Mathematical Modelling to Investigate the Effect of Industrialization and Urbanization on Temperature Rising. *WSEAS Transactions on Systems and Control*.	Indexed	47
48	**Hossain, M. M**., Amin, M. S., Khairunnasa, F., & Rizvi, S. T. H. (2025). Lexicon and Transformer-Based Sentiment and Emotion Analysis of Twitter Responses to the 2023 Turkey-Syria Earthquakes. *Informatica*.	2.8	48
49	Das, K., Asadullah, M., **Hossain, M. M.,** Tanni, A. S., Islam, S., Islam, M., & Sumy, M. S. A. (2025). Deciphering COVID-19 Narratives: A Comparative Study of ML Models (RF, MNB, GB, LR, SVM) and DL Models (CNN, Bi-LSTM) for News Article Classification. *Informatica*.	2.8	49
50	Sumy, M. S. A., Parh, M. Y. A., Soni, M. S. M., Saifuddin, N., Elma, J. F., Zarei, H., & **Hossain, M. M.** (2024). Differences in Associated Factors of Underweight and Overweight According to Rural-Urban Residence Strata among Ever-Married Non-Pregnant Women of Reproductive Age in Bangladesh. *The Malaysian Journal of Medical Sciences*.	1.5	50
51	**Hossain, M. K**., Islam, M. N., Uddin, M. T., & Hossain, M. S. (2024). Understanding the impact of socioeconomic and health factors on geriatric depression: A comparative study in rural and urban Bangladesh. *Health Science Reports*.	2.1	51
52	Wu, L., Yu, R., Yao, M., **Rahaman, M. M**., & Fang, Z. (2025). Modelling and optimizing combination therapeutic strategies for KRAS-and EGFR-mutant lung cancer. *Journal of Bioinformatics and Computational Biology*.	Indexed	52
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RESEARCH ARTICLE

Deep transfer learning-based bird species classification using mel spectrogram images

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Abstract

The classification of bird species is of significant importance in the field of ornithology, as it plays an important role in assessing and monitoring environmental dynamics, including habitat modifications, migratory behaviors, levels of pollution, and disease occurrences. Traditional methods of bird classification, such as visual identification, were time-intensive and required a high level of expertise. However, audio-based bird species classification is a promising approach that can be used to automate bird species identification. This study aims to establish an audio-based bird species classification system for 264 Eastern African bird species employing modified deep transfer learning. In particular, the pre-trained EfficientNet technique was utilized for the investigation. The study adapts the fine-tune model to learn the pertinent patterns from mel spectrogram images specific to this bird species classification task. The fine-tuned EfficientNet model combined with a type of Recurrent Neural Networks (RNNs) namely Gated Recurrent Unit (GRU) and Long short-term memory (LSTM). RNNs are employed to capture the temporal dependencies in audio signals, thereby enhancing bird species classification accuracy. The dataset utilized in this work contains nearly 17,000 bird sound recordings across a diverse range of species. The experiment was conducted with several combinations of EfficientNet and RNNs, and EfficientNet-B7 with GRU surpasses other experimental models with an accuracy of 84.03% and a macro-average precision score of 0.8342.

Introduction

Bird species classification using deep learning and audio data is a rapidly evolving field with numerous applications in bioacoustics, ecology, ornithology, and conservation [1]. Bird

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Exploring transformer models in the sentiment analysis task for the under-resource Bengali language

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ABSTRACT

In the sentiment analysis (SA) task, we can obtain a positive or negative-typed comment or feedback from an online user or a customer about any object, such as a movie, drama, food, and others. This user's sentiment may positively impact various decision-making processes. In this regard, a lot of studies have been done on identifying sentiments from a text in high-resource languages like English. However, a small number of studies are detected in the under-resource Bengali language because of the unavailability of the benchmark corpus, limitations of text processing application software, and so on. Furthermore, there is still enough space to enhance the classification performance of the SA task. In this research, we experiment on a recognized Bengali dataset of 11,807 comments to find positive or negative sentiments. We employ five state-of-the-art transformer-based pretrained models, such as multilingual Bidirectional Encoder Representations from Transformers (mBERT), BanglaBERT, Bangla-Bert-Base, DistilmBERT, and XLM-RoBERTa-base (XLM-R-base), with tuning of the hyperparameters. After that, we propose a combined model named Transformer-ensemble that presents outstanding detection performance with an accuracy of 95.97% and an F1-score of 95.96% compared to the existing recent methods in the Bengali SA task.

1. Introduction

Social media, online reviews, news articles, and various online sources generate enormous quantities of textual data in the digital age today. Extracting meaningful insights from this unstructured data has become a formidable obstacle. Identifying the sentiment or emotional tone as positive, negative, or neutral from this insight is known as sentiment analysis (SA). SA tasks enable individuals and organizations to obtain an awareness of public opinion and emotional responses. In the past, organizations apply to spent a lot of time on this task and frequently found it difficult to assess market demand and recent changes. At present, SA is widely utilized in many contexts. Manufacturers can elevate and refine their product or service content by gathering user feedback, whether positive or negative, using opinion mining (Ireland and Liu, 2018). Again, sentiments, ideas, and emotions among individuals play a significant role in decision-making. While purchasing a product, whether it be a book, clothing, or electronic device, users first read opinions and evaluations of that product, which have an impressive impact on their decision-making (Hossain et al., 2021). SA produces an objective measure of fans' sentiment, thereby facilitating the evaluation of the overall success of a drama or film. Negative sentiment may indicate areas that require improvement, whereas positive sentiment may indicate victorious audience reception (Sazzed, 2021). Furthermore, marketing research can employ the findings generated by SA techniques. This approach enables the examination of public opinion concerning a product, service, or recent governmental policy (Rambocas and Pacheco, 2018).

With the advancement of artificial intelligence (AI) and the evolution of machine learning (ML) models, plenty of research works focus on SA tasks in English and other highly-resourceful languages (Xu et al., 2022; Wankhade et al., 2022). However, we have detected few contributions in the low-resource Bengali language because of the standard annotated datasets and the computational resource limitations. Although, according to the report from the New World Encyclopedia (NWE), Bengali is the sixth most widely spoken language worldwide, with roughly 230 million native speakers. Moreover, Bengali is the official language of Bangladesh and the second most common language in India. Additionally, the 1952 Bengali language movement stimulated UNESCO to officially recognize February 21 as International Mother Language Day starting in 2000. Thus, we are inspired to experiment with the Bengali SA task in this research.

We find several research endeavors for classifying sentimental text in the Bengali language. Hasan et al. (2023) explored the subject of

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MedNet: a lightweight attention-augmented CNN for medical image classification

Md. Ferdous[1]✉, Saifuddin Mahmud[2] & Md. Eleush Zahan Shimul[1]

Disease detection using medical images enables early and precise diagnosis. Despite the growing success of deep learning models, accurate classification remains a significant challenge. Medical images often exhibit characteristics such as limited spatial resolution, subtle visual differences between disease categories (low inter-class variance), and substantial variation within the same class (high intra-class variability). These factors collectively hinder the ability of standard vision models to generalize effectively, frequently resulting in misclassification. These challenges highlight the need for efficient architectures that can focus on critical spatial and contextual features for reliable performance.
To mitigate these challenges we propose MedNet, a lightweight CNN architecture that combines depthwise separable convolutions with the CBAM attention mechanism to efficiently extract and refine spatially and contextually relevant features. The core ResidualDSCBAMBlock captures local patterns while CBAM enhances important spatial and channel-wise information, followed by adaptive pooling, dropout, and fully connected layers for robust classification. The model is trained and validated on the DermaMNIST, BloodMNIST, OCTMNIST which from MedMNIST, and Fitzpatrick17k datasets. MedNet matches or exceeds CNN baselines across these medical image datasets achieving higher accuracy with significantly fewer parameters and lower computational cost, demonstrating its effectiveness and efficiency in medical image classification tasks. Code is available at https://github.com/Md-Ferdous/MedNet.

Keywords MedNet, CBAM, MedMNIST, Fitzpatrick17k, ResidualDSCBAMBlock

Skin cancer, hematological conditions, and retinal pathologies are prevalent health concerns that demand timely and accurate diagnosis to prevent complications. Early detection plays a critical role in guiding effective treatment strategies. Medical imaging has emerged as a non-invasive and widely accessible modality for disease screening and diagnosis, offering critical support for early detection and treatment planning. The availability of DermaMNIST, BloodMNIST, and OCTMNIST from the MedMNIST collection[1], along with the Fitzpatrick17k dataset[2], has substantially accelerated research in automated diagnostic systems leveraging deep learning techniques. These datasets encompass a broad spectrum of medical imaging tasks, including skin lesion classification, blood cell morphology analysis, and retinal disease identification, providing standardized benchmarks that facilitate the comparison and evaluation of computer-aided diagnosis methods. Despite the advances enabled by these datasets, conventional Convolutional Neural Networks (CNNs) face significant challenges when applied to medical image analysis. Medical images frequently exhibit small spatial dimensions, subtle inter-class variations, and considerable intra-class variability, all of which complicate accurate classification and increase the risk of misdiagnoses. Furthermore, the deployment of deep learning models in clinical environments requires not only high predictive accuracy but also computational efficiency, particularly in resource-limited settings, such as portable devices or point-of-care diagnostic tools. These factors highlight the necessity for lightweight, interpretable, and computationally efficient architectures capable of focusing on the most informative and discriminative features within medical images. To address these challenges, attention mechanisms such as the Convolutional Block Attention Module (CBAM)[3], SE-Net[4], and BAM[5] have been proposed to guide neural networks to emphasize salient spatial regions and channel-wise features, thereby improving classification performance, especially in the presence of noisy or cluttered backgrounds. In parallel, depthwise separable convolutions, introduced in MobileNet[6] and Xception[7], have demonstrated the ability to reduce the number of parameters and computational complexity while maintaining strong representational capacity. MedViT[8] showed accuracy and AUC scores across all 12 MedMNIST classification datasets when

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SST-HID: Scale-aware and shift-invariant teeth feature matching for human identification using OBB and SSIM

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ABSTRACT

Teeth-based human identification is particularly valuable in forensic investigations due to the durability of dental structures under challenging conditions. This study investigates the use of Oriented Bounding Boxes (OBBs) for the geometric representation of tooth structures. Unlike Horizontal Bounding Boxes (HBBs), OBBs accurately localize rotated or irregularly shaped objects. OBBs align with the natural orientation of the teeth, providing a more accurate geometric representation of the individual dental structures, since each tooth has a unique orientation. Unlike existing works, we propose a matching approach that uses the Structural Similarity Index Measure (SSIM) for scale correction and Rotated Intersection over Union (RIoU) for feature matching, ensuring scale-aware identification. Furthermore, we account for the variability in the interspace between the upper and lower jaw at different time periods, we apply a statistical mean to determine the shift vector, thereby making our identification method shift invariant. The experimental results confirm the effectiveness of our strategy, with the highest precision and recall observed at IoU thresholds ranging from 0.5 to 0.9. These findings highlight the potential of OBB-based detection in forensic and biometric applications. The proposed method can be applied to disaster victim identification, criminal investigations, and scenarios where traditional biometric data (e.g., fingerprints or facial recognition) are unavailable.

1. Introduction

This section introduce the importance of dental biometrics in forensic human identification, review existing approaches, and highlight the research gaps that motivate our study. An essential component of forensics is the identification of individuals. Human identification has traditionally relied on a variety of biometric characteristics, such as DNA, fingerprints, facial features, and voices [1]. However, natural conditions and accidents, such as fires, can cause these traits to deteriorate [1]. DNA testing is a trusted method for identifying individuals, but it can sometimes take considerable time and involve high costs. Teeth, protected by enamel — the hardest tissue in the human body [2] — are more resistant to deterioration, particularly from burns and melting. When comparing antemortem and postmortem records, teeth are highly useful since their morphology remains largely unchanged after fire exposure or death [1]. Features such as tooth shape, size, arch dimensions, bite marks, dental age, restorations, and growth patterns can be utilized for identification, either individually or in combination [3]. Natural teeth also exhibit unique textural features, with each set displaying distinct patterns [4]. Accurately capturing these patterns enables their exploitation for biometric applications. For example, Fan et al. [5] developed a convolutional neural network (CNN) for human identification using panoramic dental radiographs. Sharif et al. [6] proposed a framework for human action recognition in video sequences that integrates uniform segmentation with a combined feature selection strategy. The method segments video frames uniformly to capture spatiotemporal information and extracts features using Euclidean distance and joint entropy. A feature selection process is then applied to retain the most discriminative features, which are classified using machine learning models. By leveraging uniform segmentation and joint feature selection, the framework demonstrates robust and accurate recognition of human actions in complex video data. To enhance feature representation, Lai et al. [7] introduced a network with a channel attention module. Similarly, Chen et al. [1] addressed the identification problem

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Design and Analysis of Smart Lighting System for Room Environments Using Simulation Supporting Diverse Light Bulbs

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***Abstract*—Recently, the demand for intelligent, energy-efficient lighting systems has increased due to rising environmental concerns and increasing electricity consumption in smart room environment buildings. Conventional lighting systems often operate inefficiently, using outdated bulb technologies and lacking automation, which results in substantial energy waste, especially in rooms with variable occupancy. Lighting significantly contributes to energy consumption in indoor spaces, which presents vast opportunities for smart lighting model development through automation and adaptive control. This study proposes a smart lighting system model for room environments that dynamically adapts to user presence and supports diverse light bulb types. The study analyzes energy usage while maintaining automatic light control and operational effectiveness through simulation. The system is developed using AnyLogic by integrating agent-based and discrete event simulation to model occupant behavior and manage event-driven lighting logic. It incorporates sensors, smart door mechanisms, and energy-measuring processes, all powered by solar energy and managed through battery storage. The system dynamically adjusts lighting based on occupancy, minimizing idle energy usage for the room. LED bulbs offer more promising energy efficiency, while incandescent bulbs show the highest consumption. The outcome provides a visualized simulation model for designing adaptive lighting systems and reinforces the potential to enhance energy efficiency to support sustainability in smart room applications.**

***Keywords*—Bulb; energy; light; model; simulation**

I. Introduction

In an era characterized by boosted environmental awareness and resource limitations, the implementation of efficient lighting systems has become a crucial aspect of energy management in commercial and residential buildings. With their substantial impact on electrical consumption, optimizing lighting systems is essential for reducing overall energy usage and advancing sustainability initiatives. With urbanization and increasing indoor activity, there has been a critical push towards optimizing lighting technologies [1] to enhance energy efficiency and environmental sustainability. The advent of smart room technology, powered by automation and data-driven modeling, enables efficient energy management through dynamic control of lighting. Modern intelligent lighting systems are no longer limited to manual operations; they now integrate occupancy sensors to optimize light intensity in real-time [2]. This results in a reduction of energy waste and operational costs while also enhancing environmental sustainability [3]. Conventional lighting systems, such as incandescent and halogen bulbs, though widely used, are characterized by higher energy demands and shorter lifespans. In contrast, compact fluorescent lamps (CFLs) and light-emitting diodes (LEDs) [4] offer higher lighting efficacy, longer durability, and better energy performance. These diverse bulb types, while functionally different, collectively influence how energy is consumed in smart room environments. A significant challenge in designing energy-efficient lighting for indoor environments lies in accommodating the diverse characteristics of light bulbs such as incandescent, halogen, CFL, and LED, each with distinct energy consumption patterns and lighting efficacy.

In smart room environment, automation is transforming the management of lighting through the integration of sensing devices, energy data, and user behavior. Smart lighting systems equipped with motion sensors, ambient light detectors can dynamically control bulb power and operating time. The purpose is to ensure that lighting is delivered only when and where it is needed, thereby minimizing unnecessary consumption and improving energy efficiency. To analyze the efficiency of smart lighting systems, simulation-based modeling plays a crucial role [5], [6]. AnyLogic, a multi-method simulation tool, supports both Agent-Based Simulation (ABS) and Discrete Event Simulation (DES), enabling a detailed investigation of human-light interaction and dynamic system behaviors. These simulation paradigms are essential for mimicking real-world room scenarios that involve diverse bulb types and variable occupancy patterns. The present study leverages AnyLogic to simulate smart lighting control within a room environment, focusing on the behavioral dynamics of incandescent, halogen, CFL, and LED bulbs under various conditions.

Fig. 1 illustrates the basic structure of a smart lighting system for the room environment, which integrates motion sensors, ambient light sensors, and the energy measuring module. Each component of this structure has shown the basic strategy of reflecting real-time interactions, where automatic lighting is turned on and off based on user presence, lighting control is adjusted, and energy consumption is recorded across bulb types. This system-level visualization reinforces the need for adaptable lighting control systems that incorporate diverse bulb types for optimized energy consumption.

Despite advances in lighting control with energy-saving strategies, many existing lighting systems remain manually controlled or inadequately automated, leading to considerable energy wastage. Traditional systems often operate lights irrespective of occupancy status, resulting in excessive and

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Leaf Disease Detection in Plant Care using CNN Architecture: AlexNet and ResNet-50 Models

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***Abstract*—Global agricultural productivity is integral to fulfilling basic nutrition needs and economic growth. Moreover, plants are essential in protecting the environment and food chain balance. However, plant growth and health naturally depend on whether they are affected by various diseases. Agricultural cultivators in remote regions often lack precise information on effective disease detection methods, leading to significant crop losses. Manual observation is an unreliable technique for disease detection, making it challenging to identify and address issues promptly. Accurate disease detection through analyzing leaf images can be a crucial tool for quickly and easily noticing and solving potential issues in digital cultivating. This paper proposes a method for disease detection in plant care using the image dataset of tomatoes and potatoes to help cultivators better manage plant health. The approach leverages image analysis of plant leaves, employing AlexNet and ResNet-50, two well-known convolutional neural network models. This approach has utilized a dataset from Kaggle that includes images of tomato and potato plant leaves to explore leaf diseases. Hence, to detect leaf disease early, processes have been performed that involve preparing images, augmenting them, identifying important features, and classifying them through AlexNet and ResNet-50, including model evaluation using accuracy as the metric. According to experimental results, the proposed work achieves an overall 95.9% accuracy of the AlexNet and 97.3% accuracy of the ResNet-50 for identifying leaf diseases. It contributes to agriculture by providing an effective method for detecting plant leaf diseases and taking timely preventive measures for plant health.**

***Keywords*—AlexNet; detection; leaf disease; plant care; ResNet-50.**

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I. INTRODUCTION

The vitality and health energy of all living beings in the world are closely linked to the nutritional quality of crops and vegetables [1]. The growth of a country's economy is vital not just for financial reasons but also for protecting the environment and the balance of the food chain, which naturally depend on the growth, health, and quality of plants [2]. The economy's performance is heavily reliant on agriculture, particularly plant health care. However, conventional farming practices and various cultivation factors influence the quality and quantity of crops [3]. Crops and vegetables are vulnerable to diseases in different climates and environments, leading to significant losses for cultivators worldwide [4]. The reduction in global crop production due to leaf disease has become a major concern in the agricultural industry at present. The primary challenge is to effectively recognize leaf diseases in crops and implement appropriate measures to increase production rates while maintaining quality [5]. Failure to promptly detect and manage leaf diseases can lead to negative impacts on both crop profit and quality, ultimately affecting cultivators' financial claims. In this case, to accurately recognize diseases in crops, it is important to analyze the leaves of two specific crops: tomato and potato. These crops are widely consumed and are crucial in providing essential nutrients to the human body. Therefore, it is critical to monitor and maintain their health to ensure the continued availability of these vital nutrients.

In recent times, deep learning approaches have led to the achievement of significant advancements in computer vision, particularly in the early diagnosis of leaf illnesses in the context of plant care. The existing applications of deep learning models [6], namely ResNet-50 and AlexNet for accurate identifications and classifications of leaf diseases, can be a crucial step in preventing agricultural deterioration.

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IoT-enabled smart cities towards green energy systems: a review

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ABSTRACT

Integration of internet of things (IoT) in smart city management to improve various functions and living standards due to increasing population growth has dramatically evolved ubiquitous and essential services at various stages of urbanization. Hence, smart cities need to be eco-friendly by improving various sectors like education, health, and transport to provide an urban and sustainable quality of life through solving complicated green energy networks, controlling toxic pollution risks, and public safety. Linking optimized green energy systems with the production and automation of advanced applications is crucial to compose implementation strategies for smart city services. This paper aims to conduct a review on eco-friendly plans and infrastructure of IoT-enabled smart cities by exploiting green energy approaches. This study performs critical observations, ideas, and analyses of recent research in the context of our mentioned research theme. This paper points out the technical and functional challenges of an optimal performance-based green IoT-enabled smart city infrastructure. In this sense, this study organizes observations of relevant initiatives, technologies, and experiences in IoT-enabled smart cities, as well as how to embed it with green energy. Moreover, it can provide significant directions to intellectuals and authorities to develop IoT-enabled smart city applications for prospective research.

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1. INTRODUCTION

The notion of the smart city is of great significance in the present daytime, where the progressive urbanization of the world population is particularly related to the ability to assure the citizens' quality of life with all kinds of technological services and digital communication. The impact of urbanization on the rural environment is evident due to the transfer of all services from urban areas to citizens due to rapid population growth [1]. The interoperability of internet of thing (IoT) technology signifies the potential for a better life for the ubiquitous citizen to emerge as smart cities in the urban context in recent years. IoT technology is becoming more prosperous daily due to the tremendous development of new types of accessing devices and technologies, and its inclusion in smart city applications is happening. IoT-empowered smart city framework helps citizens create any kind of convenience and secure lifestyle using any medium at any time.

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Detecting cyberbullying text using the approaches with machine learning models for the low-resource Bengali language

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ABSTRACT

The rising usage of social media sites and the advances in communication technologies have led to a considerable increase in cyberbullying events. Here, people are intimidated, harassed, and humiliated via digital messaging. To identify cyberbullying texts, several research have been undertaken in English and other languages with abundant resources, but relatively few studies have been conducted in low-resource languages like Bengali. This research focuses on Bengali text to find cyberbullying material by experimenting with pre-processing, feature selection, and three types of machine learning (ML) models: classical ML, deep learning (DL), and transformer learning. In classical ML, four models, support vector machine (SVM), multinomial Naive Bayes (MNB), random forest (RF), and logistic regression (LR) are used. In DL, three models, long short term memory (LSTM), Bidirectional LSTM, and convolutional neural network with bidirectional LSTM (CNN-BiLSTM) are employed. As the transformer-based pre-trained model, bidirectional encoder representations from transformers (BERT) is utilized. Using our proposed pre-processing tasks, the MNB-based approach achieves the best accuracy of 78.816% among the other classical ML models, the LSTM-based approach gains the highest result of 77.804% accuracy among the DL models, and the BERT-based approach outperforms both with 80.165% accuracy.

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1. INTRODUCTION

Social communication platforms like Facebook, Instagram, YouTube, and others are now heavily used for disseminating personal feelings and opinions. According to the observation of Statista in 2021, about 2.9 billion users actively interact with Facebook each month, and 2.4 billion and 1.4 billion people, respectively, prefer YouTube for sharing videos and Instagram for photos. During this sharing, a person is often threatened or embarrassed by sending unpleasant messages through electronic technology. Thus, the term cyberbullying comes, and it is growing throughout the world. Sometimes, it results in extreme emotional and physical torment and even self-destruction [1].

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Shielding privacy: a technique of extenuating composition attacks in various independent data publication

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ABSTRACT

Protecting personal information from unauthorized access is a critical concern for individuals. However, the accumulation of confidential information by various organizations, such as banks and hospitals, for regular communication creates a potential vulnerability. If an individual visits two hospitals and both facilities independently release the individual's gathered data, a malicious adversary could potentially deduce confidential information through a composition attack. Therefore, developing methods that protect individuals from composition attacks is crucial. According to the size of the dataset and the percentage of overlapping persons, our study examines the effectiveness of composition attacks. We propose a knowledge domain-based design to mitigate successful composition attacks, which has shown promising results in reducing such attacks and compared to existing studies based on the k-anonymity and *l*-diversity models. Our approach leverages a knowledge domain to reduce the likelihood of data breaches, demonstrating the effectiveness of our method in protecting individuals' privacy and preventing unauthorized access to sensitive information. Finally, the effects of data utility on the diverse data set have been measured.

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1. INTRODUCTION

In recent years, the preservation of privacy in the publication of data has grown to be an issue with amazing potential. Organizations are recipients of personal data and thereafter engage in the dissemination of such data in accordance with governmental and legal regulations. A distinct organization, such as a bank, hospital, etc., gathers and disperses personal information in a way that conceals the identity of the individual (e.g., information about a person's health or finances, for example, is disguised).

We assume that these organizations are in multiple independent data publishing environments. In that situation, a person may go to various hospitals, and their private information may be disclosed by invoking a composition attack. Although several distributed knowledge sets pose little secrecy upon personnel, studies show that a person's secrecy is at risk of raising disparate organizations to have some common tuples, and they release the common data sets individually [1].

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ANALYSIS OF THE PROPERTIES OF VACANCY MEDIATED METHYL AMMONIUM LEAD IODIDE PEROVSKITE: A DFT BASED STUDY

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Intrinsic defects have a significant impact on carrier transport properties of Methyl Ammonium Lead Iodide (MAPI) Perovskite $CH_3NH_3PbI_3$. In this paper, we investigated how lead vacancies affect the photovoltaic properties of MAPI using density functional theory (DFT) studies. Lead vacancies in perovskite materials can significantly impact carrier dynamics and device efficiency. Our findings indicate that the lower energy configuration of the Pb vacancy does not create deep trap states that would otherwise reduce carrier lifetime. This suggests that Pb vacancies in MAPI might not be as detrimental to carrier dynamics as previously thought. Pb vacancies could potentially be compensated by other defects or dopants in the material, which might mitigate their negative effects on carrier dynamics. The introduction of a Pb vacancy leads to additional electronic states near the conduction band minimum (CBM) within the fundamental band gap. This indicates that the vacancy introduces localized electronic states that influence carrier behavior. The Highest Occupied Molecular Orbital (HOMO) becomes more localized around the vacant area, while the Least Unoccupied Molecular Orbitals (LUMOs) are only partially localized. This localization around the vacancy does not create strong trapping states that could hinder carrier movement. The presence of vacancies causes atomic movements that result in a more distorted optimized structure. This structural distortion can influence the overall material properties and potentially impact device performance. The HOMO and LUMO levels are primarily derived from the p orbitals of the atoms involved. This highlights the importance of p orbital interactions in determining the electronic properties of the material
Keywords: *$CH_3NH_3PbI_3$; Density functional theory; Pb vacancy; Band gap energy; Structural distortion*
PACS: 71.15.Mb, 71.20.-b, 61.72.-y

INTRODUCTION

Hybrid organic/inorganic perovskites (HOIPs) have drawn significant research interests due to the incomparable rapid rise in energy conversion efficiency seen in photovoltaic devices based on CH3NH3PbI3. Current research attempts in this field have concentrated on searching for similar perovskites with better properties, manifested by good carrier mobility and long carrier lifetime with efficient transport properties. Defects play a vital role in carrier transport in semiconductors [1]. The carrier traps and nonradiative recombination center are basically created due to the presence of deep defect centers which are still detrimental for carrier transportation [1]. A great deal of studies has been examined a large number of native point defects under density functional theory (DFT) [2-5] that show the conflicted results regarding the positions of defect level in $CH_3NH_3PbI_3$. Indeed, a list of particular native defect can introduce deep charge transition in the band gap whenever other native defects have been shown a shallow level of transition. Due to the record of discrepancy outcome in the calculated defect level of $CH_3NH_3PbI_3$, it might be expeditious to reexamine the computational calculation of defected structure. Additionally, the point defects undergo a critical role in determining the electron hole diffusion length which are responsible for non-radiative recombination center [6]. A long electron hole diffusion length resumed the unusual defect properties of $CH_3NH_3PbI_3$. On the other hand, the thermodynamic stability under a humid condition and/or irradiation of $CH_3NH_3PbI_3$ and the formation mechanism of the dominant intrinsic defects are crucial for the efficiency improvement of halide perovskite based thin film solar cells [6]. Therefore, understanding defect properties is immensely important for optimizing the performance of halide perovskite solar cells.

In this letter, we discussed the electronic properties of intrinsic vacancy (Lead) defect of $CH_3NH_3PbI_3$ as the representative material for the methylammonium lead halide (MALHs). More importantly, the defect in $CH_3NH_3PbI_3$ with low formation energy creating only shallow levels can be ascribed to the unique electronic properties through DFT. The HOMO and LUMO level electronic charge distributions both of bulk and defected conditions and their corresponding optimized distorted structure are also considered under this discussion.

Computational Details: All calculations were performed with the Vienna ab initio simulation package (VASP, version 5.4.1), [7] based on DFT and the results were visualized by the VESTA (visualization for electronic and structural

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Regular Article

Structural, optical, and dielectric properties of Al–Zn co-doped SnO_2 nanoparticles synthesized by co-precipitation method

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Abstract This study reports the preparation and characterization of Al and Zn co-doped SnO_2 nanoparticles prepared by the co-precipitation method. The samples were prepared at different Al and Zn concentrations ranging from 0 to 5%. The nanoparticles were then examined using techniques such as X-ray diffraction (XRD), scanning electron microscopy (SEM), UV–Vis spectrophotometer, Fourier transform infrared spectroscopy (FTIR), and dielectric spectroscopy. With an average crystallite size of 5.52–3.14 nm, the XRD study shows that both the undoped and doped SnO_2 nanoparticles have a rutile structure. The FTIR measurement confirms metal oxide bonding. Doping of Al and Zn atoms is seen to raise the optical band gap from 3.64 to 5.76 eV. The SEM images show the formation of spheroidal nanoparticles of size 37 to 25 nm. At low frequencies, the AC conductivity of the used samples is independent of concentration and the conductivity was found to be of lower value. However, when the frequency of the applied field was gradually increased, the AC conductivity also increased. This rising frequency increases the hopping frequency of electrons. As the concentration of Al and Zn ions increases, the overall values of tanδ drop across the samples.

1 Introduction

In the twenty-first century, nanotechnology is expected to significantly impact our economy and society, similar to that of semiconductor technology, computer technology, or cellular and molecular biology [1]. Nanostructured materials have drawn considerable attention because they possess different optical, electrical, chemical, magnetic, etc. properties as compared to bulk materials. Nanoparticles are composed of various materials such as metals, metal oxides, polymers, and dendrimers. The composed materials are characterized based on their applications. Metal oxide nanoparticle characteristics, including optical, electronic, magnetic, catalytic, dielectric, etc., are influenced by their size, shape, crystal structure, chemical environment of metal ions, and characteristics of their content [2]. Recently, various metal oxide characteristics have been investigated by different researchers all over the world, including TiO_2, ZnO, NiO, Al_2O_3, Fe_2O_3, SnO_2, CeO_2, etc. Out of all these metal oxides, SnO_2 is a significant metal oxide semiconductor as it is cheap and nontoxic, having some remarkable properties such as transparency, relatively high electrical conductivity, sensitivity to different gases, and high band gap [3–5]. Bulk SnO_2 has a band gap at ambient temperature of 3.6 eV. It crystallizes in the tetragonal rutile structure with $a = b = 4.76$ Å $c = 3.21$ Å. Its electrical, optical, electrochemical, and magnetic properties are widely used in various fields such as catalysis, heat mirrors, gas sensing flat panels, transparent electrode preparation, and spintronics [6–10].

Adding suitable dopant atoms in SnO_2, its electrical, optical, magnetic, etc., property, size, and shape can be changed [11–14]. Besides, co-doping is a somewhat easy and efficient way to change the host metal atoms' interstitial and vacancy counts, which is helpful for investigating structural, electrical, optical, magnetic, and other properties.

The preparation of nanoparticles involves several techniques such as co-precipitation[15], solid-state reactions [16], chemical vapor deposition [17], ball milling [18], laser ablation[19], solgel [20], hydrothermal process[21], and pyrolysis [22], which can be used to create nanoparticles. There are a plethora of studies on SnO_2 nanoparticles with doping materials to change their properties according to application. SnO_2 is usually doped with other elements like aluminum [23], indium [24], zinc [25], fluorine [26], as well as co-doping with aluminum and iron [27], aluminum, and copper [28]. A thin film was characterized by Al and Zn co-doped SnO2 and found to have different properties. The band gap of the thin film at different annealing temperatures was in the range of 3.87–4.21 eV [29]. So far, to our knowledge no report has been published on Al, Zn co-doped SnO_2 nanoparticles.

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RESEARCH PAPER

Electro-Optical Properties of Cesium Lead Iodide: A Computational Approach

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Abstract: *Perovskite materials have garnered considerable attention in recent years due to their exceptional electro-optical properties, making them promising candidates for various applications in photovoltaics, light-emitting devices, and beyond. Among these perovskite materials, $CsPbI_3$ stands out as a notable example due to its remarkable stability, tunable bandgap, and efficient light-emitting properties. The crystal structure, composition, and introductory properties of $CsPbI_3$ perovskite are being focused on using density functional theory (DFT). In a detailed exploration of Electronic, Elastic, and Optical properties, Population analysis, and shedding light on the unique attributes of this material, this study highlights these attributes. To do the above computation, we have used CASTEP in Material Studio.*

Keywords: *$CsPbI_3$, Density functional theory, Structural properties, Electronic properties, Optical properties, Elasticity.*

1. INTRODUCTION

Perovskite materials have emerged as a pivotal class of materials, not only in the field of materials science but also in condensed matter physics, due to their remarkable optoelectronic properties and diverse applications. Among the various perovskite materials, $CsPbI_3$ has garnered significant attention as a talented candidate for applications in photovoltaics, light-emitting devices, and as a potential platform for fundamental research in solid-state physics. $CsPbI_3$ belongs to the family of lead halide perovskites, characterised by its unique properties, including optical, elastic, band structure, density of states, and population analysis, which have become crucial points of research in recent years [1]. $CsPbI_3$ perovskite materials exhibit intriguing electronic properties, including a direct bandgap and excellent charge carrier mobility. By considering the band structure and density of states, we can elucidate the charge transport mechanisms, which are pivotal for optimising device performance in electronic and optoelectronic applications [2]. The optoelectronic properties of $CsPbI_3$ perovskite materials are of specific interest because of their potential to revolutionize the field of photovoltaics. Their high absorption coefficients, tunable bandgap, and long carrier lifetimes make them excellent contenders for next-generation solar cells.
Understanding the fundamental optical properties, such as absorption and emission characteristics, is crucial for optimizing their performance and stability in photovoltaic applications. Furthermore, these properties can be fine-tuned by controlling the material's size, shape, and crystallinity, opening up new avenues for tailoring perovskite materials for specific applications [3]. Elastic properties, as determined by Young's modulus and Poisson's ratio, play a crucial role in the mechanical stability and durability of perovskite materials. Investigating the elastic properties of $CsPbI_3$ is essential to predict their mechanical behaviour under different environmental conditions and can guide the design of robust perovskite-based devices [4]. Population analysis and the identification of defect states are critical for refining the stability and efficiency of perovskite materials. $CsPbI_3$ is known to suffer from defects and trap states, which can adversely affect device performance. Investigating the population of defect states and understanding the factors that influence their formation and dynamics is vital for devising strategies to mitigate these issues [5]. Additionally, the cut-off energy, which represents the energy at which the electronic states of the

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Understanding the Role of Six BSF on SnSe Thin Film Solar Cell and Efficiency Enhancement Beyond 32%

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This study explored the use of cadmium telluride (CdTe) as a back surface field (BSF) in tin selenide (SnSe)-based heterojunction thin-film solar cells to enhance affordability and performance. Using the Solar Cell Capacitance Simulator (SCAPS-1D), we first modeled and analyzed a baseline structure of Cu/SnO_2/CdS/SnSe/Au without a BSF layer. Subsequently, we investigated six alternative configurations incorporating different BSF materials: Cu/SnO_2/CdS/SnSe/CFTS, MoS_2, PEDOT:PSS, CuO, P3HT, CdTe/Au. Our detailed analysis revealed that the CdTe BSF provided superior performance compared to the other BSFs. Additionally, we optimized the thickness of the electron transport layer (ETL) and the absorber layer to maximize power conversion efficiency (PCE), short-circuit current (Jsc), fill factor (FF), and open-circuit voltage (Voc). We also varied the bulk defect density and interface defect density to assess the device's defect tolerance. Analyzing series resistance (Rs), shunt resistance (Rsh), carrier concentrations at different device depths, J–V curves, and temperature effects, we identified optimal photovoltaic (PV) parameters for the CdTe BSF, alongside a Voc of 0.96 V, Jsc of 38.42 mA/cm^2, FF of 86.49%, and PCE of 32.34%. In contrast, the reference structure without a BSF achieved only a 26.81% PCE. This cost-effective novel structure demonstrates promising durability and high performance.

1. Introduction

Power consumption nowadays demands an efficient and cost-effective power source. From the perspective of environmental side effects, renewable energy sources are the best solutions.[1,2] Harnessing energy from these sources still requires technological innovations. The journey of a new pathway with the application of photovoltaics began by William Grylls Adams and Richard Evans Day in 1877.[3] The effect of light on selenium (Se) was examined in their work. Since then, many materials and compounds have been used in solar cell (SC) research. Crystalline silicon (c-Si) solar cells (SCs) are the most common; however, the need for a large installation area, high manufacturing cost, several intermittent problems including light-induced degradation, temperature sensitivity, and indirect bandgap manifests some disadvantages.[4] III-V SCs, e.g., GaAs SCs, are developed as high-efficiency models, but due to their high manufacturing cost, research is still ongoing for cost-effective methods.[5] CIGS SC, which is the most prominent thin-film technology with a recorded efficiency of 20.3%, has process complexities, and the rarity of indium makes it harder.[6,7] Perovskite materials are extensively researched for photovoltaic applications for several reasons, including ease of fabrication, materials availability, and the usage of organic compounds.[8–10] The main drawback of these materials is their vulnerability to moisture, heat, and oxygen.[11]

Researchers are increasingly focusing on thin-film solar cells to address the aforementioned challenges. 2D materials are central to these structures due to their outstanding optoelectronic properties. Their ability to accommodate strains exceeding 10%, combined with their enhanced performance, makes them a significant area of research.[12] Metal chalcogenides and transition metal dichalcogenides (TMDC), based absorbers, e.g., CdTe, CIGS, CZTS, CdS, PbS, MoS_2, WSe_2, $MoSe_2$, WS_2, $NbSe_2$, are showing good performances due to their favorable optoelectronic properties.[13–18] The use of CdTe-based solar cells has yielded laboratory and module scale efficiencies of 22.1% and 18.6% respectively, making them an ideal choice for achieving a maximum efficiency-to-cost ratio.[19] Nonetheless, the use

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Full Length Article

Investigating charge transport layer flexibility for boosted performance in Lead-Free $CsSnBr_3$-based perovskite solar cells

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ABSTRACT

Perovskite solar cells (PSCs) have garnered significant interest due to their high-power conversion efficiency (PCE) and potential applications in both organic and inorganic materials. $CsSnBr_3$ has emerged as a promising material for the absorber layer in photovoltaic applications, offering excellent stability, cost-effectiveness, and outstanding efficiency. This study employed SCAPS-1D for the numerical simulation of $CsSnBr_3$-based PSCs. The objective was to fine-tune multiple parameters of the hole transport layer (HTL), absorber layer, and electron transport layer (ETL). The simulations with V_2O_5 as the HTL were used to study $CsSnBr_3$-based PSCs employing various ETLs (WS_2, C_{60}, ZnO, and IGZO). It further investigated how variation in the thickness, defect density, and doping density of the absorber layer, HTL, and ETL will affect the critical device performance parameters, i.e., PCE, fill factor (FF), open circuit voltage (V_{OC}) and short-circuit current density (J_{SC}). The results indicate that the ETL can be modified to enhance the cell's power conversion efficiency. Indeed, ETL using WS_2, C_{60}, ZnO, and IGZO gives rise to 24.69%, 23.99%, 23.79%, and 23.77% PCE values, respectively. Moreover, it studied PSC structures with temperature and changes in capacitance–voltage characteristics, series-shunt resistance, and the Mott-Schottky plot. Based on these observations, the associated values of quantum efficiency (QE) and current density–voltage (J-V) have been determined.

1. Introduction

Solar cells produce solar energy into electrical energy, providing a potential and practically inexhaustible renewable energy source, particularly in comparison to wind and hydroelectric power [1–3]. It is imperative to identify novel renewable energy sources as part of the worldwide endeavors to address pollution and diminish greenhouse gas emissions. The advancement of economically viable, readily producible, and ecologically sustainable photovoltaics (PV) presents a substantial prospect for tackling the worldwide energy problem [4,5]. The growing need for electricity and sustainable energy, fueled by improvements in intelligent manufacturing and the ongoing Industrial Revolution 4.0, highlights the necessity for creative energy solutions [6,7]. Although silicon-based solar cells can be acquired, their PCE is capped at approximately 26 % [8,9]. Perovskite solar cells (PSCs) are becoming popular because of their beneficial characteristics, such as adjustable bandgap energy, longer diffusion lengths, excellent carrier transport nature, and more accessible manufacturing procedures [10]. Perovskite materials have been extensively used in PSCs since Kojima et al. introduced $MAPbI_3$ in 2009 [11]. The efficiency of lead-based perovskite solar cells has risen markedly, from 3.8 % in 2009 to 26.6 % in 2024 [12]. Although lead-based PSCs provide efficiency improvements, the issue of lead (Pb) toxicity and environmental pollution continues to be a serious concern. This hard-to-solve problem has attracted growing scientific attention to finding a safer alternative to lead perovskites. While lead-based perovskites are highly efficient, these significant advantages come at the cost of lead toxicity and environmental concerns associated with the degradation of such materials. To address these challenges, scientists have proposed that lead-free perovskites could be a non-toxic alternative with equal or superior efficiency [13,14]. Although the metal hybrid perovskites can be produced through metals with relatively low toxicity, which have been investigated as alternatives, they are mainly

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Simulating High-Efficiency, Lead-Free Inorganic-Organic Perovskite Tandem Solar Cells with over 46% Efficiency

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Perovskite-based tandem solar cells (SCs) show significant potential for improving efficiency. In this study, three configurations were designed and optimized: a top cell (ITO/ZnSe/$CH_3NH_3GeI_3$/CuSCN/Ni), a bottom cell (ITO/ZnSe/$CH_3NH_3SnI_3$/CuI/Ni), and a tandem cell combining both. Using SCAPS-1D, the study evaluated how the absorber layer thickness, doping concentration, and defect density affected photovoltaic (PV) performance. It also explored the influence of doping in the back surface field (BSF), interface defect densities, temperature, and back contact work function. The top cell achieved a power conversion efficiency (PCE) of 28.47%, with an open-circuit voltage (V_{OC}) of 1.21 V, a short-circuit current density (J_{SC}) of 27.17 mA/cm^2, and a fill factor (FF) of 86.24%. The bottom cell reached a PCE of 18.46%, with a V_{OC} of 0.83 V, a JSC of 27.17 mA/cm^2, and an FF of 81.839%. The optimized tandem structure demonstrated a notably higher efficiency of 46.89%, with a J_{SC} of 27.17 mA/cm^2, a V_{OC} of 2.04 V, and an FF of 84.31%. These results suggest the proposed $CH_3NH_3GeI_3$/$CH_3NH_3SnI_3$ tandem design could pave the way for efficient, eco-friendly, and cost-effective PV cells in a near future.

1. Introduction

The detrimental environmental impact of fossil fuel combustion has spurred a renewed emphasis on renewable energy alternatives. Among these, solar power stands out as a highly promising long-term, sustainable energy source. The photovoltaic community has particularly concentrated on perovskite solar cells (PSC) owing to its excellent efficiency, affordability, versatility, and simplicity of manufacturing.[1,2] Regarding perovskite-based solar cell (PSCs), the power conversion efficiency (η) has experienced significant enhancements since its original use in dye-sensitized cells,[3] with the present highest achieved η standing at 25.2% during the preceding decade. The Shockley–Queisser (SQ) limit was first predicted in 1961[4] by Shockley and Queisser for single-junction PV devices. The first factor limiting performance of PV cell is the photon energy below the bandgap that remains unabsorbed. Second, thermalization losses occur when the carrier thermalizes due to receiving a photon's energy that is more than what is needed to form free electron-hole pairs. The use of several SCs constructed from a semiconductor material with the right bandgap can assist reduce these losses. In this method, the BC and TC are constructed employing narrow and wide bandgap materials, accordingly, to maximize the usage of both shorter and longer wavelength photons. In 1955, Jackson first proposed tandem structures and multijunction concentrator cells have since been the subject of several theoretical and empirical studies.[5,6]

Recent studies have focused on increasing device efficiency by employing tandem SC. Regarding this, Zhou at al. have built a 7% efficient device utilizing a solution processing technique to create a tandem SC based on perovskite.[7] The PCE of a tandem SC based on $MAPbBr_3$/$MAPbI_3$ realized by Heo et al. using a solution processing approach was 10.4%.[8] Furthermore, Eperon et al.[9] reported the 17% conversion efficiency with V_{OC} of 1.98 V. Subsequently, Zhao et al.[10] achieve a 21% device efficiency using a $FASnI_3$ based tandem SC. Device efficiencies of upwards to 23.3% have been achieved utilizing a $FA_{0.75}Cs_{0.25}Sn_{0.5}Pb_{0.5}I_3$ based structure fabricated adopting the atomic layer deposition

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Efficiency improvement of $CsSnI_3$ based heterojunction solar cells with P3HT HTL: A numerical simulation approach

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ABSTRACT

Recently, lead free $CsSnI_3$ based solar cells are gaining popularity among researchers due to their outstanding semiconducting characteristics. To improve the efficiency of the recently suggested ITO/ZnMgO/$CsSnI_3$/P3HT/Au solar cell and examine the effects of the five HTL such as (P3HT, PEDOT:PSS, PTAA, MoO_3, CFTS) and ZnMgO as ETL via SCAPS-1D on key performance indicators like PCE, FF, J_{SC} and V_{OC} is the main purpose of this works. The effects of thickness variation, carrier density, each layer's interface defect, bulk defect density, operating temperature, and front and rear electrode placement have been studied. The PCE, V_{OC}, J_{SC}, and FF have shown 7.03 %, 0.32 V, 33.76 mA/cm^2, and 62.50 %, respectively with reference structure's (ITO/ZnMgO/$CsSnI_3$/Au). The highest PCE, V_{OC}, J_{SC}, and FF is improved to 17.04 %, 0.67 V, 35.61 mA/cm^2, and 71.39 %, respectively by adding P3HT layer as a HTL with proposed structures (ITO/ZnMgO/$CsSnI_3$/P3HT/Au) then other four HTL (PEDOT:PSS, PTAA, MoO_3, CFTS).

1. Introduction

There has been a rise in research on photovoltaic technology due to the increasing need for sustainable and clean energy sources. Since then, there has been a progress in creating photovoltaic cells that are both more efficient and cost-effective, with an emphasis on minimizing the ecological consequences and expanding their market viability[1]. Solar photovoltaic systems are recognized as a crucial solution to the energy crisis, with applications in both power generation and water treatment [2]. The progress of cost-effective and high-performing photovoltaic cells has been a major focus of research in this area [3]. The improvement of PSCs is vital for their commercialization and widespread use. The structure of perovskite films plays a crucial role in shaping their performance, and several techniques for controlling the structure have been devised[4]. Nevertheless, the durability of these cells continues to be a matter of concern, underscoring the necessity for more enhancement [5]. Significant advancements in the progress of effective PSCs include the development of high-performing tandem solar cells combining perovskite and silicon, as well as the enhancement of stability in inorganic PSCs, resulting in improved efficiency [6]. The progress in device design, material deposition procedures, and improved device engineering techniques has facilitated these developments [7]. Promising results have been observed in PSCs utilizing $CsSnI_3$ as the absorber material and P3HT as the HTL. Li et al. [8], demonstrated the potential of $CsPbI_2Br$ PSCs with utilizing a P3HT HTL devoid of dopants to achieve both high productivity and stability. The efficiency and stability of triple cation hybrid PSCs were significantly improved [9] by including a doped P3HT HTL. Gupta et al. [10], introduced a perovskite solar cell that utilizes carbon as the main component and incorporates a PbS-TBAI HTL. This solar cell demonstrated consistent performance and

Abbreviations: J–V, Current density-voltage; N_D,N_A, Shallow identical donor (acceptor) density; EA, χ, Electron affinity; ϵ_r, Dielectric permittivity (relative); μ_n, μ_h, Electron (hole) mobility; SCAPS, Solar cell capacitance simulator; VB, Valence Band; EBD, Energy band diagram; ETL, HTL, Electron (hole) transport layer; J_{SC}, Short circuit current density; PCE, Power conversion efficiency; BSF, Back-surface Field; CB, Conduction band; N_C, N_V, Conduction (valence) band effective density of states; N_t, Defect density; ITO, Indium-doped tin oxide; PSC, Perovskite solar cell; FF, Fill factor; QE, Quantum Efficiency; WF, Work function; PV, Photovoltaic; R_s, R_{sh}, Series (shunt) resistance; V_{OC}, Open voltage current; G-R, Generation-Recombination.

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Exploring dynamic behaviors of diverse electrical soliton pulses in lossy nonlinear electrical transmission lines: Insights from analytical method and linear stability analysis technique

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Abstract The study aims to explore the intricate dynamics of various types of pulses within a nonlinear, lossy electrical transmission line, describing the propagation of electrical solitons in nonlinear dispersive media. In pursuit of these aims, an analytical method known as the unified method is employed to the nonlinear, lossy transmission lines periodically loaded with symmetric voltage-dependent capacitances. By applying Kirchhoff's law in the continuum limit, a nonlinear partial differential equation for the voltage on the transmission line is derived. Subsequently, with the aid of the unified method, a variety of electrical soliton pulses, including dark, bright, singular, periodic singular, periodic W-shaped, and periodic waves, are obtained from the voltage equation. Additionally, stability analysis of the model is assessed using linear stability analysis technique, confirming the stability of dispersion. The coefficients of the nonlinear transmission lines model are found to play a substantial role in changing the shapes of the solitons. By adjusting the parameters for the obtained analytic solutions for nonlinear transmission lines to suitable values, the model can effectively modify the characteristics of the waves and produce desired wave profiles. The received solitons could find their applications in telecommunication systems to carry information and increase the bit rate of data. The ability of electrical soliton pulses to propagate with minimal dispersion makes them an efficient approach for transmitting data modulated as short pulses over long distances.

1 Introduction

Soliton is a term commonly used by physicists and engineers, particularly those who specialize in the fields of elementary particle physics and electrical engineering [1]. Solitons are a special class of waveforms that maintain their shape and amplitude as they travel through nonlinear dispersive media [2]. In electronics, electrical solitons, a type of nonlinear wave, can propagate as voltage waves across nonlinear transmission lines (NLTLs), serving as nonlinear dispersive media [3]. These transmission lines are very convenient tools for investigating wave propagation in nonlinear dispersive media, as they serve as nonlinear dispersive media themselves and allow for the examination of the behavior of nonlinear excitations within a medium [4]. The NLTL can be constructed either by periodically loading a normal transmission line with varactors or by arranging inductors and varactors in a one-dimensional lattice [2]. The NLTLs sustain solitons when the dispersion in the system balances the nonlinearity in the transmission line. The dispersion in NLTLs arises from the periodic location of capacitors, while the nonlinearity in the system arises from varactors whose capacitance changes with applied voltage through the dielectric material [5]. In most cases, the dominant source of nonlinearity in the system arises from the nonlinear behavior of the charge in a capacitor. It should be stated here that nonlinearity and dispersion are generally considered undesirable in electrical engineering. However, an NLTL can balance these two effects and generate soliton-like pulses [6]. Solitons can propagate along an NLTL in the form of bell-shaped short-duration voltage pulses, as stable waves [7]. When loss is present, the soliton cannot maintain its shape as it loses energy during traveling. Nevertheless, it retains the spatial localization of energy even as the pulse shape changes, and it does not disintegrate into multiple sinusoidal components [8].

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PAPER

Performance analysis of p-$MoTe_2$/n-$MoSe_2$ -based bifacial solar cells with p^+-N:Cu_2O as BSF layer by SCAPS-1D

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Supplementary material for this article is available online

Abstract

Photovoltaic solar cells (PVSC) with Molybdenum telluride ($MoTe_2$) have received considerable attention because of their wide range of absorption, along with the absence of dangling bonds at their surface. Here, $MoTe_2$-based PVSC with a preliminary device structure of Al/ITO/n-$MoSe_2$/p-$MoTe_2$/Pt was designed and estimated its performance by using the solar cell capacitance simulator in one dimension software program (SCAPS-1D). The effect of different parameters like thickness, doping density, and interface defect density of each layer was also investigated. Our investigation reveals that a moderate thickness of ~1000 nm of $MoTe_2$ and 500 nm of $MoSe_2$, a higher concentration of more than 10^{17} cm^{-3} for both layers and moderate defect density of below 10^{14} cm^{-3} are favorable for the better PVSC device. The effect of integrating of **p^+-N:Cu_2O** layer in the $MoTe_2$-based PVSC as a back surface field (BSF) layer was also taken into account to improve the device performance. We also evaluated the output parameters of the optimized **Al/ITO/*n-$MoSe_2$*/*p-$MoTe_2$*/p^+-N:Cu_2O/Pt** PVSC with different series and shunt resistance, back-metal work function, and working temperature. Our analysis shows that minimum series resistance, higher shunt resistance, lower working temperature, and a high back-metal work function of more than 5.35 eV are advantageous for superior PVSC due to low recombination losses, low electrical losses, and better transport of charge carriers. The best performance of 28.75% with J_{sc} of 34.11 mA cm^{-2}, V_{oc} of 0.98 V, and FF of 86.3%, was achieved by optimizing all parameters. To further improve the device performance, the bifacial mode of optimized **Al/ITO/*n-$MoSe_2$*/*p-$MoTe_2$*/p^+-N:Cu_2O/Pt** was considered and the PV performance of the proposed bifacial-PVSC has been also studied by using SCAPS-1D. Compared to the mono-facial device, a bifacial-PVSC device shows better performance with the bifacial factor of 77.5%, bifacial gain of 14.78%, and a higher PCE of 32.17%.

1. Introduction

The extensive global energy consumption and the related ecological problems have produced a constant demand for alternative energy sources which is superior to traditional ones. Solar energy is considered as the main alternative candidate that can fulfill the energy demand for the future and reduce ecological problems. Photovoltaic (PV) devices called solar cells (SCs) are the most effective way to transform solar energy into electrical energy. In 1950, the first SC made of silicon was reported [1]. Nowadays, about 95% of the worldwide solar market is being controlled by the silicon solar cells. In practice, the highest efficiency for silicon solar cells has been recorded to date about 26.7% [2], whereas about 38% efficiency is acquired in the theoretical research [3]. However, Silicon solar cells have several weak points, including the indirect band-gap which causes of low absorption coefficient, extremely high temperature of about 1400 °C needed for silicon production, etc [4].

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Numerical evaluation of bi-facial ZnO/$MoTe_2$ photovoltaic solar cells with N-doped Cu_2O as the BSF layer for enhancing V_{OC} *via* device simulation†

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Molybdenum telluride ($MoTe_2$) shows great promise as a solar absorber material for photovoltaic (PV) cells owing to its wide absorption range, adjustable bandgap, and lack of dangling bonds at the surface. In this research, a basic device structure comprising Pt/$MoTe_2$/ZnO/ITO/Al was developed, and its potential was assessed using the SCAPS-1D software. The preliminary device exhibited a photovoltaic efficiency of 23.87%. The integration of a 100 nm thick nitrogen-doped copper oxide (N-doped Cu_2O) layer as a hole transport/BSF layer improved the device performance of the $MoTe_2$/ZnO photovoltaic solar cell (PVSC), increasing the open circuit voltage (V_{OC}) from 0.68 V to 1.00 V and, consequently, its efficiency from 23.87% to 34.45%. Recombination and C–V analyses were conducted across various regions of the device with and without the BSF layer. The results of these analyses revealed that this improvement in the device performance mainly stemmed from a decrease in recombination losses at the absorber/BSF interface and an increase in the built-in potential of the device, resulting in improved V_{OC} and photovoltaic efficiency. Additionally, the performance of the device in a bifacial mode was studied. The calculated bifacial factor (BF) values suggested that there were negligible additional losses affecting some parameters when the solar cell was under backside illumination and emphasized the potential for improved energy harvest in bifacial solar cells without significant drawbacks.

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1. Introduction

Energy from non-renewable energy sources increases the temperature of the earth by the emission of SO_2, CO_2, and CH_4 gases.[1] The use of renewable resources, such as sunlight and wind, must be increased in order to bring down fossil fuel consumption. The relentless pursuit of sustainable energy sources has propelled significant advancements in the field of solar energy. Different technologies have been applied to utilize solar energy, but photovoltaic (PV) cells have received considerable attention from researchers due to their cost-effectiveness and availability.[2–5] Nowadays, silicon-based solar cells dominate about 95% of the worldwide solar market. However, silicon (Si) possesses an indirect type bandgap, and its optical absorption is not as suitable as those of direct bandgap semiconductor materials. Industrial production of silicon wafers requires temperatures of about 1400 °C, and thick wafers are often used for commercial purposes, which increases costs and the amount of materials used.[6–8] TFSCs have achieved notable progress in recent years, leading to the enhancement of cell performance and cost-effectiveness. TFSCs use a much thinner layer of semiconductor material in comparison with conventional silicon solar cells, making them cost-effective, lighter, and more flexible. The 2nd generation TFSCs are based on CdTe, CIGS, and lead chalcogenide PbX (X = S, Se). These are all direct bandgap semiconductors and have received considerable attention because of their exceptional performance in PV applications.[9–12] High production costs, *i.e.*, expensive materials and manufacturing processes associated with these technologies, primarily limit the commercialization of the 2nd generation TFSCs. Additionally, efficiency, reliability, and toxicity issues have hindered their widespread adoption in the market. These technologies have not yet achieved the same level of efficacy and long-term reliability as silicon-based solar cells, making them less attractive to commercial developers and investors.

To overcome these challenges, researchers have turned to earth-abundant, inexpensive, and eco-friendly materials like transition metal dichalcogenides (TMDCs) as the main

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YOLO11 for High Accuracy Real-Time Detection and Classification of Diverse E-Waste Categories: Enhancing Recycling Efficiency

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Keywords: environmental sustainability | E-waste classification | real-time detection | smart E-waste management | YOLO11

ABSTRACT

The rising challenges posed by electronic waste (e-waste) to environmental and human health necessitate the advancement of smarter, faster, and more accurate e-waste management solutions. Despite significant advancements in object detection technologies, current models often struggle with the real-time classification of diverse e-waste categories, limiting their practical application in large-scale recycling operations. Addressing this gap, this paper introduces **YOLO11**, a next-generation real-time object detection framework specifically optimized for the detection and classification of diverse e-waste categories. Leveraging the power of deep learning, our model was trained on two distinct custom datasets, achieving remarkable classification accuracies of 99% and 98%, respectively. This study is among the first to demonstrate the real-world applicability of the newly released YOLO11 architecture in the domain of e-waste, showcasing its robustness and speed in diverse and cluttered environments. The system is capable of accurately detecting and classifying various categories of e-waste in real-time, offering a practical solution for automated sorting and collection processes. Through extensive experiments, the YOLO11 model achieved exceptional performance, achieving a recall of 0.968, mAP@ (Mean Average Precision) 0.5 of 0.992, and mAP@0.5–0.95 of 0.884 in all classes. Strong generalization and precise object recognition are shown by high class-wise mAP@0.5–0.95 values, such as 0.991 for phone, 0.943 for keyboard, and 0.912 for laptop. The model is ideal for real-time applications since it can identify a variety of e-waste objects with a fast GPU-based inference time (4.9 ms). The experimental findings show that YOLO11 is not only a significant advancement in the field of real-time object detection but also a promising step toward smarter, more automated e-waste management systems. By bridging AI innovation with environmental sustainability, the proposed work contributes to the urgent global effort to foster greener, more circular economies.

1 | Introduction

The exponential proliferation of electronic devices has led to a dramatic surge in e-waste, presenting a mounting global challenge [1]. With the rapid pace of urbanization and industrialization, the volume of waste generated annually is increasing at an alarming rate. Waste, in any form, is harmful and e-waste, in particular, is becoming a major concern [2, 3]. According to the

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Effects of temperature on electrical impedance of biological tissues: ex-vivo measurements

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Abstract

Bioelectrical impedance techniques have been useful in various applications, including body composition analysis, impedance plethysmography, impedance cardiography, lung ventilation, perfusion, and tissue characterization. Electrical impedance methods have also been useful in characterizing different foods like meat, fruits, and beverages. However, the temperature of tissue samples can change their dielectric properties, affecting their impedance. This research investigated the effects of temperature on the impedance of various biological tissues over the frequency range of 10 Hz to 5 MHz. Freshly excised animal tissues (lamb, cow, chicken), fish, fruits, and plants were considered as biological samples. The samples were placed in a test cell and submerged in a water bath heated by a hot plate to vary the temperature. Impedance measurements were conducted using a bioimpedance spectrometer in 2 °C steps within the temperature range of 20 °C to 50 °C. Impedance values decreased with increased temperature across all measurement frequencies for all biological samples. Curve fitting indicated that impedance decreased linearly with temperature, with a mean correlation coefficient of 0.972 for all samples. For all biological samples under investigation, the relative impedance change ranged from −0.58% to −2.27% per °C, with a mean and standard deviation of (−1.42±0.34) %/°C. On average, animal samples exhibited a higher relative temperature coefficient of −1.56% per °C (±0.41) across the frequency range, compared to −1.31% per °C (±0.26) for fruit and vegetable samples. Additionally, the relative temperature coefficient values were generally higher at lower frequencies than at higher frequencies. The findings of this research can be valuable for studies or biomedical applications involving variable tissue temperatures.

Keywords: Bioimpedance; temperature coefficient; dielectric properties; temperature effect; impedance spectroscopy.

Introduction

Cells are the structural and functional units of biological tissues, surrounded by semipermeable membranes. These membranes, consisting of a phospholipid bilayer, act as electrical insulators, whereas the intra- and extracellular fluids contain ions and thus conduct electricity. Electrically, the cell membrane can be modeled as a capacitor, while the intra and extracellular fluids function as resistors. The flow of electric currents through biological tissues are characterized by these resistive and capacitive elements, known as electrical bioimpedance [1]. Bioimpedance is a passive dielectric property of biological tissues, which can provide information about the composition and physiological state of the tissue [2-4]. The dielectric properties of biological materials vary across different types, and even within a specific tissue, these properties differ between healthy and diseased states. For instance, the electrical impedance of cancerous tissue is notably lower than that of normal tissue [5,6]. As a result, electrical bioimpedance techniques have gained the attention of scientists for monitoring anatomical structures, physiological processes, and characterizing tissues.

Bioimpedance techniques have been valuable in various applications, such as body composition analysis, impedance plethysmography, impedance cardiography, and lung ventilation and perfusion. Electrical bioimpedance techniques have been used in the study of various cancers including breast cancer [7], lung cancer [8], cervical cancer [9], skin cancer [10], and oral cancer [11]. Recent studies showed the utility of bioimpedance spectroscopy in the detection of diabetics [12], monitoring of hemodynamics

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Exploring the Adaptability of the Charge Transport Layers for Enhanced Efficiency in Lead-Free $CH_3NH_3SnI_3$ Perovskite Solar Cells

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Abstract

Perovskite solar cells (PSCs) have attracted a lot of interest due to their remarkable energy transformation productivity (PCE) and the possibility of their application in both organic and inorganic compounds. Perfect for sustainable solar technologies, methylammonium tin iodide (CH_3NH_3) is a lead-free, non-hazardous perovskite displaying amazing optoelectronic properties. Its tunable bandgap helps to absorb solar energy efficiently. Its cost and great efficiency render it a perfect photovoltaic material. To improve essential characteristics of the hole transport layer (HTL), absorption area, and electron transport layer (ETL), this work models $CH_3NH_3SnI_3$-based PSCs using SCAPS-1D software. Simulations have been used to investigate the utility of $CH_3NH_3SnI_3$-based PSCs using Cu_2O as the HTL and including WS_2, C_{60}, IGZO, and ZnO as ETL compounds. Moreover, the effects on essential performance criteria like power fill factor (FF), conversion efficiency (PCE), open-circuit voltage (V_{oc}), and short-circuit current density (J_{sc}) of thickness, defect levels, absorber, HTL, and ETL have been investigated. The results show how much changing the ETL improves device efficiency. With PCE values of 33.43%, 33.19%, 33.19%, and 33.23%, respectively, ETLs consisting of WS_2, C_{60}, IGZO, and ZnO have been shown. Furthermore, this work investigated the effect of temperature on PSC performance. These results demonstrate quantum efficiency (QE) and the current density-voltage (J-V) responses.

Index-words: *Perovskite Solar Cell (PSC), Lead-free, $CH_3NH_3SnI_3$, SCAPS-1D, ETL, HTL, WS_2, C_{60}, IGZO, ZnO.*

I. Introduction

Energy has become an essential requirement in nearly all aspects of contemporary life. By 2026, over one-third of the global energy is expected to derive from renewable sources, supporting climate objectives and reducing greenhouse gas emissions [1]. Due to its abundant availability and ease of use for efficient energy conversion compared to alternative sources of energy, solar power is regarded as one of the most promising alternatives [2].

A photovoltaic solar cell, commonly referred to as a solar cell, is a solid-state device that utilizes an electrical system (p-n junction) to directly transform sunlight into direct current (DC) through the photovoltaic effect. The discoveries related to the photovoltaic effect have led to the evolution of modern solar technology and solar cells. Developments in manufacturing technologies and materials have lowered the cost of solar panels, therefore enabling solar electricity to be more reasonably priced and widely available.

A. Basic PV parameters

The performance and behavior of photovoltaic cells are detected by parameters, open-circuit voltage (V_{oc}), short current (J_{sc}), fill factor (FF), and efficiency of power conversion (PCE).

1. Open Circuit Voltage (V_{oc}) is the peak output voltage that the solar cell can generate when its terminals are unconnected, indicating that no current flows.

$$V_{oc} = \left(\frac{\alpha KT}{q}\right) ln\left(I_L/I_0\right) \quad (1)[3]$$

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Effect of surface tension modification in lead ion adsorption from water using different microwave exfoliated graphene from graphite obtained by varying intercalating agent composition

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ABSTRACT

This study investigates the impact of the intercalating agent composition on the exfoliation efficiency of graphite into graphene using a microwave irradiation method and the resulting materials' performance in Pb^{2+}ion adsorption. Two microwave-exfoliated graphene (MG) samples were synthesized using ammonium bicarbonate as the intercalating agent in molar ratios of 1:1 and 1:2 relative to graphite. This process achieved high mass yields of 99.5 %, with MG (1:2) exhibiting superior structural and surface properties confirmed by FTIR, XRD, TGA, and SEM analysis. Surface tension (ST) measurements showed that MG (1:2) formed more stable aqueous dispersions, promoting enhanced metal ion interaction. Both MG (1:1) and MG (1:2) demonstrated a maximum Pb^{2+} removal efficiency of 98.81 % and 96.0 % within just 20 min, exhibiting rapid adsorption performance, with an impressive adsorption capacity of 296.43±3.9 mg/g and 285.93±3.7 mg/g, respectively. The adsorption followed pseudo-second-order kinetics and fit well to the Langmuir isotherm model. The MG (1:2) sample performed over five cycles at 78.87±3.21 % efficiency, which signifies its potential for industrial utilization. The results achieved were significantly positive with the intercalating agent amount and MG dosages. 0.7 % MG (1:2) suppressed the maximum water ST from 71.9 ± 0.5 to 59.9 ± 1.3 mN/m at 30.5 ± 0.5 °C. These results demonstrate the potential of MG, particularly MG (1:2), as an effective and regenerable adsorbent for lead removal from water.

1. Introduction

The contamination of water bodies by heavy metals, particularly by lead (Pb^{2+}), has become a pressing global environmental and public health concern due to their toxicity, persistence, and bioaccumulative nature [1–3]. It primarily arises from industrial activities such as mining, battery manufacturing, and wastewater discharge, posing significant threats to human health, including brain damage and organ dysfunction, and disorders such as nausea, anemia, infertility, convulsions, and renal failure. Removing all organic and heavy metal impurities from natural water sources prevents the spread of harmful contaminants in food chains and protects the ecosystem [4–6]. Conventional water treatment methods, such as chemical precipitation, ion exchange, reverse osmosis, electrochemical processes, and membrane filtration, often encounter limitations, such as low efficiency, high operational costs, and difficulties in regeneration, emphasizing the need for more sustainable and cost-effective alternatives [7–10].

Among the various strategies explored for heavy metal removal, adsorption has emerged as a promising technique due to its simplicity, high efficiency, and environmental friendliness. However, the choice of adsorbent material is critical in determining the effectiveness of this method [11–13]. Carbon-based nanomaterials, such as carbon nanotubes, fullerenes, and graphene, have garnered significant attention as advanced adsorbents due to their large surface area, high mechanical

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Synthesis and characterization of polyvinyl alcohol-based bioplastic film incorporated with keratin extracted from duck feathers

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ARTICLE INFO

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PVA
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Biocompatible

ABSTRACT

The growing environmental impact of petroleum-based plastics has led to increased interest in biodegradable alternatives. However, many bioplastics still face limitations in terms of cost, mechanical properties, and degradability. To address these challenges, this study aims to develop an eco-friendly bioplastic film. Our methodology involves utilizing discarded feather keratin sourced from duck feathers, which is then incorporated into polyvinyl alcohol (PVA). The PVA matrix, along with the keratin filler, provides the bioplastic film with the necessary attributes for biodegradability as well as imparting mechanical and thermal properties that make it suitable for a wide range of sustainable applications. The keratin was successfully extracted from waste duck feathers, resulting in a commendable yield of 79 %. The bioplastic film was prepared using different concentrations of the constituents and subsequently analyzed using various characterization techniques. The thermal and mechanical properties of the bioplastic exhibited a notable enhancement when compared to pure PVA. The prepared film's optimal composition was determined to be P5K0.05 (PVA 5 wt% and Keratin 0.05 wt%). The other characterization techniques, such as FTIR, SEM, and TGA, also exhibit a commendable agreement with the obtained results. The results of the cytotoxicity assessment indicated that the prepared bioplastic exhibits biocompatibility.

1. Introduction

The imperative of environmental sustainability has driven both the scientific and industrial sectors to explore biomass as a renewable source for developing environmentally friendly specialty materials. Raw materials derived from animal and plant sources, such as proteins, sugars, cellulose, and oils, exhibit immense potential as sustainable and cost-effective feedstock for a diverse range of applications with a focus on sustainability [1]. Simultaneously, the utilization of edible starch or protein for the formulation of packaging materials may engender a potential rivalry for precious food resources. Nonfood-borne keratin exhibits immense potential as a highly favorable contender for the development of biodegradable packaging materials [2]. Feathers, which possess a substantial keratin content of approximately 90 %, can be readily procured in significant volumes within the poultry sector. The annual production of feathers, a valuable byproduct, is estimated to reach a staggering 3–4 billion pounds in the United States [3], while China contributes over 1.5 billion pounds [4]. Nevertheless, their industrial-scale applications are somewhat restricted, primarily confined to animal feed, and their ultimate fate typically involves incineration or landfill disposal [5]. Feathers exhibit remarkable accessibility, cost-effectiveness, renewability, and biodegradability, rendering them a highly reliable feedstock for biopolymers, which are anticipated to possess analogous characteristics to polyamides [6]. In the realm of contemporary scientific exploration, diligent scholars have been meticulously exploring novel avenues for the utilization of feather-based materials. These materials, with their inherent properties, have shown great promise in diverse domains, including but not limited to sustenance or biodegradable encasements [4,7], ingestible membranes [8], biosorbents [9], and other composites [10]. Nevertheless, it is imperative to acknowledge that biodegradable packaging exhibits certain constraints pertaining to its thermal stability, resistance to aqueous environments, mechanical attributes, and economic viability [11]. Keratins exhibit a remarkable abundance of intermolecular and

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Transparent and flexible MXene-chitosan nanocomposite film for effective UV and high-energy blue light shielding applications†

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Facile, flexible and highly transparent nanocomposite films were synthesized *via* a solution casting approach by incorporating MXene nanoparticles into chitosan (CS) films and exhibited excellent UV and high-energy blue light absorbing ability. The prepared composite (CMX) films were characterized *via* ATR-FTIR, X-ray diffraction (XRD), FESEM, thermogravimetric analysis (TGA) and derivative thermogravimetric (DTG) analysis. ATR-FTIR spectroscopy, X-ray diffraction (XRD), and FESEM results confirmed that the MXene nanoparticles were uniformly distributed throughout the chitosan film, with strong hydrogen and static bonds formed between the two, while TGA and DTG data confirmed the thermal stability of the composite films. The moisture content (MC), water solubility (WS) index and water swelling (W) of the composite films were thoroughly monitored to investigate the efficiency of the films. CMX-0.04 composite films exhibited improved UV blocking performance: 99.55% of UV-A (320–400) nm, 100% of UV-B (280–320) nm, and 100% of UV-C (200–280) nm. Additionally, this film demonstrated exceptional absorption capabilities around 97.48% within the range of high-energy blue light (HEBL) (400–450 nm) radiation. Furthermore, addition of MXene nanoparticles in the CS film showed enhanced mechanical properties (tensile strength and Young's modulus of 80.09 ± 1.13 MPa and 19.72 ± 1.401 MPa, which was 303% and 830% higher than those of the pure CS film, respectively) with excellent film flexibility. This work offers a method to develop a composite film based on CS and MXenes, which has a lot of potential for expanding real-world applications in UV and HEBL blocking.

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Sustainability spotlight

In this study, chitosan was initially produced from shrimp shells (in general, shrimp shells have almost no uses) as a renewable biomass source, which offer excellent environment-friendly reinforcement materials. Moreover, the fabricated MXene-incorporated chitosan composite (CMX) film exhibited excellent UV and HEBL shielding (absorbing) with almost no environmental impact. Besides, this research work addresses particularly the following UN sustainable development goals: "Make cities and human settlements inclusive, safe, resilient and sustainable (SDG 11)", "Ensure sustainable consumption and production patterns (SDG 12)" and "Take urgent action to combat climate change and its impacts (SDG 13)".

1 Introduction

Ultraviolet (UV) light is detrimental to human health, causing major injuries to the skin and even serious DNA damage, leading to skin cancer after prolonged exposure.[1–3] Solar radiation is the abundant supply of energy for photosynthesis and the vital heat source for the modern world's atmospheric circulation. This radiant energy emits 43% visible, 52% infrared and about 5% of UV light. Shorter wavelength UV light ranges from 315 to 400 nm (UV-A), 280 to 315 nm (UV-B), and 100 to 280 nm (UV-C). Almost 95% of UV-A and only 5% of UV-B reaches the earth surface, while UV-C is completely absorbed by the ozone layer.[4,5] Short-wavelength high-energy blue light (HEBL) in the 400–450 nm range travels through the cornea and lens to the retina, where it can lead to age-related macular degeneration, cataracts, and dry eyes. It can also stimulate the brain, suppress melatonin secretion, and increase the release of adrenocortical hormones, all of which can upset the hormonal balance and negatively impact the quality of sleep.[6,7] Some of

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Biodegradable MXene-Alginate Composite: A Sustainable, Transparent, and Flexible Solution for Next-Generation Ultraviolet Shielding

Md. Hanif Munshi, Md. Didarul Islam, M. Mehedi Hasan,* Shaikh Almoon Hussain, and Md. Kamruzzaman*

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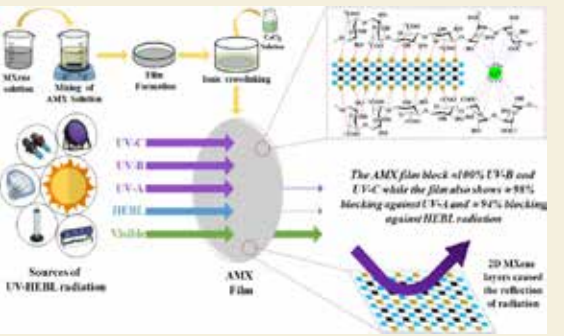
ABSTRACT: In this study, a transparent and flexible biodegradable MXene-incorporated alginate film was developed by the solvent casting method followed by cross-linking with $CaCl_2$ for ultraviolet (UV) shielding application. The mechanical, optical, thermal, and structural properties of the synthesized Ca-alginate (Alg)/MXene (AMX) films were investigated using a variety of characterization techniques, including Fourier transform infrared spectroscopy (FTIR), X-ray diffraction, field emission scanning electron microscopy (FESEM), thermogravimetric analysis, differential thermogravimetric analysis, ultimate tensile strength, and UV−visible spectroscopy. The FESEM image of the AMX film showed that MXene was evenly distributed throughout the alginate film matrix, and FTIR results indicated that there was a strong intermolecular hydrogen bond between AMX. The composite AMX-0.04 films were found to have a tensile strength of 143.58 ± 1.86 MPa and a Young's modulus of 30.15 ± 0.397 MPa, which were approximately 17 and 55% greater than those of the Alg film, respectively. Better UV and high-energy blue light (HEBL) blocking performance was also demonstrated by the AMX-0.04 composite films, which demonstrated 98.46% UV-A radiation, 99.86% UV-B radiation, 99.90% UV-C radiation, and 94.04% HEBL radiation. It was also discovered that the AMX film's UV and HEBL blocking capabilities rose dramatically with an increase in MXene content. Our research demonstrated that a straightforward and easy fabrication process is a viable approach to creating robust, transparent, and highly flexible AMX films with exceptional physicochemical qualities. These films also showed great promise for extending their practical applications in blocking UV/HEBL radiation.



KEYWORDS: *MXene, alginate, biodegradable, mechanical properties, thermal properties, UV shielding*

1. INTRODUCTION

The main source of energy for the planet, sunlight, is the foundation and guarantee for the existence of all living things. Approximately 5, 43, and 52% of the total solar energy are represented by the ultraviolet (UV), visible (vis), and infrared (IR) wavelength bands, which make up the majority of the solar spectrum.[1] UV light comes in three major types, each with a wavelength between 200 and 400 nm, which are distinguished by their unique effects on biology and the environment: 200−280 nm (UV-C), 280−315 nm (UV-B), and 315−400 nm (UV-A). It is noteworthy that whereas only 5−10% of UV-B and the majority of UV-A reach the Earth's surface, UV-C is completely absorbed by the atmosphere.[2] Significant health risks, including weakened immune systems, significant genetic damage, a higher risk of skin cancer, and cataracts, can be brought about by ultraviolet light. Furthermore, UV radiation will hasten the fading and aging of furnishings, furniture, etc.[3,4] Small amounts of UV-B light stimulate the body to produce more melanin, but long-term exposure can cause DNA damage, delayed tanning, aging, and an increased risk of skin cancer. A number of eye conditions, including photokeratitis, pterygium, and pinguecula, are also linked to UV-B exposure. However, UV-A rays have the ability to reach deeper skin layers, which can cause instant tanning and a higher risk of skin cancer. Additionally, macular degeneration, a disorder marked by gradual retinal degradation and eventual vision loss, and cataract formation can be attributed to UV-A radiation.[5] Apart from the harmful impacts of UV radiation on human health, high-energy blue light

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REVIEW ARTICLE

Recent Advancements in Biomaterial Applications: A Review

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Abstract
Biomaterials have been developed as a transformative tool in various applications of the modern world. Biomaterials have advanced with time and applications, from structural implants to replacing biological functions in the human body, and so on. This review article provides a detailed examination of the diverse categories of biomaterials, including natural, synthetic, and composite materials. Recent unique properties, advantages, and challenges have been described in the article. Natural biomaterials are known for their excellent biocompatibility, biodegradability, and versatility in healthcare applications. Those are used in different applications such as wound healing, drug delivery, and tissue scaffolding. Synthetic biomaterials are critical for load-bearing applications. Composite biomaterials combine the strengths of individual materials to offer superior mechanical performance and biological functionality. The field of biomaterials is fast-growing sector to meet the demand for personalized medical treatment. Future research will focus on the development of multifunctional biomaterials that integrate healthcare solutions and daily life needs. This review highlights recent advancements, emerging trends, and future directions in biomaterial research that will help in shaping the next generation of biomedical innovations.

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Integrating multiphasic CuS_x/FeS_x nanostructured electrocatalyst for enhanced oxygen and hydrogen evolution reactions in saline water splitting

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Iron Sulfide
Seawater

ABSTRACT

This study employed an electrodeposition approach to synthesize multiphasic CuS_x and FeS_x on nickel foam (NF) for application in saline water splitting. This multiphasic electrocatalyst exhibits a cauliflower morphology and develops a porous fused-type morphology upon partial oxidation. The NF/CuS_x/FeS_x electrode with partial oxidation exhibits the lowest overpotential of 181 mV at 10 mA/cm^2 and a Tafel slope of 163 mV/decade for the oxygen evolution reaction (OER). The overpotential of 73 mV at 10 mA/cm^2 and a Tafel slope of 165 mV/decade were found for the hydrogen evolution reaction (HER). A charge transfer coefficient value of ~0.5 in OER and HER indicates that the rate-determining step depends on the surface adsorption of reaction species. The presence of an unpaired electron during partial oxidation can create additional active sites and reduce solution resistance (R_s). This can improve the interaction between reactants and intermediates, improving OER and HER performance. NF/CuS_x/FeS_x composites demonstrated robust stability using real seawater splitting over 80 hours in HER with negligible degradation. However, catalyst breakdown in OER after 10 hours due to prolonged exposure to higher potentials, resulting in oxidative corrosion. This study offers a multiphasic electrode design using the electrodeposition technique to produce green hydrogen energy through seawater splitting.

1. Introduction

As society develops rapidly, traditional fossil fuels are quickly depleting [1]. This depletion is leading to energy shortages and pollution [2]. Significant efforts are being made to transition towards renewable energy sources to maintain a cleaner environment and reduce the dependence on fossil fuels [3–7]. Electrocatalytic water splitting is recognized as a sustainable and eco-friendly method for green hydrogen production [8–11]. However, it requires higher energy (>1.23 V) due to the sluggish four-electron transfer in the anodic oxidation reaction [12]. Large-scale hydrogen production is hindered by high energy consumption, which in turn increases the production costs [13]. Better technologies are required to produce hydrogen efficiently with readily available materials. In this regard, transitional metal sulfides (TMSs) are readily available, efficient, and low-cost in production materials, making them viable options as electrocatalysts for saline water splitting [14]. In addition to the selection of materials, the design of the catalyst is also crucial. The heterogeneous interfaces between materials can enhance the electrocatalytic activity [15]. Different interface interactions speed up the charge transfer process and create more active sites [16]. Metals like Cu and Fe in TMSs are stable, affordable, non-toxic, and function well as electrocatalysts [17]. In TMSs, sulfur-to-metal component ratios typically vary significantly, meaning that each element corresponds to many sulfides (MS, MS_2, M_9S_8, M_7S_4,

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Effect of sulfidation on ethaline-assisted electrodeposited iron sulfide-based electrocatalyst for efficient saline water splitting

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ABSTRACT

This study investigated the synthesis of ethaline-assisted iron sulfide on nickel foam (NF) using the electrodeposition method to facilitate saline water splitting. The oxidization of iron and the formation of $Fe(OH)_3$ on the cathode surface pose challenges for the electrodeposition of iron sulfide from aqueous solutions. To tackle these issues, deep eutectic solvent-assisted electrodeposition and ethaline-assisted sulfidation methods have been investigated for synthesizing FeS_2. These approaches aim to enhance the efficiency of the iron sulfide electrode by preventing unwanted oxidation and ensuring the formation of high-quality coatings. Sulfidation in non-aqueous media was performed at varying durations, revealing that sulfur content significantly impacts the morphology of the prepared electrode. The optimum FeS_2/NF catalyst offers the lowest overpotential of 194 mV at 10 mA cm^{-2} for oxygen evolution reaction (OER) and 176 mV at 10 mA cm^{-2} for hydrogen evolution reaction (HER) in saline water splitting. The enhanced catalytic activity is attributed to the formation of multiphasic components in the catalyst. The electrodes exhibited stability in saline water conditions for approximately 10 h for both OER and HER. Moreover, FeS_2/NF exhibited stability for 50 h in OER and 20 h in HER when applied to pure water splitting. The investigation explores the unique synthesis of FeS_2 in non-aqueous media and examines its catalytic activity in saline water electrolysis.

1. Introduction

The electrolytic water splitting process is regarded as a promising method for generating green hydrogen [1,2]. There has been substantial global research focused on creating cost-effective, readily available, proficient, and stable electrocatalysts to replace noble metals [3,4]. Due to the outstanding catalytic abilities of transition-metal sulfides (TMSs) in water splitting, they have gained a lot of interest recently [5–7]. TMS emerges as a promising candidate for corrosion-resistant electrodes, primarily because sulfur's strong electronegative properties repel chloride anions in seawater [8–10]. Electrodeposition is a suitable method for the industrial use of electrodes due to its repeatability, cheap cost, and short production time. Because of the oxidation from Fe(II) to Fe(III) and the formation of $Fe(OH)_3$ precipitates at the cathodic surface, the electrochemical deposition of FeS from aqueous solution is complicated [11]. However, using non-aqueous solutions such as deep eutectic solvents is a valuable option, particularly for iron-based systems. This technique reduces pH dependency of the electrochemical bath and produces high-purity deposits [12]. Abbott et al. introduced a class of ionic liquids of a novel kind known as deep eutectic solvents (DESs) in 2003 [13]. Due to their significant ability to dissolve in polar solvents and electrical conductivity, metal ions are well-suited for electrodeposition processes [14]. Kefeng Pan et al. investigated ethylene glycol and ethylenediamine-assisted FeS_2/C nanowire catalysts for water splitting

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Materials Research Express

PAPER

Demethylation strategies for spiro-OMeTAD to enhance the thermo-opto-electronic properties as potential hole transport materials in perovskite solar cells

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Keywords: hole transport material, perovskite solar cell, spiro-OMeTAD, SCAPS-1D, energy conversion

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Abstract

Spiro-OMeTAD is a widely used hole-transporting material (HTM) that plays a crucial role in achieving highly efficient perovskite solar cells (PSCs). In this work, a series of demethylated functionalized spiro-OMeTAD-based derivatives with different numbers of hydroxyl substituted groups (named as **SOH2**, **SOH4**, and **SOH6**) were synthesized, and their thermal, optical, electrical, and electrochemical properties have been investigated as potential HTMs for PSCs. It has been found that the molecule with six hydroxyl substituted groups on the spiro-OMeTAD-based structure **SOH6** exhibited the highest glass transition temperature (T_g) and melting point (T_m) as compared to **SOH2** and **SOH4** molecules. The UV–vis absorption spectra portrayed a distinct pattern with the increase in hydroxyl substituted groups as it was slightly blue-shifted for the **SOH6** molecule compared to red-shifted for **SOH2** and **SOH4** molecules. Carrier mobility shows a notable improvement with the hydroxyl substitution. The density functional theory (DFT) has provided useful insight into identifying the chemical stability of spiro-OMeTAD derivatives. In the device simulation, hydroxyl-substituted spiro **SOH2** was found to outperform its pristine counterpart, achieving a peak PCE of 17.61% with a V_{oc} of 0.98 V, a J_{sc} of 22.69 mA cm^{-2}, and an *FF* of 80.67% within the device structure FTO/TiO_2/$MAPbI_3$/HTMs/Au. This investigation provided insight into the development of novel spiro-OMeTAD-based derivatives with enhanced optoelectronic properties and showed promising potential for addressing the limitations of traditional HTMs in PSCs.

Introduction

In today's technological landscape, optoelectronic devices play an indispensable role by seamlessly integrating electronics and optics. These versatile gadgets, capable of both emitting and absorbing light, are pivotal across various industries, including light-emitting diodes (LEDs), sensors, solar cells, displays, and communication systems [1, 2]. The main optoelectronic devices that have attracted a lot of interest recently are perovskite-based

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Facile electrodeposited sandwich-like CuS_x/MnS_x electrocatalyst for efficient hydrogen evolution in seawater splitting

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Copper sulfide
Manganese sulfide
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ABSTRACT

This study investigates a sandwich-like CuS_x/MnS_x electrode fabricated through electrodeposition technique on nickel foam (NF) substrate for hydrogen evolution reaction (HER) in seawater splitting. The synthesized electrode exhibits plenty of active sites, substantial specific surface area, and a distinctive morphology reminiscent of a tuberose-type nanostructure. Moreover, synergistic activity between the copper and manganese components enhances the rate of electron transfer process, thereby augmenting the electrocatalytic performance. Partial oxidation serves to increase active sites and control the morphology of the nanoparticles. The optimized electrode exhibits a minimal overpotential of 144 mV at 10 mA/cm^2 for saline water splitting. The Tafel slope of 197 mV/dec and a transfer coefficient (α) of 0.3 indicate that the rate-determining step for the HER is likely the initial Volmer reaction. A higher electrochemical surface area (ECSA) of 2268 cm^2, a solution resistance of 0.84 Ω, and a charge transfer resistance of 5.18 Ω suggest improved ion diffusion in the synthesized electrode. The electrocatalytic performance was also investigated by carrying out experiments with varying alkalinity in natural seawater electrolytes. The catalyst demonstrated robust stability for HER in natural seawater splitting with constant current density after 50 h of chronoamperometric analysis. The facile electrodeposited electrocatalyst exhibits energy-efficient and sustainable performance, effectively catalyzing reactions in a seawater-based electrolyte during the HER.

1. Introduction

With the acceleration of the energy crisis and environmental pollution, the transition to clean energy poses significant challenges. Electrocatalytic water splitting is an efficient method of generating hydrogen fuel, offering a viable clean energy source [1]. Using seawater for water splitting is important because around 80 % of the world's population faces severe drinking water shortages [2]. Technologies for green energy production should not take precedence over necessities like food and fresh water. Another important factor in using seawater for industrial water splitting is that it eliminates the need for water purification systems, which reduces costs and saves space [3]. The primary challenge in seawater splitting arises from corrosion reactions at electrodes in chloride-rich environments. In recent decades, novel catalysts Pt, Ir, Pd, and Ru have been used to develop seawater-splitting electrodes [4]. But they are rare materials and a scarce source. Therefore, Transition metal sulfides (TMSs) have garnered significant attention due to their distinct morphological properties, natural abundance, and exceptional performance [5]. Notably, transition metals like copper and manganese-based materials are recommended due to their intense redox activity and

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Correlation between defect properties and the performance of eco-friendly $CsSnI_3$-based perovskite solar cells

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Abstract

This study investigates the potential use of eco-friendly, all-inorganic cesium tin iodide ($CsSnI_3$) perovskite (PVK) as an absorber layer. Despite having higher temperature stability of $CsSnI_3$, the challenge is to get a uniform and defect-free film that hinders the performance. To accomplish this goal, we investigated several performance-related variables for perovskite solar cells (PSCs), including material defect density (N_t), transport materials, layer thickness, temperature impacts, and back contact work functions. Negative valence band or conduction band offset values indicate no barrier preventing photogenerated carriers from flowing into the charge transport layers. The simulation result shows that hole transport layer thickness shows a higher impact than electron transport layer thickness. For the PVK thickness of 500 nm and a carrier density of 10^{18} cm^{-3}, the device offers an optimum power conversion efficiency of 20.1%. The performance is more significantly affected by the defects in the PVK material compared to the defects present at the interface. Higher recombination (R_{e-h+}) occurs at the TiO_2–$CsSnI_3$ interface. Defects located within the deep-level trap positioned at the mid-point of the band gap energy (E_g) have a negative impact on the performance. The temperature coefficient (C_T) is approximately -0.367% K^{-1}, indicating excellent thermal stability in an open environment. The selection of 'A' cation, the addition of additives, or carefully controlled fabrication techniques can mitigate the defect. This research shows the strategy for creating defects-free PSC devices, ultimately enhancing performance and the stability.

Keywords: perovskite, defect, Pb-free, $CsSnI_3$, SCAPS-1D

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Nanoscale Advances

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REVIEW

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Plant extract-mediated green-synthesized CuO nanoparticles for environmental and microbial remediation: a review covering basic understandings to mechanistic study

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This review provides a comprehensive overview of nanoparticles, with a particular focus on plant extract-mediated green-synthesized copper oxide nanoparticles (CuO NPs). This article is one of the simplest to read as it aims at beginner researchers, who may not have advanced knowledge on topics like nanoparticles, including metal and metal oxide nanoparticles, their classification, and techniques to prepare them. Various synthesis procedures are discussed, emphasizing green synthesis methods that utilize plant extracts as reducing and stabilizing agents. Subsequently, the mechanisms involved in the formation of CuO NPs are highlighted. Their significant applications with a mechanistic overview on environmental remediation, especially in the eradication of textile dyes and pharmaceutical wastes, and their antimicrobial properties are elucidated. By carefully scrutinizing the information available in the literature, this article aims to equip novice researchers with a foundational understanding of nanoparticles, their synthesis, and their practical applications, fostering further exploration in the field of nanotechnology.

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1. Introduction

Research on nanomaterials, which have at least one dimension within the nanoscale region (1–100 nm), known as nanomaterials, has become one of the most intriguing disciplines of science. As the surface areas of nanomaterials becomes larger compared to their size, they exhibit superior physical and chemical properties compared with their bulk counterparts.[1] From electronics to medicine, nanomaterials have been offering enhanced performance, efficiency, and functionality, enabling targeted drug delivery, improved energy storage, and production of light-weight materials with a higher strength.[2] Among various types of nanomaterials, transition metal oxide (MO) NPs have garnered significant attention owing to their comprehensive applicability in functional smart material fabrication.[3] The MO NPs beget unique phenomena such as quantum confinement effects, altered surface energies, interface effects, and increased surface-to-volume ratios, which are not observed in non-NPs of MO.[4]

Copper(II) oxide (CuO) has gained great interest in recent years as a p-type semiconductor with its monoclinic structure, superior conductivity, photovoltaic features, and large stability among nanomaterials.[5] Realizing and utilizing these exceptional properties broadened the scope of applications of CuO NPs as effective anti-bacterial and anti-fungal agents,[6,7] materials for environmental remediation *via* photodegradation or adsorptive removal of toxic substances,[8,9] catalysts for increasing the rate of oxidation reactions,[10] sensors for the identification of gases and biomolecules,[11,12] and energy-storing materials, such as batteries or supercapacitors with the desirable electrochemical characteristics.[13]

There are several existing methods widely used for the synthesis of CuO NPs, which include chemical precipitation, sol–gel, hydrothermal, and biological methods.[14] The traditional chemical and physical methods of CuO NP synthesis often involve toxic reagents and complex procedures. To reduce or eliminate the use of toxic chemicals, finding an alternative source is crucial, and the use of plant extracts for the green synthesis of CuO NPs presents a sustainable alternative.[15] In this greener approach, the phytochemicals that are present in the plant extract act as a reducing and stabilizing agent for the CuO NPs. Through this process, use of harmful chemicals can be avoided, and thus, an eco-friendly synthesis procedure can be established. Various plant sources

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Research article

Effect of selective preservatives on shelf-life of guava juice extracted using pectinase enzyme

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ARTICLE INFO

Keywords:
Guava juice
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ABSTRACT

The study investigated the feasibility of enzymatic extraction for guava juice and evaluated the effects of various preservatives on its shelf life. The crushed guava puree was undergone different pectinase enzyme concentrations over three incubation periods. The findings revealed that pectinase concentrations of 0.1 % and 0.2 %, when incubated for 1 and 2 h, were the most effective. Juice yields ranged from 65.24 % to 78.64 %, with Total Soluble Solids (TSS) varying from 9.12°Brix to 11.56°Brix. The physicochemical properties of the guava juice resulted 84.2 % moisture, 2.16 % protein, 0.77 % fat, 3.27 % fiber, 0.65 % acidity, 2.25 % reducing sugars, 8.27 % non-reducing sugars, 79.53 % antioxidant activity, 173.2 mg/100g of ascorbic acid, 10.52 TSS, 109.7 mg/100g of phenolic content, and a pH of 3.2. Eight juice samples were prepared as per formulation with sodium benzoate and potassium metabisulfite (KMS) at concentrations of 150 ppm, 200 ppm, and 250 ppm, in addition to one refrigerated sample and one control. The stability of these guava juice samples was monitored every 15 days over a 90-day period. Results showed that acidity, TSS, pH, reducing sugars, and non-reducing sugars changed over time. Samples with preservatives exhibited slower changes compared to the control. Phenolic compounds diminished more quickly at ambient temperature than in refrigerated or preservative-treated samples. Initially, phenolic content and antioxidant capacity were 44 mg GAE/100g and 44 %, respectively, but declined to 10–15 mg and 15–17 % by the end of the storage period. Color changes were more noticeable in samples stored at room temperature, whereas preservatives effectively reduced color degradation caused by enzymatic browning. Moreover, ascorbic acid retention was better in samples with preservatives and those stored under refrigeration. The ascorbic acid degradation rate was highest at room temperature (0.023 dayˆ-1) and lowest with 250 ppm KMS (0.016 dayˆ-1). Microbiological tests indicated that the juice remained safe for 40 days at room temperature, 90 days under refrigeration, and approximately 85 days with preservatives.

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Effects of Coconut Flour and Milk Powder Supplementation on the Physicochemical Properties of Peanut Butter

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M. Khan, S. Rana, J. Rana, E. Jony, S. Arifin, F. Jubayer, A. Alim, 2024

Abstract.
Peanut butter is a popular, versatile food spread globally known for its nutritional value and unique flavor. As consumer preferences evolve, there is an increasing demand for fortified products. Coconut flour and milk powder are potential fortification agents due to their nutritional benefits and compatibility with various food matrices.

We explored the effects of incorporating coconut flour and milk powder into peanut butter, analyzing its nutritional composition and sensory qualities. Various combinations (0, 5, 10, and 15% w/w) of coconut flour, milk powder, and their mixture were introduced into peanut butter followed by a thorough physicochemical and sensory analysis.

The results showed notable changes in both physical and chemical attributes. Coconut flour and its combination with milk powder increased the moisture content in peanut butter, while milk powder had the opposite effect. The protein content peaked in the peanut butter with 15% coconut flour, while the fat content diminished with higher concentrations of coconut flour and milk powder. Carbohydrate levels in the supplemented samples surpassed those of the control and commercial peanut butters. All the variants exhibited a pseudoplastic flow behavior, with coconut flour and milk powder concentrations affecting viscosity. The textural analysis revealed differences in oil separation, spreadability, and firmness, with 15% coconut flour yielding the highest firmness and oil separation. Noteworthy color changes were evident, particularly with the inclusion of 15% milk powder. Sensory assessments favored the peanut butter with a 15% blend of coconut flour and milk powder, while the color preference leaned towards the 15% milk powder variant. The consumers preferred the peanut butter fortified with a 15% blend of coconut flour and milk powder.

Our research can help food manufacturers create healthier, more appealing products that cater to evolving consumer preferences and dietary requirements.

Keywords. Butter, nuts, milk powder, fortification, rheology, texture, quality, sensory evaluation

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Sustainable shelf-life extension of *Musa acuminata* using starch-based coatings infused with pomelo peel essential oil

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ABSTRACT

An edible coating made from corn starch and pomelo peel essential oil was developed to modulate the post-harvest physiological processes of *Musa acuminata*, extending its ripening period. The efficacy of the coating was evaluated based on alterations in the physicochemical characteristics of bananas, including weight loss, visual color, firmness, titratable acidity, total soluble solids, ascorbic acid, pH, and total plate count. The findings indicated that the coating effectively lowered the weight loss (15.65%) and microbial load (10% spoilage) for T-III (5 % essential oil), the most effective treatment. The expected lifespan of coated fruit was prolonged by 12 days in comparison to the untreated control, which ripened in seven days and became unmarketable after Day 6. The physicochemical properties of bananas held at refrigerated temperatures were superior to those stored at room temperature. This study illustrated the efficacy of a starch-based edible covering infused with pomelo peel essential oil formulation in enhancing the preservation capacity of banana fruit under ambient and refrigerated conditions, offering a promising solution for tropical fruit preservation.

1. Introduction

Banana (*M. acuminata*) is one of the most extensively cultivated and consumed fruit in tropical and subtropical climates globally, serving as a significant food source for millions (Deka et al., 2006). Bangladesh is ranked 24th among the world's banana-producing countries in reference to banana production (SE et al., 2024). In Bangladesh, total banana production in the year 2023-2024, was recorded at 813,559.8 metric tons from the cultivated areas of about 122,858.57 acres (BBS, 2024). Several banana cultivars such as Champa, Amritsagar, Sabri, Kabri, etc. are often found (Zafar et al., 2013). Among them, 'Sabri' (*M. acuminata*) is one of the most consumed varieties in this region (Tabassum et al., 2018). Banana is highly nutritious and a substantial source of energy (89 kcal/100 g), rich in vitamins, particularly vitamin B, contains a high carbohydrate content and also rich in magnesium, calcium, phosphorus, and potassium (Sidhu & Zafar, 2018).

Because of physiological changes, increased warmth, and humidity, bananas suffer postharvest losses of 25 to 50 % (Thakur et al., 2019a). Hossain et al. (2016) indicated that Bangladesh experiences an annual postharvest loss of 24.62 % for bananas, amounting to 0.567 billion BDT. This fruit is prone to quick deterioration because of their high perishability, which results in significant postharvest losses (Maqbool et al., 2010).

Various effective methods, including low temperature, modified atmosphere packaging and coating have been employed to prolong the longevity of postharvest fruits and vegetables (Adetunji et al., 2013). Sun drying is cost-effective but susceptible to contamination due to its reliance on weather conditions (Martínez et al., 2024), whereas tray drying may result in inconsistent drying and suboptimal rehydration characteristics (Umairah & Hasmadi, 2023). Freeze drying effectively retains nutrients but entails substantial operational expenses (Martínez et al., 2024), and vacuum microwave drying, while efficient, necessitates costly apparatus and may produce inconsistent quality (Umairah & Hasmadi, 2023). Chemical preservation prolongs shelf life but raises health concerns (Mohapatra et al., 2011). Although refrigeration slows down ripening, it can also cause chilling damage, which can cause

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Research Article

Effect of Foam-Mat Drying Methods on Quality Attributes of Green Chili Powder

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This study evaluated foam-mat drying methods (sun, cabinet, and vacuum) for green chili powder production. Fresh chilies (86.21% moisture) contained 6.24% protein, 412.81 mg GAE/100g phenolics, 141.43 mg/100 g vitamin C, and 1666.27 μg/g capsaicin, with strong antioxidant activity (DPPH: 145.21 μM Trolox eq./g; FRAP: 236.74 mM Fe(II)/100 g). Foamed chili foamed paste supplemented with 5%–15% albumin and 2% starch was dried, with vacuum drying showing optimal kinetics (diffusion coefficient: 9.15×10^{-10} m^2/s) and nutrient retention: highest protein (11.78%), phenolics (965 mg GAE/100g), flavonoids (395.43 mg QE/g), and β-carotene (985.16 μg/100 g). It preserved chlorophyll (2.67 mg/100 g chlorophyll a; 3.71 mg/100 g chlorophyll b), minimized vitamin C loss, and maintained capsaicin content. Vacuum-dried powder exhibited superior antioxidant activity (DPPH: 338.78 μM Trolox eq./g; FRAP: 553.63 mM Fe (II)/100 g) and color stability, alongside excellent functional properties (water absorption: 178 g/100 g; oil absorption: 111 g/g). Microstructure analysis revealed compact, smooth particles, confirming structural integrity. In contrast, cabinet drying and sun drying caused higher nutrient degradation and color deterioration. The results demonstrate that vacuum drying combined with foaming is the most effective method for producing nutrient-rich, high-quality green chili powder with enhanced bioactivity and functional quality.

Keywords: bioactive compounds; capsaicin; functional properties; microstructure

1. Introduction

Spices have long been integral to human culture, infusing diets with aroma, flavor, and intrigue since ancient times. Among these, chili (*Capsicum annum* L.) holds a distinguished position as the world's most widely consumed spice [1, 2]. In the Indian subcontinent, only two chili species, *Capsicum annum* and *Capsicum frutescens*, are native, with the majority of cultivated varieties belonging to the former [3]. Globally, green chili and pepper production reached 36 million tons in 2020, with nearly half originating from China [4]. Bangladesh, with its subtropical climate conducive to green chili cultivation, has emerged as a notable player in chili production. According to the Bangladesh Bureau of Statistics [5], chili ranks second among the top five consumed spices in the country, with a remarkable yield of 623 kg per acre during the 2018–19 fiscal year, a 17% increase from 2016 to 17, underscoring the growing efficiency of the sector.

Beyond their culinary applications in oleoresins, sauces, pickles, and chutneys, green chilies are a powerhouse of bioactive compounds, including carotenoids, phenolics, capsaicinoids, ascorbic acid, and antioxidants. These compounds offer numerous health benefits, such as reducing the risk of cancer, cardiovascular disease, and anemia [6]. Capsaicin, the compound responsible for chili's pungency,

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Effect of NaCl pretreatment and frying conditions on the physico-chemical and sensory properties of potato peel chips

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Potato peel
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Texture Analysis
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ABSTRACT

Potato processing produces nutritious peels that have mostly been discarded as waste. Valorizing such a by-product into snacks aligns with sustainable food systems. This study aimed to develop air-fried potato peel chips: their physicochemical and sensory properties were investigated with respect to NaCl pre-treatments, and frying temperatures. The potato peels were soaked in NaCl solutions (3 % and 5 %), air-fried, and performed proximate analysis at three frying temperatures (170, 180, and 190 °C) for all treatments, frying kinetics, texture profiling, color test, and sensory evaluation. Moisture content decreased corresponding to increasing NaCl concentrations and temperatures, with chips treated with 5 % NaCl having the lowest moisture (6.94 %). Ash and carbohydrate content showed a proportional relation with NaCl concentrations. Across all frying temperatures (170–190 °C), control chips consistently showed the highest fat content (41.43–43.53 %), while 5 % NaCl-treated chips exhibited significantly lower fat values (36.03–38.01 %), with fat content increasing slightly with higher frying temperatures. Control chips contained the highest energy. Activation energies were reduced by additives (10.21 kJ/mol for control chips, 4.04 kJ/mol for 5 % NaCl). The sensory evaluation found that the chips fried at 180°C with 5 % NaCl were the most preferred (highest score: 6.86/9). In addition to being strongly correlated with moisture loss and Maillard reactions, the treatments had a considerable impact on the chips' hardness and color (L*, a*, b*, C*, h°). Chroma (C*) and hue angle (h°) analyses were also incorporated, revealing that C* decreased while h° shifted toward greener tones with higher frying temperatures. Air-fried potato peel chips, especially those treated with 5 % NaCl, are represent low-fat snacks with elevated mineral levels (ash content up to 6.51 %) and remain within an acceptable range of sensory qualities. This method will implement waste valorization and contribute to sustainable food production.

1. Introduction

Potatoes are the third most significant food crop in the world, after rice and wheat, due to their high energy yield and rich nutritional makeup, which includes dietary fibers, protein, potassium, and vitamin C (Ahmed, 2024). In Bangladesh, annual potato production reached approximately 9.61 MT in 2020 (Sabur, Miah, Begum, Rahman, & Molla, 2021). Potato peels account for roughly 15–40 % of tuber weight depending on peeling method, representing an estimated 1.44–3.84 MT of peel waste each year (Rodríguez-Martínez, Gullón, & Yáñez, 2021). Despite being widely consumed, the processing of potatoes produces an abundance of by-products, especially peels, which are frequently thrown away as agricultural waste. Potato peels are a nutrient-dense byproduct with more dietary fiber, phenolic acids, flavonoids, anthocyanins, essential amino acids, vitamins (C, B_1, B_2, B_3), and minerals including phosphorus, calcium, and iron. However, they also contain antinutrients like glycoalkaloids (solanine and chaconine) and phytic acid. At elevated levels these can reduce mineral absorption or cause gastrointestinal irritation, though standard processing typically reduces the glycoalkaloid content below harmful thresholds (Akyol, Riciputi, Capanoglu, Caboni, & Verardo, 2016; Jimenez-Champi, Romero-Orejon, Moran-Reyes, Muñoz, & Ramos-Escudero, 2023; Joshi, Sethi, Arora, Azizi, & Thippeswamy, 2020). Valorization is the process of either preserving or increasing the value or worth of anything. Valorization of potato peel waste refers to converting potato peels into valuable products, which are produced in enormous volumes, generating

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2949-8244/© 2025 Elsevier B.V. All rights are reserved, including those for text and data mining, AI training, and similar technologies.

Finding an Affordable Place to Live: Socio-Economic Challenges of Middle-income Communities in Khulna, Bangladesh

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Abstract

In densely populated countries like Bangladesh, people find it hard to secure a place to live due to unaffordability of housing, insecurity of tenancy, poor housing standards, as well as limited land and overpopulation. Middle-income communities, in particular, are struggling to secure affordable housing as the overall living expenses are increasing. Rapid urbanization and urban-rural migration are also disrupting their social, cultural, and economic conditions. These problems are present not only at a household level, but also affect social and community relations. The experiences of their struggles and adaptive strategies have received little attention. In this context, this study investigates various social and economic challenges of rental affordability, rent stress, and adaptive strategies that middle-income communities are employing in Khulna, in finding a place to live.

It employs a mixed-methods approach for research. Data is gathered from middle-income households of some selected areas in Khulna through household-based questionnaires and focus group discussions to reveal the deep insight of family dynamics and impact of rent burdens and rent stress on their daily lives. It performs a multifactor analysis to determine the influential factors from the data. This approach identifies subtle dynamics behind the financial choices and trade-offs of the renters.

The findings indicate that middle-income communities living in Khulna are under a high rent stress level, which is often more than the affordability limit. As a result, they cut back on catering to their basic needs. This is exacerbated by insecure tenancies, poor housing, and poor access to services. However, they also employ numerous adaptive strategies. These involve revision of spending, changes in employment, and changes in locations to secure less expensive houses. These coping habits affect social identity, family life, and housing satisfaction. The paper concludes that strategic and sensitive policies are needed to address the issues of rent regulation, tenure security, and fair access to housing, which will curtail the increasing severity level of rent stress and uphold stability in urban housing, enabling the middle -income communities in Bangladesh to find affordable places to live.

Keywords: Rental housing affordability, Rent stress, Middle-income community, Socio-cultural influence, Khulna, Bangladesh

Regeneration of Distressed Communities in Settlements Around Brownfields: Insights from Khulna, Bangladesh

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Abstract

As is known, Khulna, the third largest metropolis in Bangladesh has played a pivotal role in trade and industry during the 1950s and 60s. From the late 60s, the political shifts have caused a rapid decline of the industries, worsening the socio-economic condition of the workers' community and the physical condition of the surrounding urban areas of the industrial belt. Partial closures, leasing out, laying off of the mills and finally turning into urban brownfields, have made thousands of workers jobless. Khulna Newsprint mill is such a brownfield, closed in 2002 leaving a total of 6000 workers and employees unemployed with a hope of reopening. Despite 16 years passing, they continue to hold onto this hope of relaunching the mill while living next to the mill area with multiple deprivations in socio-economic aspects. In this context, the government has introduced a new industrial policy in 2010, emphasizing investment in State Owned Enterprises only for reopening. However, without recognizing distressed vernacular communities and a concurrent regeneration plan, this strategy has proven ineffective in a developing country like Bangladesh.

This research examines how distressed vernacular communities of urban brownfields can be regenerated. The objectives are to identify the socio-economic needs of the distressed community and investigate the spatial and physical resources of the Brownfield, which can be useful for the regeneration of the distressed community.

It employs qualitative case study method. Data is collected through a questionnaire survey, focus group discussion, participant observation, Key person interview, planning document study, drawing and photography analyzed through content analysis using NVivo and Spatial Mapping analysis.

In conclusion, the paper formulates a framework for the regeneration of distressed vernacular communities around the urban brownfields. It also provides recommendations for specialized policy guidelines on the sustainable regeneration of such distressed communities.

Keywords: Distressed Community, Urban Brownfield, Sustainable Regeneration

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Study on the microscopic characteristics of successive droplet clusters impacting on the wall

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ARTICLE INFO

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Fuel adhesion
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Droplet size and velocity

ABSTRACT

In Direct Injection Spark Ignition (DISI) internal combustion engines, fuel droplets inevitably impact the cylinder walls, resulting in droplet adhesion and incomplete combustion, thereby increasing pollutant emissions. The injection strategy has been proven to significantly improve the droplet-wall interaction. Initially, the Refractive Index Matching (RIM) method was used to measure fuel adhesion under both single and double injection conditions, with results confirming that the double injection strategy significantly reduced the fuel adhesion mass. To investigate the mechanisms underlying the reduction in fuel adhesion with double injection, Particle image analysis (PIA) and a multiple droplets producer were employed to examine the micro-behavior of successive droplet clusters near the wall surface. Statistical analyses were conducted on droplet size and velocity. Results showed that, when the two successive droplet clusters impact the wall, the Sauter Mean Diameter (SMD) of the second cluster is greater than that of the first cluster. There are two reasons for this. First, this difference is attributed to the coalescence between the leading droplets of the second droplet cluster and the trailing droplets of the first droplet cluster. Second, when the second droplet cluster impacts the wall, the breakup of fuel adhesion can also lead to the formation of larger droplets. Moreover, the second droplet cluster exhibits a significantly higher penetration velocity than that of the first, which can be attributed to the interaction of the velocity fields between the trailing droplets of the first cluster and the leading droplets of the second cluster. Furthermore, analysis of the average minimum droplet distance shows that droplet number density near the wall is relatively high and decreases with increasing distance from the wall. Lastly, the Bai model was used to predict the probabilities of stick, rebound, spread, and splash of successive droplet clusters at various observation points.

1. Introduction

Droplet impacting on solid surfaces is commonly observed in engineering applications, such as printing, spray cooling, coating technologies, agricultural spraying, and fuel injection systems in internal combustion engines [1–5]. In Direct Injection Spark Ignition (DISI) internal combustion engines, the limited cylinder volume, combined with substantial fuel spray penetration, presents challenges in preventing fuel spray impacting on piston surfaces and cylinder walls. Spray-wall interaction significantly affects the formation of the pre-combustion fuel–air mixture, leading to increased emissions of particulate matter (PM) and unburned hydrocarbons (UHC) [6,7]. Particularly

Abbreviations: DISI, Direct Injection Spark Ignition; PM, Particulate Matter; UHC, Unburned Hydrocarbons; LIEF, Laser Induced Exciplex Fluorescence; PIV, Particle Image Velocimetry; RIM, Refractive Index Matching; LIF, Laser-Induced Fluorescence; PDA, Phase Doppler Anemometry; PDPA, Phase Doppler Particle Analyzer; SMD, Sauter Mean Diameter; PDIA, Particle/Droplet Image Analysis; PIA, Particle Image Analysis; ASOI, After Start of Injection; CCD, Charge-Coupled Device; Ra, Arithmetic mean roughness; T_{amb}, Ambient Temperature; $C_{droplet}$, Perimeter of the droplet particle; $S_{droplet}$, Area of the droplet particle; *We*, Weber number; *Re*, Reynolds number; *Oh*, Ohnesorge number; *La*, Laplace number; ρ, Density of liquid; *V*, Relative velocity of droplet; *d*, Droplet diameter; σ, Surface tension coefficient; μ, Dynamic viscosity; v_{IN}, The component of the droplet velocity perpendicular to the wall.

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Physics of Fluids ARTICLE pubs.aip.org/aip/pof

Numerical investigation of the effect of porous blockage on fluid velocity and pressure using OpenFOAM

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ABSTRACT

The Linux-based, open-source computational fluid dynamics tool OpenFOAM investigates how porous blockages influence fluid velocity and pressure. It solves fluid flow problems using the popular numerical method known as the finite volume method. The entire simulation process took place in three phases: pre-processing, running the simulation, and post-processing. The tools employed for these stages included Visual Studio Code for pre-processing, OpenFOAM for the core simulations, and ParaView for post-processing and visualization. The differences in velocity and pressure are analyzed as the fluid passes through porous media in this study. Additionally, statistical analysis of the simulation data is performed to reinforce the findings. The Darcy–Forchheimer equation is a well-established model for resistance in porous media used in the simulations. The findings demonstrate how porous obstructions significantly affect fluid dynamics by causing discernible variations in pressure and velocity. The simulation also demonstrated that OpenFOAM can effectively handle transient flow problems, which is also a part of this study. For the simulation, a fluid with a kinetic viscosity of $5 \times 10^{-3}\,\mathrm{m}^2/\mathrm{s}$ (motor oil at cold temperature) and a porous blockage with a Darcy coefficient of 500, a porosity of 0.9, and a permeability of 0.002 have been taken. Subsequently, the variation in fluid momentum due to time and horizontal distance was examined.

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I. INTRODUCTION

Mechanics, environmental engineering, and materials science were very interested in investigating flow through a porous obstruction. Numerous experiments have been conducted to understand the drag and resistance of porous blockage.[1,2] Understanding fluid flow has become crucial in the modern world. Porous blockages have many applications, such as heat exchangers, drug delivery, fuel cells, and filtering systems for both water and air. Turbulent flow can be decreased by using porous obstruction. Due to its unique properties, porous blockage is utilized in engineering to construct dams and various obstruction types. Since our resources are limited and cannot be used frequently, an alternative strategy, such as simulation, must be employed to solve the problem. In different sectors, simulation is being increasingly used. Numerous experiments are being conducted using simulation.[3–9] Simulation software such as COMSOL, OpenFOAM, ANSYS, SimScale, and CFX relies on numerical methods. For example, COMSOL uses the finite difference method, which is a popular numerical approach for solving computational fluid dynamics (CFD) problems involving complex geometry. OpenFOAM, which is based on the finite volume method, is one of the most popular tools for solving CFD problems due to its easy accessibility. It is also useful for heat- and radiation-related problems, as many heat-related issues are solved using numerical methods.[10,11]

Porosity and permeability are fundamental characteristics of a porous obstruction. They are closely related and reflect the geometric properties of the core porous structure. Although porosity and permeability are interdependent, porosity is often the primary control parameter in experimental studies for modifying the cylinder's hydrodynamic or aerodynamic properties due to its ease of adjustment. Open-cell foam is often selected as a porous material due to its exceptionally high levels of porosity and permeability. Open-cell foam provides uniform global porosity measured by the number of pores per inch despite its intricate and spatially irregular internal structure.[12] Open-cell foam coatings on cylinders have been used in earlier experimental investigations, which have effectively shown a significant decrease in drag, noise, and vortex-induced vibrations that correlate with greater porosity.[1,2] Two dimensional (2D) porous solids with homogeneous and ordered internal structures have also been studied

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Characterization of diesel spray with novel high-speed laser absorption scattering technique under diesel engine-like condition

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ARTICLE INFO

Keywords:
Diesel engine
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Mixture formation

ABSTRACT

In Diesel Engines, the injection process plays a decisive role in the combustion efficiency. Hence, the characterization of diesel sprays is very important. Several methods are developed, however, none of them records the temporal fuel distribution throughout the individual injection event and measures the liquid/vapor concentration of an evaporating diesel spray. In this work, two light sources i.e., an ultraviolet LED and a continuous wave laser, were used with two high-speed video cameras. A fuel mixture with the compositions of 97.5 % n-tridecane and 2.5 % of volume-based 1-methylnaphthalene was selected as the test fuel. The fuel was intermittently injected into an inert environment at 4.8 MPa and 800 K by applying a seven-hole injector with a hole diameter of 0.123 mm. The injection pressure was set at 100 MPa and the injection amounts were set as 2.5 and 5.0 mg/hole to observe the effect of the injected mass on the spray characteristics and mixture formation process. Calibration, based on the scattering by non-evaporating sprays and molar absorption coefficients for fully evaporated sprays, indicates a measurement error of 15 %. The findings of the experiments show that, under large injection mass conditions, the liquid phase equivalence ratio is quite low and close to zero just after the end of injection which points out that as the air-fuel mixing quality improves, the majority of the liquid fuel is rapidly converted to vapor. The air-fuel mixture is overall richer at large injected mass compared to the small mass condition. Furthermore, after the end of injection, the high fuel vapor concentration area near the nozzle soon mixes with ambient gas, decreasing the equivalence ratio to low levels, whereas a high-vapor-concentration region is still present at the spray head. This study provides a valuable insights into the behavior of the fuel spray, which could be used to improve the efficiency and performance of diesel engines.

1. Introduction

The air-fuel mixture, in diesel engines, is known to have a key role in subsequent ignition, combustion and emission processes. The ignition characteristics and development of combustion are all controlled by both spatial and temporal variations within the fuel-air mixing process. Moreover, the atomization and vaporization features of the intermittent fuel spray are greatly dependent on the turbulence within this mixing event. In recent years, the adoption of high-performance piezo injectors for diesel engine passenger cars has enabled the reduction of emissions, particularly through the use of smaller injection masses [1]. As a result, it's essential to investigate the process of diesel spray mixture formation under various injection mass conditions. However, due to the insufficient availability of diagnostic techniques, the relationships between injected mass and shot-to-shot variation are not well recognized.

Quantitative measurement becomes complicated in diesel spray evaporation because liquid droplets and vapor coexist at the same time. Various diagnostic procedures for making such measurements have been developed during the previous several decades. Schlieren and Shadowgraph imaging systems were very early optical diagnostics procedures, and they were mostly employed to observe the qualitative information of the evaporating diesel spray morphology [2,3]. Holography is one of the unique systems to capture three-dimensional information on a fuel spray using laser light interference. It has proved the ability to offer temperature distributions, velocity, droplet size, and vapor concentration inside a fuel spray [3–5], however, it can only create measurements in moderate ambient temperature/density and low ambient vapor

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Research article

Comparative simulation of nonlinear radiative nano casson and maxwell fluids with periodic magnetic force and sensitivity analysis

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ARTICLE INFO

Keywords:
Nanofluid
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ABSTRACT

This study investigated cyclic magneto-hydrodynamic radiative effects in Casson and Maxwell fluids, including nonlinear radiation and Arrhenius activation energy. It promotes non-Newtonian fluid use in diverse fields like industry, manufacturing, sciences, medicine, and engineering. Using boundary layer approximations, non-dimensional equations are formulated. For numerical solutions, widely recognized explicit finite difference method (EFDM) has been utilized. To ensure the robustness of EFDM results, stability and convergence tests are performed. Exploration involve a detailed sensitivity analysis by using RSM, offering a thorough understanding of influential parameters. These analyses explore complex interactions among physical parameters, affecting Nusselt number, skin friction, and Sherwood number. Maxwell fluid's velocity is more affected by periodic magnetic force than Casson fluid, during the presence of nonlinear radiation. Additionally, nonlinear thermal radiation has a greater impact on temperature and concentration profiles compared to linear radiation for both fluids. Moreover, Casson fluid has a stronger influence on the average heat transfer rate compared to Maxwell fluid with nonlinear thermal radiation which is 8.6 % greater than the Maxwell fluid. On the other hand, at constant thermal radiation (*Ra*), due to decrease of Brownian motion (*Nb*), the rate of heat transfer is reduced by 1.2 % and 0.3 % respectively for Maxwell and Casson fluid. Also, for thermophoresis parameter (*Nt*), this rate is reduced by 2 % and 1.6 % respectively. The investigation also revealed that the *Ra* exhibits a positive sensitivity towards average Nusselt number, while *Nb* and *Nt* are displayed a negative sensitivity.

1. Introduction

Nowadays, modern nanotechnology gives innovative scopes to produce and process different sorts of manufacturing materials with traditional crystallite sizes less than 100 nm. For this reason, research on nanofluid is becoming much better interesting from the last few years. In 1995 from Argonne National Laboratory in the U.S.A, Choi et al. [1] introduced a fluid mixture that contained solid nanoparticles (for example: *Cu*, *CuO*, *Ag*, Al_2O_3, TiO_2 etc.) which was called nanofluid. In fact, these solid particles are stably and uniformly distributed into a base fluid (such as: water, engine oil, pump oil, ethylene glycol, etc.). It is anticipated that nanofluid will

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Theoretical Study of Slightly Underexpanded Jets from Elliptical Nozzles*

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The flow features of shock-containing jets from elliptical convergent nozzles operating under slightly off-design conditions have been studied analytically, where the jet mixing layer is approximated by a vortex sheet and the shock-cell structure is confined to the interior of the vortex sheet. Perturbation conservation equations are solved using eigenfunction expansion, and shock-cell structures for the elliptical jets are obtained explicitly. Only the first Fourier mode of the eigenvalue problem is considered for simplicity. The effects of flow parameters such as the nozzle pressure ratio, aspect ratio, and design Mach number on the shock-cell structure and shock-cell spacings are investigated.

Key Words: Elliptical Supersonic Jet, Shock Wave, Shock-cell Spacing, Theoretical Analysis

Nomenclature

a: focal length
A: area
c: speed of sound
D: diameter
e: eccentricity
L: length
M: Mach number
p: pressure
S: perimeter
v: velocity
γ: gas constant
ρ: density

Subscripts

b: ambient
d: design
e: nozzle exit
j: fully expanded
m: major
n: minor
s: shock-cell spacing
eq: equivalent
os: stagnation state
0: particularly

1. Introduction

A thorough understanding of the flow properties of shock-containing jets is of great importance for development in a variety of engineering and aerospace applications. Shock-containing jets from supersonic nozzles operating under off-design conditions produce shock-associated noises with prominent multiple peaks.[1)] Especially, high-intensity discrete-frequency acoustic noise referred to as the screech tone plays a critical role in the design of advanced aircraft because it can cause sonic fatigue failure.[2)] However, almost all studies on shock-containing jets are limited to free jets from round nozzles,[3)] because of canonical flow fields.

Shock-containing jets from elliptical nozzles exhibit significant flow features relative to round nozzles. Gutmark et al.[4)] compared the mixing characteristics between circular, elliptical, and rectangular underexpanded jets, and found that the elliptical and rectangular jets have a higher spreading rate when compared to the circular jet; especially in the minor axis plane. Kinzie and McLaughlin[5)] compared the aeroacoustics properties of supersonic round and elliptical jets and showed that elliptical jets radiate less noise than the round jet under comparable operating conditions. Menon and Skews[6)] investigated the near-field shock structures of underexpanded sonic jets from square, rectangular, slot, and elliptical nozzles using the grey scale schlieren technique and Reynolds-averaged Navier-Stokes (RANS) simulations. Mitchell et al.[7)] acquired the velocity fields and turbulent statics of underexpanded jets from a convergent nozzle with an aspect ratio of 2 at the exit using planar particle image velocimetry (PIV). Kumar and Rathakrishnan[8)] obtained the flow characteristics of supersonic jets from a design Mach number of 2 with an aspect ratio of 2 using Pitot probe measurements along the jet centerline and a shadowgraph technique. Kalyan and Karabasov[9)] proposed a new flow model to predict the broadband shock-associated noise from axisymmetric and asymmetric jets, and found that for the same thrust conditions, the elliptical nozzles lead to noise reduction at the source when compared to corresponding axisymmetric jets. In addition, they showed that the aspect ratio (AR) of the major to minor axis dimensions at the exit of an elliptical nozzle increases the number of shock-cells while

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RESEARCH PAPER

Mathematical modelling of using renewable energy in the power sectors for the sustainable environment

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Abstract

Currently, human-caused greenhouse gas emissions are one of the main causes of global warming. Burning fossil fuels (such as coal, oil, and gas) have become a climate change due to the uptake of heat-trapping gases. A lot of CO_2 is produced from this, which helps in the creation of greenhouse gases. On the other hand, global electricity demand has been rising for decades, such to rising populations, increasing industrialization, and higher incomes. The power sector is the biggest source of carbon dioxide emissions because of fossil fuel, the main source of energy used for power generation all over the world that's why climate change as well as increased global warming. Therefore, most countries have set targets for the use of renewable energy (RE) to reduce their electricity and need for energy and carbon emissions. In this study, RE is used to keep the environment sustainable, where the system of ODEs has been formed using different types of parameters to analyze the mathematical structure of four variables associated with RE. Positivity test, stability analysis, and bifurcation analysis are examined to prove the truth for the sustainability of the environment. The model plays a special role in increasing electricity production and reducing greenhouse gases in the environment. This study emphasizes the significance of employing RE in the power sector for environmental sustainability.

Keywords: Renewable energy; environmental sustainability; bifurcation analysis; logistic model
AMS 2020 Classification: 34A34; 37N25; 65L05; 92D25; 92B05

1 Introduction

The environment is an important component of human civilization. Since the development of civilization, people have gradually developed their environment. Just as humans are exploiting

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A Mathematical Modelling to Investigate the Effect of Industrialization and Urbanization on Temperature Rising

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Abstract: - In the modern world, temperature rise is a serious issue that is getting worse every day. We'll create a mathematical model to show how urbanization and industry contribute to temperature increases. Increased industrial activity, including manufacturing and energy production, often results in higher emissions of greenhouse gases such as CO_2, CH_4, and N_2O. These gases trap heat in the Earth's atmosphere, increasing the planet's temperature. These models can take into account four different factors: growing air pollution, deforestation, the urban heat island effect, and greenhouse gas emissions. Numerical simulations are used to develop the model, while observed temperature data from specific places is used for validation. To determine the most important parameters and their proportional contributions to temperature variations, sensitivity studies are carried out. The results can help environmental scientists, urban planners, and legislators devise ways to lessen the negative impacts of urbanization and industry on climate change.

Key-Words: - Mathematical Modelling, Temperature Rising, Logistic Model, Stability Analysis, Urban Planning, Stability Analysis.

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1 Introduction

The pursuit of progress and modernization has led to tremendous growth through industry and urbanization. However, rapid industrialization has created environmental issues, including rising global temperatures.

A publication proposes a nonlinear dynamical model to investigate the impact of urban development on temperature rise, with a focus on the establishment of urban heat islands, [1]. The model incorporates variables including forest resources, population, urban infrastructure, and temperature using differential equations. A paper proposes a nonlinear mathematical model to study the deforestation of forest resources due to lack of awareness about their importance and to increase forestry resources through plantation for conservation purposes, [2]. The paper examines how population pressure affects forest resources and proposes conservation strategies to preserve equilibrium levels based on population density. Examine air pollution in Dhaka, Bangladesh, with an emphasis on anthropogenic sources of particulate matter (PM) and black carbon (BC). The study also explores the effects of population and population pressure on forest resources, proposing conservation models to maintain equilibrium levels of forest resources dependent on population density. The research paper focuses on air pollution in Dhaka, Bangladesh, particularly on particulate matter (PM) and black carbon (BC) emissions from anthropogenic sources, [3]. The study utilizes Positive Matrix Factorization (PMF) to analyze fine particle composition data from 2007 to 2009, revealing insights into the contributions of different sources like motor vehicles and brick kilns to BC concentrations. The paper also explores the sources of fine particles and BC concentrations in Dhaka using back-trajectory methods, aiming to understand the causes of haze in the South Asian region, especially during winter.

When fossil fuels like coal, oil, and natural gas are burned for energy, they release carbon dioxide (CO_2) and other greenhouse gases into the atmosphere. Global warming is increasing at an alarming rate due to the extreme emission of GHGs, [4]. The paper also highlights the importance of improving the density of forest resources through plantation to replace the clear-cutting of forest areas and conserve forest density and habitat. Maintaining appropriate temperatures in greenhouses is crucial

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Lexicon and Transformer-Based Sentiment and Emotion Analysis of Twitter Responses to the 2023 Turkey-Syria Earthquakes

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Keywords: twitter sentiment analysis, emotional reaction, nrclex classification, catastrophic events

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This study analyzes Twitter data to investigate public emotional responses to the earthquakes in Turkey and Syria using a combination of Transformer-based binary sentiment analysis, VADER for multi-sentiment classification, and NRCLex for emotion categorization. The dataset comprises tweet subsets ranging from 5,000 to 40,000 posts, collected using relevant earthquake-related hashtags and keywords during the immediate aftermath of the February 2023 earthquakes. The findings reveal a clear predominance of negative sentiment across all models and tweet samples. In binary classification, 47.4% of tweets expressed negative sentiment, compared to 37.0% positive and 15.6% neutral. Multi-sentiment classification using tweet subsets ranging from 5,000 to 40,000 consistently showed higher negative sentiment levels (45.6%–48.4%) than positive sentiment (34.5%–38.7%). Emotion analysis using NRCLex further confirmed this trend, identifying "negative" as the most prevalent emotion (16.70%–17.78%), followed by "fear" (14.58%–15.58%) and "anger" (12.45%–13.47%), with positive emotions like "joy" being much less frequent (3.86%–4.11%). These results highlight the substantial psychological impact of natural disasters, where negative emotions outweigh positive and neutral expressions. The insights gained have significant implications for public health and disaster management, underlining the importance of timely, targeted interventions to address emotional distress in affected populations. Future research should aim to enhance affective response analysis and support the development of tailored mental health strategies.

Povzetek: Ogrodje RoBERTa-BiLSTM-GAT združuje večnivojsko učenje značilk in grafne pozornostne mreže ter omogoča bolj kvalitetno ekstrakcijo vedenja in ujemanje primerov iz pravnih ter multimodalnih podatkov kot metode T5, DGI in MANN.

1 Introduction

Social networking sites like Twitter have grown in importance as data sources for analyzing attitudes. These platforms are perfect for sentiment research since they give users a quick and informal way to express themselves. Sentiment analysis applied to Twitter data has garnered significant interest in a variety of domains, including public health emergencies, commercial campaigns, social response prediction, and even harassment detection. This study aims to look into the emotional responses that people had on Twitter in the wake of the most recent quakes in Turkey and Syria. When it comes to gathering viewpoints throughout a variety of events, including political shifts and natural disasters, Twitter has shown itself to be a useful tool. Evidence supporting this notion was supplied by earlier research conducted by Ruz et al. using sentiment analysis on Twitter datasets during the Chilean crisis and the Catalan independence vote [1]. Ilyas and Sharifi (2025) systematically reviewed 139 studies on social media-based sentiment analysis in disaster risk management. They analyzed data from platforms like X, Weibo, and Facebook, covering disasters such as hurricanes and earthquakes. Common methods included lexicon-based tools, machine learning, and hybrids. Findings show sentiment analysis helps assess public emotions, misinformation, and responses across disaster phases. However, the review highlights gaps like reliance on English and Chinese data, lack of coverage for Africa and Latin America, and limited multimodal and multilingual analysis. The authors call for broader linguistic and platform inclusion to improve global disaster management. [2]. These studies emphasize how crucial it is to use sentiment analysis on Twitter to comprehend the views and responses of the general public on significant events. Additionally, Twitter's usefulness in sharing information during emergencies has been acknowledged; the Great East Japan Earthquake on March 11, 2011, serves as an example of this [3].

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Deciphering COVID-19 Narratives: A Comparative Study of ML Models (RF, MNB, GB, LR, SVM) and DL Models (CNN, Bi-LSTM) for News Article Classification

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Keywords: Machine Learning (ML), Natural Language Processing (NLP), Roc Curve, GloVe, and FastText

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The COVID-19 pandemic has provided an unprecedented amount of information in news outlets, which include scientific, health-related, political, economic, and social narratives. This study compares the effectiveness of machine learning and deep learning algorithms for classifying text data, with a certain emphasis on how well the former handle COVID-19 news narratives. The study dataset contains news articles regarding COVID-19. To achieve the primary purpose of this research is to classify COVID-19 related news, we integrate multiple datasets. The analysis reveals machine learning models exhibit superior performance in text data classification. In particular, the Random Forest model reaches a 98% accuracy rate. In contrast, with regards to deep learning models, the Bidirectional Long Short-Term Memory model with FastText integration turns out to be the best option due to its exceptional accuracy. Exploratory data techniques such as topic modeling and word cloud approaches are incorporated to uncover hidden patterns in the data. Pre-trained (e.g., deep learning) and non-pre-trained ML models are implemented highlighting the versatility of ML in text classification tasks. The specific purpose to compare to the deep learning and machine learning algorithm to classification of the new article. Notably, a predictive model employing Bi-LSTM with the FastText pre-trained model achieved an impressive 94% accuracy in classifying COVID-19 news reports.

Povzetek: Primerjalna analiza modelov ML in DL za klasifikacijo novic COVID-19 razkrije RF kot najbolj natančno (98 %), medtem ko Bi-LSTM s FastText (94 %) odlikuje kontekstualno razumevanje, kar izboljšuje učinkovitost klasifikacije besedila.

1 Background of the study

Natural language processing has made extensive use of text classification to divide texts into different classes. In the context of COVID-19 news articles, text classification is crucial for identifying and categorizing the vast amount of information generated daily. In text categorization tasks, machine learning algorithms have demonstrated encouraging results, especially when applied to COVID-19 news items. Empirical evaluation has been conducted to determine the efficacy of several machine learning techniques for text classification of COVID-19 news items.
Jin et al. (2024) investigated the use of AI techniques, such as natural language processing and machine learning, to improve text classification [1]. Their findings highlight the potential of technologies to enhance accuracy and efficiency in text processing, supporting information retrieval and decision-making despite operational challenges. Didi et al. (2022) undertook studied on the categorization of tweets related to COVID-19 using machine learning methods and analysed public sentiment about the pandemic through their novel hybrid feature extraction method that combines syntactic elements with semantic aspects for more accurate text data representation and enhanced classification. Their research built upon previous work exploring Twitter's potential in understanding public opinion during the pandemic, focusing on sentiment analysis using ML models as naïve Bayes and Logistic Regression [2]. The authors demonstrated with a focus on diagnostics and predictive modelling. It emphasized deep learning's impact on healthcare applications, especially

Original Article

Differences in Associated Factors of Underweight and Overweight According to Rural-Urban Residence Strata among Ever-Married Non-Pregnant Women of Reproductive Age in Bangladesh

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Abstract

***Background*: This study sought to compare the prevalence of underweight and overweight among ever-married, non-pregnant women of reproductive age in Bangladesh by urban or rural residency status.**

***Methods*: This study used Bangladesh Demographic and Health Survey (BDHS), 2017 data. Cross-sectional study design with two-stage stratified sampling method was employed. A sample of ever-married non-pregnant women of reproductive age was selected and multinomial logistic regression was utilised in analysis.**

***Results*: It was found that around half of rural women (45.0%, *N* = 4,934) and more than half of urban women (60.3%, *n* = 3,913) were overweight. Nearly one in seven rural women (14.0%, *n* = 1,537) and 1 in 12 urban women (9.0%, *n* = 564) were reported as underweight. Our analyses revealed that being overweight was substantially connected with age, husband's occupation, economic status, television access, and division for both urban and rural areas. Women from poor households were significantly more likely to be underweight than women from middle- income households for both urban (*P* < 0.05; OR: 1.41; 95% CI: 1.03, 1.94) and rural (*P* < 0.05; OR: 1.23; 95% CI: 1.04, 1.46) areas. Interestingly, women without television access both in urban (*P* < 0.001; OR = 0.78; 95% CI: 0.67, 0.91) and rural (*P* < 0.001; OR = 0.75; 95% CI: 0.68, 0.84) areas had an inverse association with overweight/obesity compared to women with television access. In both areas, women in Sylhet and Mymensingh had higher likelihood of being underweight than Barisal division. Additionally, in both residential zones, women in Sylhet had lower likelihood of being overweight than Barisal division.**

***Conclusion*: This study reveals that multiple characteristics are linked to both overweight and underweight among ever-married, non-pregnant women of reproductive age in Bangladesh. Addressing these variables should be a priority in public health efforts to combat the dual challenge of malnutrition in Bangladesh.**

Keywords: *overweight, obesity, underweight, rural women, urban women, Bangladesh*

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ORIGINAL RESEARCH

Health Science Reports Open Access WILEY

Understanding the impact of socioeconomic and health factors on geriatric depression: A comparative study in rural and urban Bangladesh

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Abstract

Background and Aims: The prevalence of depression among the elderly is a growing concern, and this study examines the differences between urban and rural areas in terms of geriatric depression.

Methods: Using a two-stage random sampling approach in urban areas and a multistage random sampling approach in rural areas, the study surveyed 944 elderly individuals of both sexes.

Results: The results indicate that the prevalence of depression was high, with 52.5% of the elderly population experiencing mild to severe depression. The study found that increasing age, female gender, nuclear family structure, and involvement of housewives or others were significant factors affecting depression in urban areas, while increasing age and elderly people without spouses were significant factors in rural areas. Additionally, the study identified hearing impairment, asthma, and arthritis as risk factors for depression in rural areas, and bronchitis, heart disease, and thyroid illness as significant factors in urban areas.

Conclusion: These findings highlight the need for policymakers to focus on addressing the mental health needs of older people, particularly women and those without spouses.

KEYWORDS
Bangladesh, depression, elderly, geriatric depression, geriatric depression scale (GDS), rural-urban

1 | INTRODUCTION

Globally, depression has been a leading cause of disability for many years and is a major mental health issue among the geriatric population.[1] Even though, after adjusting for population size, disability, and suicide, they are comparable across nations of all economic levels, the absolute cost of depression-related disability and suicide are disproportionately felt by low- and middle-income countries.[2]

Age has a significant role in determining mental health. Old age is a time of transition when one must cope with issues impacting their emotional and social well-being in addition to the physical aging

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Modelling and optimizing combination therapeutic strategies for KRAS- and EGFR-mutant lung cancer

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Non-small cell lung carcinoma (NSCLC) is well-known for its high incidence (about 80% of lung cancer) and genetic heterogeneity. Personalized driver mutations such as EGFR and KRAS have established targeted therapies with kinase inhibitors, whereas immune checkpoint inhibitors (ICIs) have revolutionized immunotherapy. However, challenges such as frequent drug resistance and low response rates highlight the need for novel therapeutic strategies. Boolean network modeling is a powerful mathematical tool to simulate complex biological processes and optimize potential treatment strategies. This study developed a Boolean network model for

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An integrated approach for key gene selection and cancer phenotype classification: Improving diagnosis and prediction

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Keywords:
Microarray
Gene expression data
Feature selection
Cancer classification
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ABSTRACT

The identification of key features and reliable phenotype classification remains pivotal in cancer research, with direct implications for early diagnosis, prognosis, treatment optimization, and cost reduction in healthcare. This study introduces a hybrid model that integrates statistical and machine learning (ML) algorithms to enhance feature selection and improve classification accuracy for cancer phenotypes. Five well-known statistical tests (LIMMA, SAM, ANOVA, KW-test, and t-test) are employed to identify significant features based on statistical decision markers. The dominant features identified across both binary and multi-class datasets are then used for cancer phenotype classification using various ML methods, including LDA, LR, NB, GPC, KNN, ANN, SVM (with radial, polynomial, linear kernels), and RF. The model's robustness is validated using eight distinct microarray gene expression datasets, combined with various resampling protocols. The results show consistent improvements over previous benchmarks in the literature, with the RF classifier performing better in binary classification tasks and SVM-r demonstrating superior performance in multi-class settings. Additionally, the analysis of the bladder cancer dataset led to the identification of 13 key genes (*MYH11, CCN1, FHL1, MYL9, EFEMP1, FILIP1L, RGS2, MATN2, CALD1, TNC, PALLD, ADAMTS9-AS2,* and *CELF2*) that demonstrated strong discriminatory power. These genes were further validated through enrichment in relevant GO terms and KEGG pathways, emphasizing their diagnostic and prognostic significance. Moreover, Gene-TF and Gene-miRNA network analyses highlighted critical regulators, including TFs like CYR61, SMAD4, SOX2, TP63, and AR, along with miRNAs such as hsa-let-7b-5p, hsa-miR-34a-5p, hsa-let-7a-5p, hsa-let-7c-5p, and hsa-miR-16-5p, underscoring the functional impact of the selected features. In conclusion, the proposed approach effectively generates a streamlined set of optimal features, providing valuable biological insights and laying the groundwork for more accurate and effective tools in cancer diagnosis and prediction.

1. Introduction

Cancer remains the leading cause of death worldwide, accounting for 9.6 million deaths each year. Approximately 18.1 million new cases are reported annually, spanning various types such as liver, colon, ovarian, and breast cancer, among others [1,2]. These statistics are particularly alarming for developing countries, which are projected to account for over 9 million cancer-related deaths by 2030 [3]. The growing threat of fatal diseases underscores the urgent need for effective diagnostic and therapeutic strategies. Given its paramount importance in cancer analysis, researchers are focusing on gene expression data to identify the most significant features that can improve treatment.

Microarray technology is widely used for gene expression (GE) data, providing a series of features or gene expression profiles. GE data typically consists of numerous genes collected from small tissue samples. These high-dimensional datasets are often highly correlated and may

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PLOS ONE

RESEARCH ARTICLE

In-silico discovery of common molecular signatures for which SARS-CoV-2 infections and lung diseases stimulate each other, and drug repurposing

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Abstract

COVID-19 caused by SARS-CoV-2 is a global health issue. It is yet a severe risk factor to the patients, who are also suffering from one or more chronic diseases including different lung diseases. In this study, we explored common molecular signatures for which SARS-CoV-2 infections and different lung diseases stimulate each other, and associated candidate drug molecules. We identified both SARS-CoV-2 infections and different lung diseases (Asthma, Tuberculosis, Cystic Fibrosis, Pneumonia, Emphysema, Bronchitis, IPF, ILD, and COPD**)** causing top-ranked 11 shared genes (*STAT1*, *TLR4*, *CXCL10*, *CCL2*, *JUN*, *DDX58*, *IRF7*, *ICAM1*, *MX2*, *IRF9* and *ISG15*) as the hub of the shared differentially expressed genes (hub-sDEGs). The gene ontology (GO) and pathway enrichment analyses of hub-sDEGs revealed some crucial common pathogenetic processes of SARS-CoV-2 infections and different lung diseases. The regulatory network analysis of hub-sDEGs detected top-ranked 6 TFs proteins and 6 micro RNAs as the key transcriptional and post-transcriptional regulatory factors of hub-sDEGs, respectively. Then we proposed hub-sDEGs guided top-ranked three repurposable drug molecules (Entrectinib, Imatinib, and Nilotinib), for the treatment against COVID-19 with different lung diseases. This recommendation is based on the results obtained from molecular docking analysis using the AutoDock Vina and GLIDE module of Schrödinger. The selected drug molecules were optimized through density functional theory (DFT) and observing their good chemical stability. Finally, we explored the binding stability of the highest-ranked receptor protein RELA with top-ordered three drugs (Entrectinib, Imatinib, and Nilotinib) through 100 ns molecular dynamic (MD) simulations with YASARA and Desmond module of Schrödinger and observed their consistent performance.

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Boosting edgeR (Robust) by dealing with missing observations and gene-specific outliers in RNA-Seq profiles and its application to explore biomarker genes for diagnosis and therapies of ovarian cancer

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Keywords:
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Diagnosis and therapies

ABSTRACT

The edgeR (Robust) is a popular approach for identifying differentially expressed genes (DEGs) from RNA-Seq profiles. However, it shows weak performance against gene-specific outliers and is unable to handle missing observations. To address these issues, we proposed a pre-processing approach of RNA-Seq count data by combining the iLOO-based outlier detection and random forest-based missing imputation approach for boosting the performance of edgeR (Robust). Both simulation and real RNA-Seq count data analysis results showed that the proposed edgeR (Robust) outperformed than the conventional edgeR (Robust). To investigate the effectiveness of identified DEGs for diagnosis, and therapies of ovarian cancer (OC), we selected top-ranked 12 DEGs (*IL6, XCL1, CXCL8, C1QC, C1QB, SNAI2, TYROBP, COL1A2, SNAP25, NTS, CXCL2,* and *AGT*) and suggested hub-DEGs guided top-ranked 10 candidate drug-molecules for the treatment against OC. Hence, our proposed procedure might be an effective computational tool for exploring potential DEGs from RNA-Seq profiles for diagnosis and therapies of any disease.

1. Introduction

Identification of genomic biomarkers is one of the main goals in transcriptomics studies. These genomic biomarkers are also known as key/core/hub genes of interest that are selected by the protein-protein interaction network analysis of differentially expressed genes (DEGs) between case and control samples. Identifying DEGs from RNA-Seq profiles become popular compared to microarray due to the advantages of next-generation sequencing (NGS) innovation and more accurate prediction [1,2]. DEGs are used for discovering the answers to various biological questions and maintaining phenotypic observation. It is widely used for diagnosis, prognosis, and therapies of diseases. RNA-Seq count data have low integers and range from zero to many thousands that are assumed to follow Poisson or negative binomial (NB) distributions [3,4]. It also faces problems of dimensionality and outlier issues. Identification of DEGs overcomes the dimensionality problems and then the selected DEGs are utilized for further biological investigation. Different strategies are applied for separating DEGs from RNA-Seq count data under Poisson or NB distributions [3]. The edgeR [5] approach for the count data under the NB distribution is a popular approach for the identification of DEGs from RNA-Seq profiles. It is sensitive to outliers that occur during the data generation [6]. To reduce the influence of outlying observations, edgeR (Robust) [7] has been proposed. However, it is robust against gene non-specific outlying observations only. It is sensitive to the gene-specific outliers, since its gene-specific likelihood ratio test (LRT) criterion $L(\widehat{\boldsymbol{\theta}}_{0,W}|\boldsymbol{Y}_g)/L(\widehat{\boldsymbol{\theta}}_W|\boldsymbol{Y}_g)$ depends on both gene-specific observations ($\boldsymbol{Y}_g$) and weighted estimators ($\widehat{\boldsymbol{\theta}}_W$). Though its weighted estimators $\{\widehat{\boldsymbol{\theta}}_{0,W}, \widehat{\boldsymbol{\theta}}_W\}$ are robust against both gene- specific and non-specific outliers due to the Huber weights, but some specific outlying observations in $\boldsymbol{Y}_g$ may adversely influence the LRT criterion, which may produce misleading decisions for outlier genes. Moreover, it does not work against missing observations which may be often occurred in the RNA-Seq profiles datasets due to different steps are involved in the data generation process. Therefore, further improvement is urgently needed with the edgeR (Robust) approach to

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REVIEW

JOURNAL OF HETEROCYCLIC CHEMISTRY WILEY

A review on pyrimidine-based derivatives: Synthesis and their biological application

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Abstract

Pyrimidine-based derivatives have attracted a lot of interest in heterocyclic chemistry due to its versatile structure and diverse biological activities. This study provides a comprehensive overview of synthetic strategy of different pyrimidine ring and highlights their biological importance. In this article, we start off by going through the fundamental procedures for the synthesis of pyrimidine scaffolds, including both conventional and contemporary synthetic techniques. These works cover a range of therapeutic domains, such as effects that are anticancer, antibacterial, antiviral, anti-inflammatory, antioxidant, antimalarial, and so on. Moreover, we have summarized with a discussion of future prospects and challenges in the field of pyrimidine heterocyclic chemistry. This thorough review is a significant resource for researchers in medicinal chemistry and related fields since it offers insightful information about the synthetic methods and biological applications of pyrimidine-based derivatives.

1 | INTRODUCTION

1.1 | Chemistry of pyrimidine and its derivatives

Heterocyclic compounds have attracted widespread interest due to their numerous medicinal and biological applications [1, 2]. The expanding research interest on heterocyclic molecules is driven by their wide synthetic exploration and functional versatility [3–5], also serving as a key component in understanding structure–activity relationships [6, 7]. However, pyrimidine is an essential six-membered heterocyclic compound that is present in various biologically active compounds and functional materials [8–10]. These are extracted from various natural compounds such as nucleic acids, alkaloids, and vitamins B1. In 1888, German scientist Kossel isolated pyrimidine containing

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ORIGINAL PAPER

Extraction procedure and theoretical studies of chitin from black soldier fly

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Abstract

The black soldier fly (BSF) is an efficient converter of residual biomasses into valuable product molecules and biomolecules. It has attained significant consideration for sustainable resource recovery and waste management. Chitin was extracted, isolated and purified from BSF (Yield 15%) and was characterized using Fourier transform infrared spectroscopy (FTIR) and X-ray diffraction (XRD). Two fractions were obtained by sieving and the 100-mesh sample showed a crystallinity index of 9.32% which indicates that this BSF chitin sample falls into the amorphous category. Thermogravimetric analysis (TGA) evaluated chitin's thermal properties, scanning electron microscopy (SEM) examined its surface morphologies, and energy-dispersive X-ray spectroscopy (EDX) performed elemental analysis. Moreover, density functional theory (DFT) calculations were conducted to investigate the molecular geometry and infrared vibrational properties of *N*-acetyl-D-glucosamine monomer and its conceptual dimeric and trimeric chitin sub-units.

Keywords Black soldier fly · Extraction · Chitin · DFT Calculation

Introduction

The exoskeletons of many invertebrates which, in particular, include the aquatic crustaceans such as crab, shrimp and lobsters, and also insects and spiders, contain chitin as a main component [1, 2]. The French chemist Henri Braconnot is credited with first discovering in 1811, the substance that later became known as chitin [3]. Its name is derived from the word "*khitōn*" which is the name given to a type of tunic garment that was worn by Ancient Greeks [4]. Chitin is a renewable, biodegradable, non-toxic biopolymer and is the second most naturally abundant biopolymer [5]. In its pure form, chitin is a colourless, nitrogenous and fibrous polysaccharide. Structurally, chitin is a copolymer $(C_8H_{13}O_5N)_n$ of D-glucosamine and *N*-acetyl-D-glucosamine (GlcNAc) units linked via β-(1–4) glycosidic bonds with the latter repeating units being predominant in the polymeric chain. The two main polymorphic forms of chitin are α-chitin, characterized by having anti-parallel-oriented chains and β-chitin, featuring parallel-oriented chains [6–10]. A third allomorphic form, γ-chitin, in contrast to the other two forms, has not been as widely studied but consists of both parallel and anti-parallel chains [7].

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ORIGINAL PAPER

Facile C–H Bond Activation of 2-Ethylmercaptobenzothiazole in a Tri-Osmium Carbonyl Cluster: Crystal Structure of $Os_3(CO)_{10}(\mu\text{-}H)\{\mu_{N,C}\text{-}NC(SC_2H_5)SC_6H_3\}$

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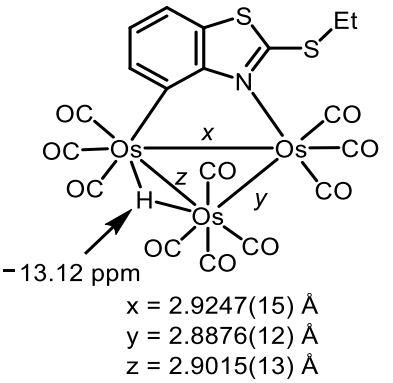
Abstract

The reaction of the labile tri-osmium carbonyl cluster, $[Os_3(CO)_{10}(NCMe)_2]$ **1**, with 2-ethymercaptobenzothiazole **2** produced a novel hydridobridged triosmium complex, $Os_3(CO)_{10}(\mu\text{-}H)\{\mu_{N,C}\text{-}NC(SC_2H_5)SC_6H_3\}$ **3** in moderate yield. The complex was formed via the regioselective C–H bond activation at the ortho-position of the ligand. The crystal structure of **3** demonstrated an N,C-bridging $NC(SC_2H_5)SC_6H_3$ group coordinated to the two osmium atoms from the axial sites. The presence of the bridging hydride was confirmed by a distinctive resonance in the ^1H NMR spectroscopy at −13.12 ppm, X-ray crystallography, and computational study. Compound **3** crystallized in the monoclinic crystal system, space group $P2_1/n$, a = 17.642(11) Å, b = 7.720(4) Å, c = 18.102(11) Å, β = 100.773(6)°, Z = 4. The molecular geometry of **3** was very close to its DFT optimized geometry, demonstrating the N,C-bridged motif's stability.

Graphical Abstract

A new tri-osmium cluster, $Os_3(CO)_{10}(\mu\text{-}H)\{\mu_{N,C}\text{-}NC(SC_2H_5)SC_6H_3\}$ **3**, was synthesized from the reaction of the labile tri-osmium cluster, $[Os_3(CO)_{10}(NCMe)_2]$ **1** and 2-ethylmercaptobenzothiazole **2**, which was structurally characterized.



Keywords Tri-osmium · Cluster · 2-ethylmercaptobenzothiazole · X-ray crystallography · DFT study

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Recent Developments in the Biological Consequences of Certain Chalcone Derivatives

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Chalcones include many naturally occurring and synthetic compounds which have attracted considerable scientific interest due to their diverse biological activities. Their basic structures are comprised of two aromatic rings connected by an α,β-unsaturated carbonyl system, which underpins some of their versatile pharmacological potential. Demonstrating robust antioxidant properties due to their phenolic groups, chalcones effectively scavenge free radicals, showing promise in combating oxidative stress-related ailments. Additionally, their anti-inflammatory effects modulate various pathways, highlighting their potential in treating inflammatory conditions. Chalcones also display antimicrobial activities against a range of pathogens and exhibit promising anticancer properties by impeding tumor proliferation and prompting apoptosis. Furthermore, their role as enzyme inhibitors extends to various targets, broadening their therapeutic potential. Despite these promising attributes, challenges related to limited bioavailability and metabolic stability necessitate ongoing research to optimize their efficacy. This review, which encompasses literature from 2010–2025, provides insights into biological applications and affords ideas for designing new chalcone-based molecules.

1. Introduction

1.1. Chalcone and Their Derivatives

Kostanecki and Tomar introduced the German name "chalkon" for their "benzylacetophenone" (i.e., benzylidene acetophenone), in their 1899 publication.[1] This designation was based upon the Greek word for copper, namely **χαλκος** ("chalkos"), since many early natural and synthetic chalcones had noted dark red–brown colors noted in other chromogenic dye molecules and also in flavone and flavinoids.[2–5] Today, chalcones are more generally known as 1,3-diaryl-2-propen-1-ones comprising two aryl or other aromatic moieties, which may or may not be different and which are connected by an α,β-unsaturated carbonyl group[6] (Figure 1). The aryl ring connected to the carbonyl group in the parent chalcone is designated as the *A* ring, while the other aryl ring is the *B* ring. In principle, chalcones could exist in four isomeric forms: two *s-cis*-(*E, Z*) and two *s-trans*-(*E*, *Z*) forms, as shown in (Figure 1) The *E*- isomer is the thermodynamically more stable configuration. The keto-ethylenic moiety (>CO—CH═CH—) extends the delocalized π-electron system between the two aromatic entities, which imparts the chromophoric properties of chalcones.[7,8] Recently, there has been increasing attention devoted to exploring the chemistry and synthesis of novel bioactive molecules, which have the basic chalcone structure. This has been prompted by their versatility as flexible building blocks, which allow for a wide range of molecular structural modification from both natural and synthetic precursors.

Naturally occurring biological chalcones include many diverse multi- and polyphenolic compounds[9] which have been extensively investigated. They are widely distributed across various plant parts including their roots, leaves, flowers, rhizomes, heartwood, buds, and seeds in genera such as *Angelica, Sophora, Glycyrrhiza*, *Humulus*, *Scutellaria*, *Parartocarpus, Ficus*, etc.[10–12] Most natural chalcones exist as individual units, with their diverse medicinal properties being influenced by the presence of different substituents on the A and/or B rings. Some prominent examples of this class of chalcones which have been isolated from natural sources, are shown in Figure 2.

Chalcones are often biosynthesized by plants via a series of enzymatic reactions within the plant cells as part of their natural defense mechanisms and play a role in pigment formation and protection against environmental stressors. The key

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First-principles and experimental study to investigate structural, elastic, electronic, thermal, and optical properties of $KCdCl_3$ metal halide perovskite crystals

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ABSTRACT

In this research, we examine the structural, elastic, anisotropic, acoustic, electronic, thermo-physical, and optical properties of $KCdCl_3$ using both the density functional theory method as well as experimental data characterizations. The x-ray diffraction and Fourier transform infrared spectroscopy showed that our synthesized sample was well crystalline (orthorhombic), and the values of the lattice parameters are closely matched those of the first principles study. The scanning electron microscopy measurements of our sample morphology and microstructure showed a high grain size. The elastic property indicates that the structure is both mechanically and dynamically stable. The band structures and the density of state computation assured the semiconducting nature of our sample. Mulliken atomic populations showed ionic and covalent bonding in these materials, which can also be said to be mechanical property. The negative value of Cauchy's pressure indicates the presence of angular bonding in the structure. In addition, the structure has high machinability. The phase transitions and thermal breakdown of $KCdCl_3$ were examined by thermo-gravimetric analysis, and we found weight loss occurs in three stages. UV–visible spectrophotometers assessed the optical absorption and transmittance, which suggests that $KCdCl_3$ is a strong UV absorber that gradually rises with wavelength. While the elastic and mechanical characteristics are anisotropic, the optical parameters are almost isotropic. The high UV reflectivity (~28.5%) shows the material may not be an efficient radiation reflector but has great photovoltaic and optoelectronics potential.

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I. INTRODUCTION

Perovskite materials have recently piqued the attention of the scientific and technical communities in photovoltaics and optoelectronics due to their promising future applications.[1] Unlike silicon or other forms of solar cells, these materials are easy to fabricate, generating power at a lower cost than even fossil fuels, and don't require any special machinery. Their outstanding optical, ferroelectric, electrical, and magnetic properties make them a desirable option for optoelectronic instruments. Perovskites are one of the most fascinating topics in optoelectronic materials research, and they are used in several lighting and energy-related products, including solar cells and photodetectors.[2,3] Features shared by members of this family include high thermo-power, charging order, superconductivity, ferro-electricity, structural-magnetism interactions, and spin-dependent transport.[4] Different classes of perovskite materials were studied extensively, including perovskites that are classified as chalcogenides (ABO_3) and halides (ABX_3), which are alkali halides

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Atomic position dependent structural, electronic, mechanical and optical properties of $ZnSbF_3$ fluoroperovskites

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ABSTRACT

In this study, we have investigated the structural, electronic, mechanical, and optical properties of $ZnSbF_3$-I and $ZnSbF_3$-II by altering the position of Zn and Sb through density functional theory (DFT) for the first time. The structural stability of both structures was confirmed by calculating formation enthalpy. A remarkable phenomenon has been observed from the electronic band structures analysis, whenever altering the atomic of Zn and Sb, which leads to a transition from semiconducting, $ZnSbF_3$-I to metallic, $ZnSbF_3$-II conductivity. The obtained bandgap value of $ZnSbF_3$-I is of the order of 0.97 eV with indirect transition and the spin-orbit coupling (SOC) effect reduced the band gap energy to 0.49 eV. Density of states (DOS) curves revealed that the Sb-*5p* state is mainly responsible for this phase transition. The estimated elastic constants suggested that both phases are mechanically stable. By assessing the different elastic parameters, it can be concluded that both phases are mechanically ductile, machinable, isotropic, and soft in nature. A large value of bulk modulus for $ZnSbF_3$-II indicates that it is harder and cannot be compressed as easily as $ZnSbF_3$-I. The structures exhibit high efficiency in absorbing UV light. $ZnSbF_3$-II's strong reflectivity in the infrared spectrum makes it an option to use for IR shielding. This study will guide further theoretical and experimental investigation.

1. Introduction

Perovskite materials have drawn immense attraction to materials scientists due to their physical and structural properties including multiferroicity [1], photoluminescence [2], and piezo-electricity [3], hence, their application in optical and electronic devices. The characteristic formula for perovskite crystal is ABX_3 [4], where A and B stand for the cations and X denotes an anion. Numerous types of perovskites arise from their general structures because of atom X. If fluorine is to replace X in the compound, the result would be fluoroperovskites (ABF_3). Fluoroperovskite compounds have the general formula ABF_3, where fluorine forms bonds with cations. Perovskite materials can be found in the form of insulators, semiconductors, or metal [5]. They have interesting applications in solid-state devices mostly for their unique optical and electronic properties. These materials offer excellent thermoelectric [6], ferroelectric [7], anti-ferromagnetic [8] properties, high-temperature super-ionic [9], and semiconducting [8] behavior. Such type of materials has specific uses in medicine, thermal neutron imaging plates and radiation dosimetry [5,10]. Furthermore, researchers have shown that fluoroperovskite materials are excellent compounds for microelectronics and telecommunications. These materials have been used in many scientific applications in photoluminescence, memory, and spintronic devices, which focus on spin-polarized materials to improve tunneling magnetoresistance in magnetic tunneling junctions [11,12]. Because of their fascinating structural characteristics and remarkable qualities, fluoroperovskite compounds are frequently studied both theoretically and experimentally. Recently A. Habib et al. [5] investigated structural, elastic, and optical properties of Zn based fluoroperovskite by full-potential linear augmented plane wave (FP-LAPW) method using WEIN2K. They found the materials are ductile and show anisotropic properties. M. Husain et al. [13] explored $ZnYF_3$ and $ZnBiF_3$ for the first time and suggested that the band structure is dependent on Zn and the compounds are ductile in nature. A.A. Mousa et al. [14] found a direct band gap for

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PAPER

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First-principles study of the ground-state properties of ternary borides with the Ru_3B_2X (X = Th, U) type structure: a comparative analysis†

Md. Raihan Islam,[a] Prianka Mondal[a] and Arpon Chakraborty *[b]

The distinctive structural, mechanical, electrical, and thermophysical characteristics of the hexagonal Ru_3B_2X (X = Th, U) compounds make them appropriate for high-temperature and cutting-edge technological applications. Their ground-state features are investigated in this work using density functional theory (DFT). Ru_3B_2U exhibits higher stability than Ru_3B_2Th, confirming mechanical stability and advantageous formation in both compounds. Both Ru_3B_2Th and Ru_3B_2U show covalent bonding, moderate hardness, and ductility, with Ru_3B_2Th exhibiting better machinability and greater ductility. Metallic behavior and the characteristic Fermi surface features are highlighted by electronic band structure investigation, with Ru_3B_2Th exhibiting increased electronic conductivity. Although both compounds show strong covalent connections, uranium and thorium have distinct effects on bonding. Both compounds have high Debye temperatures and melting points indicating their strong bonding and thermal stability. Between the two compounds, Ru_3B_2Th is preferable for thermal insulation. Optical properties show that these compounds behave in an anisotropic manner and have modest reflectivity, which is compatible with their metallic electronic structure. Due to their high optical reflectivity in the infra-red (IR) region, they are also candidates for IR-shielding applications. This thorough analysis emphasizes their potential for uses demanding robust thermal, mechanical, and optical characteristics.

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1. Introduction

Metal borides, a subclass of refractory hard materials, are used in a variety of applications, including defense, the nuclear sector, and high-temperature industries.[1] Metal borides constitute a nascent category of improved electrocatalysts for the oxygen evolution reaction (OER), while also presenting a promising opportunity to customize their electrochemical characteristics for potential application in energy storage and conversion technologies.[2] The transition metals typically generate borides that are high in metal content. Metal-rich borides, collectively, exhibit inertness and possess elevated melting temperatures. A recent classification of ternary metal borides has been provided.[3] Numerous well-defined ternary metal borides have been identified and characterized, especially by Russian researchers. Only a limited number of studies on physical and chemical properties are known. Measurements have primarily been conducted on full and terminal solid solutions of binary metal borides, which may also provide insights into the behavior of ternary borides in some instances.[4] The crystal structures of the majority of ternary metal borides can be obtained from structural units that are assembled based on topochemical principles. A categorization of ternary metal borides can be established based on boron–boron aggregation, which is dependent on the boron to metal ratio.

Numerous studies on ternary metal borides have been conducted in recent years. In the course of various experimental investigations on transition metal borides, J. M. Leitnaker observed anomalous behavior in heated mixtures of Group IV metal diborides with tungsten and molybdenum.[5–7] Density functional theory simulations have been employed to discover stable layered crystal structure phases of Li–M–B, obtained from a recently reported binary metal-sandwich (MS) lithium monoboride superconductor. They demonstrate that the stability of MS lithium monoboride is enhanced when alloyed with electron-rich metal diborides.[8] Another study observed superconductivity at approximately 8 K in the metal-rich Li–Pd–B ternary system. This is the inaugural detection of superconductivity in metal-rich ternary borides comprising alkaline metals and palladium as a late transition metal.[9] A separate study

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RESEARCH ARTICLE OPEN ACCESS

Comparative Insights Into the Structural, Electronic, Elastic, Vibrational, and Optical Properties of Rare-Earth Palladium Borides $RBPd_3$ (R = Lu, Yb)

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ABSTRACT

The structural, electronic, elastic, acoustic, thermodynamic, vibrational, and optical properties of rare-earth palladium borides, $YbBPd_3$ and $LuBPd_3$ of cubic perovskite structures, have been systematically explored in this work. The optimized lattice parameters of $YbBPd_3$ and $LuBPd_3$ are 4.291 and 4.313 Å, respectively, and both compounds exhibit mechanical stability. The band structures and density of states (DOS) indicate that the compounds possess metallic character in which Pd-4d and B-2p states are the dominating character at the Fermi level. Elastic constant and moduli suggest that $LuBPd_3$ is harder and stiffer than $YbBPd_3$. Both compounds are ductile and elastically anisotropic, although $LuBPd_3$ shows greater anisotropy. $LuBPd_3$ has a higher acoustic velocity while $YbBPd_3$ has a higher Grüneisen parameter, indicating greater thermal expansion and lower thermal conductivity. Phonon dispersion spectra confirmed that both structures are dynamically stable, and the acoustic and optical modes are mainly influenced by Yb and Lu atoms. Both compounds exhibit strong metallic behavior in their optical properties. $LuBPd_3$ shows higher optical conductivity while $YbBPd_3$ demonstrates greater reflectivity and absorption. High reflectivity in the infrared (IR) region makes them good candidates for IR shielding materials. This study will be helpful for further theoretical and experimental research.

1 | Introduction

Rare earth borides are perfect for applications in harsh conditions, such as cutting tools, electronics, and aircraft components, because of their exceptional hardness, heat stability, and electrical conductivity. Research on borides advances the technology of magnetic material and semiconductors, thus increasing their efficiency [1, 2]. Some borides show exceptionally high melting temperatures as well as high value of hardness, making them suitable for applications in thermally harsh conditions [3]. In recent years, rare earth materials have found applications in energy storage, as catalysts, in fuel cells [4–6].

Perovskites particularly, the rare earth palladium borides, $RBPd_3$, where (R = Lu and Yb), exhibit a cubic perovskite structure belonging to the space group Pm-3m [8–12]. These compounds are part of the broader formula RM_3X [7], where R represents the rare earth metal, M corresponds to 4d transition metals such as Pd, and X can be B, C, or N. It has a range of applications due to its unique combination of properties, such as high thermal

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Unveiling phase dependent physical properties of cubic and hexagonal $CsCdBr_3$: a DFT approach

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The distinctive structural, optoelectronic, photocatalytic, and elastic properties of $CsCdBr_3$ make it appropriate for cutting-edge technological applications. Important ground-state properties of the cubic and hexagonal phases of $CsCdBr_3$ are investigated in this work using density functional theory (DFT). Both phases are energetically and mechanically stable. Electronic band structure analysis revealed that both $CsCdBr_3$ polymorphs exhibit semiconducting character. The cubic phase shows an indirect bandgap (2.74 eV) while the hexagonal phase possesses a direct bandgap (4.26 eV). The density of states (DOS), Mulliken bond, and charge density distribution provide orbital contributions to the band structure and bonding nature of the polymorphs. The calculated redox potential suggested that both compounds are capable of water splitting as well as breaking down biological contaminants under UV-vis radiation. By analyzing the different elastic parameters, it can be concluded that both polymorphs are soft and ductile in nature. The cubic phase exhibits better transport properties, while the hexagonal phase showcases a degree of anisotropy in thermal properties. The optical characteristics correspond well with the electronic band structure. The high absorptivity in the UV region, lower reflectivity, and optical anisotropy of the hexagonal polymorph suggested that these could be a potential candidate for applications in the photovoltaic solar industry as well as to design waveguides, dielectric condensers, light emitting diodes (LEDs), and thermoelectric and sensing devices.

1. Introduction

The rapid population growth and mismanagement of waste materials due to this huge population have contaminated our environment. Traditional purifiers cannot cope with this increase in pollutants. In addition to this, population growth has created a global energy crisis, driving urgent demand for sustainable, efficient, and environmentally friendly energy solutions. In this context, semiconductor-based photocatalysts are widely utilized to degrade organic pollutants, decrease CO_2, and split water into hydrogen and oxygen using solar energy. As a result, photocatalysis is regarded as a feasible method for reducing pollution and alleviating the energy problem, and it has received significant attention in recent years. The principal drawbacks of photocatalytic CO_2 reduction are exacerbated by low energy conversion efficiencies and a lack of suitable catalysts. However, for water splitting for hydrogen production, wastewater treatment, and pollutant degradation, some requirements, such as the ideal bandgap, proper conduction band minima (CBM), valence band maxima (VBM), and a lower electron–hole recombination rate, must be satisfied. Semiconducting compounds such as WO_3,[1,2] ZnO,[3,4] Fe_2O_3,[5] Ta_2O_5,[6] $BiVO_4$,[7–9] $RbSr_2Nb_3O_{10}$,[10] $BaTiO_3$,[11] $BaTi_2O_5$,[12] and $CsNbO_3$[13] are used widely as photocatalysts. However, the photocatalytic performance of these compounds is still not up to the mark, and as a result, researchers are trying to find new photocatalysts with higher efficiency. Thermoelectric (TE) materials are solid-state semiconductors that can convert thermal energy into electricity, and *vice versa*, exploiting the Seebeck (S) and Thomson effects. They are good for the environment as well as provide interesting benefits for a variety of scientific applications.[14,15] TE materials are extensively used to convert waste heat from automobiles, boilers and furnaces, jet engines, *etc.* into electricity, using cooling or heating processes. There are a large number of materials including perovskites, double perovskites, chalcogenides and oxy-chalcogenides that have high potential for use in thermal applications.[11,15–19] However, most of these materials have a very low value of S resulting in limited applications. An alternative application of these materials has emerged in the cooling process if they possess a high power density ($S^2\sigma$) and have a compact form factor.

In recent decades, much effort has been devoted to the study of oxide perovskites with the general chemical formula AMO_3. For halide equivalents, however, not much study has been

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Human proximal tubular epithelial cell interleukin-1 receptor signalling triggers G2/M arrest and cellular senescence during hypoxic kidney injury

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Hypoxia and interleukin (IL)-1β are independent mediators of tubulointerstitial fibrosis, the histological hallmark of chronic kidney disease (CKD). Here, we examine how hypoxia and IL-1β act in synergy to augment maladaptive proximal tubular epithelial cell (PTEC) repair in human CKD. Ex vivo patient-derived PTECs were cultured under normoxic (21% O_2) or hypoxic (1% O_2) conditions in the absence or presence of IL-1β and examined for maladaptive repair signatures. Hypoxic PTECs incubated with IL-1β displayed a discrete transcriptomic profile distinct from PTECs cultured under hypoxia alone, IL-1β alone or under normoxia. Hypoxia+IL-1β-treated PTECs had 692 'unique' differentially expressed genes (DEGs) compared to normoxic PTECs, with 'cell cycle' the most significantly enriched KEGG pathway based on 'unique' down-regulated DEGs (including *CCNA2*, *CCNB1* and *CCNB2*). Hypoxia+IL-1β-treated PTECs displayed signatures of cellular senescence, with reduced proliferation, G2/M cell cycle arrest, increased p21 expression, elevated senescence-associated β-galactosidase (SA-β-gal) activity and increased production of pro-inflammatory/fibrotic senescence-associated secretory phenotype (SASP) factors compared to normoxic conditions. Treatment of Hypoxia+IL-1β-treated PTECs with either a type I IL-1 receptor (IL-1RI) neutralizing antibody or a senolytic drug combination, quercetin +dasatinib, attenuated senescent cell burden. In vitro findings were validated in human CKD bio-specimens (kidney tissue, urine), with elevated PTEC IL-1RI expression and senescence (SA-β-gal activity) detected in fibrotic kidneys and numbers of senescent (SA-β-gal$^+$) urinary PTECs correlating with urinary IL-1β levels and severity of interstitial fibrosis. Our data identify a mechanism whereby hypoxia in combination with IL-1β/IL-1RI signalling trigger PTEC senescence, providing novel therapeutic and diagnostic checkpoints for restoring tubular regeneration in human CKD.

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INTRODUCTION

The global burden of chronic kidney disease (CKD) has risen dramatically in recent years, driven by an ageing population and the increased prevalence of diabetes and hypertension [1]. The pathobiological hallmark of CKD is fibrosis within the tubulointerstitial compartment [2, 3]. Tubulointerstitial fibrosis is underpinned by sustained inflammation and irreversible tubular cell loss within the hypoxic CKD microenvironment [4]. Defining the hypoxic-inflammatory signalling mechanisms that culminate in tubulointerstitial fibrosis is critical for developing novel therapeutics for precision targeting of CKD progression.

Proximal tubular epithelial cells (PTECs) are a key tubular cell population in CKD [5, 6]. PTECs are susceptible to the hypoxic-inflammatory CKD microenvironment due to their reliance on mitochondrial fatty acid oxidation as a preferred energy source [7]. The induction of PTEC maladaptive repair mechanisms (e.g., cell death or cell cycle arrest/senescence) in response to these injurious stimuli is a central mediator of tubular loss and CKD progression [8–11]. In response to hypoxia alone, human PTECs undergo regulated cell death (i.e., ferroptosis) and selectively trigger pro-inflammatory interleukin (IL)-1β production in tubulointerstitial dendritic cells (DCs) [12]. IL-1β is elevated in human

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Abietic acid antagonizes the anti-inflammatory effects of celecoxib and ketoprofen: Preclinical assessment and molecular dynamic simulations

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Abietic acid
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Molecular docking and dynamics

ABSTRACT

The present work is designed to explore the anti-inflammatory properties of AA and its modulatory effects on celecoxib (CEL) and ketoprofen (KET) through *in vitro*, *ex vivo*, *in vivo*, and *in silico* approaches. Different concentrations of AA were utilized to evaluate the membrane-stabilizing potential via egg albumin and the Human Red Blood Cell (HRBC) denaturation model. In the animal model, formalin (50 μL) was injected into the right hind paw of young chicks to induce inflammation. AA was administered at 20 and 40 mg/kg (p.o.) to the experimental animals. We used CEL and KET as positive controls. The vehicle was provided as a control group. Two combinations of AA with CEL and KET were also investigated in all tests to assess the modulatory activity of AA. In addition, *in silico* investigation was used for predictions about drug-likeness, pharmacokinetics, and toxicity of the selected chemical compounds, and the study also evaluated the binding affinity, visualization, and stability of ligand-receptor interactions through molecular dynamic (MD) simulation. Results manifested that AA concentration-dependently significantly inhibited the egg albumin denaturation (IC_{50}: 27.53 ± 0.88 μg/ml) and breakdown of HRBC (IC_{50}: 15.69 ± 0.75 μg/ml), indicating the membrane stabilizing potential compared to the control group. AA also significantly ($p < 0.05$) lessened the frequency of licking and alleviated the paw edema in a dose-dependent manner in an *in vivo* test. However, AA reduced the activity of CEL and KET in combination treatment. AA showed good pharmacokinetic characteristics to be considered as a therapeutic candidate. Additionally, the *in silico* study displayed that AA demonstrated a relatively higher docking score of −9.1 kcal/mol with the cyclooxygenase-2 (COX-2) enzyme and stable binding in MD simulation. Whereas the standard ligand (CEL) expressed the highest binding value of −9.2 kcal/mol to the COX-2.

1. Introduction

Inflammation is a complicated immune system reaction that plays a crucial role in homeostasis and regenerative processes (Hirano et al., 2021). It is associated with acute phase responses against deleterious stimuli, such as infections, toxic chemicals or irritants, damaged cells, pathogens (viruses, bacteria, or fungi), and thermal mechanical stress, which can initiate the inflammation response ([1]; Lauridsen et al., 2019). Common signs of inflammation include redness, heat, swelling, pain, and loss of cell function [2]. However, an uncontrolled inflammatory reaction may lead to the development of several complicated diseases such as gout, rheumatoid arthritis, systemic lupus erythematosus, obesity, pancreatitis, Alzheimer's disease, cancer, heart disease, type 2 diabetes, inflammatory bowel disease, autoimmune diseases and ophthalmologic disorders ([3]; Sakamoto et al., 2012; [4]). Based on the period it lasts, inflammation can be categorized into two types: acute or

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Piperine exerts anti-inflammatory effects and antagonises the properties of celecoxib and ketoprofen: *in vivo* and molecular docking studies

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ABSTRACT

This study evaluates the anti-inflammatory effects of a natural product, piperine (PPN), using *in vivo* and *in silico* methodologies. In the *in vivo* segment, inflammation was induced in the right hind paw of young chicks *via* a formalin (50 µL) injection. PPN was orally administered at doses of 25 and 50 mg/kg with or without celecoxib (CXB) and/or ketoprofen (KPN) (42 mg/kg). The vehicle acted as the negative control group (NC). The *in silico* analysis predicted the drug-likeness, pharmacokinetics, and toxicity profile of PPN, along with evaluating its binding affinity and ligand-receptor interactions. Results indicate that PPN significantly ($p < 0.05$) reduced licking frequency and paw edoema in a dose-dependent manner. However, in combination therapy, PPN diminished the effects of both CXB and KPN. PPN showed high affinity (–8.6 kcal/mol) towards the COX-2 enzyme. Therefore, PPN exerts anti-inflammatory effects in chicks through COX-2 inhibition pathways and antagonises CXB and KPN activities.

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KEYWORDS
Piperine; anti-inflammatory effect; cyclooxygenase interaction

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Antiemetic activity of abietic acid possibly through the $5HT_3$ and muscarinic receptors interaction pathways

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The present study was designed to evaluate the antiemetic activity of abietic acid (AA) using in vivo and in silico studies. To assess the effect, doses of 50 mg/kg b.w. copper sulfate ($CuSO_4 \cdot 5H_2O$) were given orally to 2-day-old chicks. The test compound (AA) was given orally at two doses of 20 and 40 mg/kg b.w. On the other hand, aprepitant (16 mg/kg), domperidone (6 mg/kg), diphenhydramine (10 mg/kg), hyoscine (21 mg/kg), and ondansetron (5 mg/kg) were administered orally as positive controls (PCs). The vehicle was used as a control group. Combination therapies with the referral drugs were also given to three separate groups of animals to see the synergistic and antagonizing activity of the test compound. Molecular docking and visualization of ligand-receptor interaction were performed using different computational tools against various emesis-inducing receptors (D_2, D_3, $5HT_3$, H_1, and M_1–M_5). Furthermore, the pharmacokinetics and toxicity properties of the selected ligands were predicted by using the SwissADME and Protox-II online servers. Findings indicated that AA dose-dependently enhances the latency of emetic retching and reduces the number of retching compared to the vehicle group. Among the different treatments, animals treated with AA (40 mg/kg) exhibited the highest latency (98 ± 2.44 s) and reduced the number of retching (11.66 ± 2.52 times) compared to the control groups. Additionally, the molecular docking study indicated that AA exhibits the highest binding affinity (− 10.2 kcal/mol) toward the M_4 receptors and an elevated binding affinity toward the receptors $5HT_3$ (− 8.1 kcal/mol), M_1 (− 7.7 kcal/mol), M_2 (− 8.7 kcal/mol), and H_1 (− 8.5 kcal/mol) than the referral ligands. Taken together, our study suggests that AA has potent antiemetic effects by interacting with the $5TH_3$ and muscarinic receptor interaction pathways. However, additional extensive pre-clinical and clinical studies are required to evaluate the efficacy and toxicity of AA.

Keywords Emesis, Vomiting, *Gallus gallus domesticus*, Abietic acid, Molecular docking

Emesis, or vomiting, is a typically unpleasant condition where stomach contents are forcefully expelled through the mouth. It is closely associated with the movement of the gastrointestinal system[1]. Vomiting is induced by toxins in the gut lumen or by irritation of the stomach through the gastrointestinal tract's (GIT) mucosal chemoreceptors[2,3]. Besides ingesting toxins or irritants, several conditions, including food poisoning, gastroenteritis (diarrhea), motion sickness, hangovers, head injuries, intestinal obstruction, appendicitis, post-operative factors, and elevated intracranial pressure, can also lead to vomiting and nausea[4]. In addition, several adverse reactions to radiation therapy and cancer treatment can cause emesis[5]. There is evidence that emesis and GI

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Review

Bioactivities of morroniside: A comprehensive review of pharmacological properties and molecular mechanisms

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Morronisde
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ABSTRACT

Morroniside (MOR) is an iridoid glycoside and the main active principle of the medicinal plant, *Cornus officinalis* Sieb. This phytochemical is associated with numerous health benefits due to its antioxidant properties. The primary objective of the present study was to assess the pharmacological effects and underlying mechanisms of MOR, utilizing published data obtained from literature databases. Data collection involved accessing various sources, including PubMed/Medline, Scopus, Science Direct, Google Scholar, Web of Science, and SpringerLink. Our findings demonstrate that MOR can be utilized for the treatment of several diseases and disorders, as numerous studies have revealed its significant therapeutic activities. These activities encompass anti-inflammatory, antidiabetic, lipid-lowering capability, anticancer, trichogenic, hepatoprotective, gastro-protective, osteoprotective, renoprotective, and cardioprotective effects. MOR has also shown promising benefits against various neurological ailments, including Alzheimer's disease, Parkinson's disease, spinal cord injury, cerebral ischemia, and neuropathic pain. Considering these therapeutic features, MOR holds promise as a lead compound for the treatment of various ailments and disorders. However, further comprehensive preclinical and clinical trials are required to establish MOR as an effective and reliable therapeutic agent.

Abbreviations: ABCA1, ATP-binding cassette subfamily A member 1; ACLT + MMx, Anterior cruciate ligament transection + medial menisci resection; AD, Alzheimer disease; AGE, Advanced glycation end products; AMI, Acute myocardial infarction; ApoE, Apolipoprotein E; AST, Aspartate aminotransferase; Aβ, Amyloid-beta; CAT, Catalase; CAG, Chronic atrophic gastritis; CK-MB, Creatine kinase; CKD, Chronic kidney disease; COX-2, Cyclooxygenase-2; DM, Diabetes mellitus; DN, Diabetic nephropathy; DMM, Destabilization of the medial meniscus; ECM, Extracellular matrix; GAS, Serum gastrin; GLP-1, Glucagon-like peptide-1; GPx, Glutathione peroxidase; GSH, Glutathione; GSH-PX, Glutathionase; HFD, High-fat diet; HELF, Human embryonic lung fibroblast; HSC, Hepatic stellate cell; HTSE, Hamster tracheal surface epithelial cells; HUVECs, Human umbilical vein endothelial cells; IC50, Half maximal inhibitory concentration; IFN-γ, Interferon gamma; IL-1β, Interleukin-1 beta; IL-6, Interleukin 6; IVF-ET, *In vitro* fertilization and embryo transfer; i.a., Intra-articular injection; i.g, Intragastrically; iNOS, Inducible nitric oxide synthase; LAD, Ligating the anterior descending coronary artery; LDH, Lactate dehydrogenase; LXR, Liver X receptors; MCAO, Middle cerebral artery occlusion; MDA, Malondialdehyde; MNNG, *N*-methyl-N′-nitro-N-nitrosoguanidine; MMP, Mitochondrial membrane potential; MMP-3, Matrix metalloproteinase 3; MOR, Morroniside; mRTECs, Mouse renal tubular epithelial cells; NOs, Nitric oxide synthase; NF-κB, Nuclear factor kappa B; OA, Osteoarthritis; OP, Osteoporosis; ORSC, Outer root sheath cell; PGC-1α, Peroxisome proliferator-activated receptor γ coactivator 1α; PD, Parkinson's disease; PGE2, Prostaglandin E2; RAGE, Receptor for advanced glycation end products; ROS, Reactive oxygen species; SCI, Spinal cord injury; SOD, Superoxide dismutase; STZ, Streptozotocin; TNF-α, Tumor necrosis factor alpha; TGF-β, Transforming growth factor beta; VEGFA, Vascular endothelial growth factor A; VEGFR-II, Vascular endothelial growth factor receptor 2.

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ORIGINAL ARTICLE

Protective effects of ascorbic acid against anticancer drug-induced oxidative stress and genotoxic damage in *Saccharomyces cerevisiae*

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Abstract
The widely used dietary antioxidant ascorbic acid (AA) is evident to possess protective effects against many chronic diseases. This study aimed to evaluate the effects of AA on oxidative stress and genotoxic damage caused by 5-fluorouracil (5-FU), docetaxel (DOCE), and tamoxifen (TAMOX) in two proficient and four isogenic *Saccharomyces cerevisiae* strains. For this, we performed disc diffusion and comet alkaline assay using suitable standard drugs. The results suggest that 5-FU, DOCE, TAMOX, and their combinations induced significant oxidative damage ($p < 0.001$) in all *S. cerevisiae* strains. These anticancer drugs and their combinations also induced genotoxicity ($p < 0.05$) in the SODWT strain when compared to the negative control group. These drugs and their combinations augmented damage index (ID) and damage frequency (FD) in the comet assay. However, AA alone, as well as when co-treated with these anticancer drugs, significantly ($p < 0.05$) reduced the damaging effects (oxidative stress and genotoxicity) on all test strains. AA showed the highest damage modulation with TAMOX (ID = 51.4% and FD = 50%), followed by 5-FU + DOCE (ID = 43.5% and FD = 42.9%), DOCE (ID = 42.5% and FD = 39.1%), and 5-FU + TAMOX (ID = 37% and FD = 33.6%), respectively. Taken together, AA reduced oxidative stress caused by the inducer hydrogen peroxide and showed anti-genotoxic activities against 5-FU, DOCE, and TAMOX, and their combinations mediated genotoxic effects on *S. cerevisiae* strains. Further studies are necessary to understand the molecular interference of AA in cancer therapies.

Keywords Ascorbic acid · Anticancer drugs · Oxidative stress · Genotoxicity · Combination therapy · Protective effects

Introduction

Oxidative stress is characterized by excessive production of free radicals and by the reduction of endogenous antioxidant capacity (e.g., superoxide dismutase (SOD), glutathione peroxidase (GPx), glutathione reductase, catalase (CAT), and glutathione (GSH)) to "fight" against the stress caused by biomolecules (Islam 2017a, b). Oxidative stress is directly related to the development of several pathologies, including in the central nervous system (CNS), which is extremely sensitive to the damages caused by free radicals and also promotes damage to tissues and macromolecules (e.g., lipids, nucleic acids, and proteins), leading to neurodegenerative diseases (e.g., Parkinson's and Alzheimer's diseases), cardiovascular diseases, immune and endocrine disorders, renal and hepatic damage, chronic inflammation, and cancer (Pisoschi and Pop 2015; Islam 2017a; Teleanu et al. 2022).

Free radicals are atoms, molecules, or ions with highly unstable electrons that are active in chemical reactions. They are derived from elements such as oxygen, which produces reactive oxygen species (ROS) (Braga et al. 2018). Excessive ROS production can lead to oxidative damage, alterations in the nitrogenous bases, or deoxyribose modifications that are able to increase apoptosis and mutations, which are some of the major consequences of the development of cancer (Mendonça et al. 2014; Di Meo and Venditti 2020). Cancer is one of the most frequent causes of death worldwide due to highly complex molecular factors, which are comprised of genetic predisposition and lifestyle. Cancer development is directly related to oxidative stress through three stages:

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Tangeretin exerts and modulates the anxiolytic effects of the GABAkine drugs diazepam and flumazenil in mice: Molecular interventions through animal behavior and molecular dynamic simulations

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Anxiolytic effect
GABAergic pathway

ABSTRACT

The citrus peel flavonoid tangeretin (TAN) has diverse biological activities, including antioxidant, anti-inflammatory, anti-tumor, hepatoprotective, and neuroprotective effects. This study emphasizes evaluating the anxiolytic effect of TAN on mice. Additionally, we conducted *in silico* investigations to examine the potential molecular mechanisms behind the anxiolytic effect of TAN. For this, adult male *Swiss* albino mice were treated with TAN (10 and 20 mg/kg, p.o.) with or without the standard GABAergic agonist drug diazepam (DZP: 2 mg/kg, p.o.) and/or antagonist drug flumazenil (FLU: 0.1 mg/kg, i.p.) and checked for different locomotor behaviors using various mouse models. The molecular docking study of TAN was conducted against $GABA_A$ receptor subunits. Findings suggest that TAN dose-dependently and significantly ($p < 0.05$) increased locomotor activities such as the number of field crosses, hole crosses, swings, and light residence time while decreasing the grooming and rearing parameters of the animals. With DZP, it significantly ($p < 0.05$) reduced the test parameters while altering these parameters with FLU. In molecular docking, TAN has a strong binding affinity of −6.6 and −7.0 kcal/mol for the α2 and α3 subunits of the $GABA_A$ receptor, respectively, whereas the standard drugs DZP and FLU showed binding affinities between −6.0 and −6.7 kcal/mol for these subunits. MD simulations showed that TAN interacts with α3 subunits in a way similar to DZP, with similar RMSD and RMSF values and ligand properties. TAN also demonstrated acceptable drug-likeness and pharmacokinetics. Taken together, TAN augmented the anxiolytic effect of DZP while reducing the effect of FLU in mice.

1. Introduction

Mental health issues are one of the primary causes of worldwide disease-related burden (Tiller, 2013). Anxiety is defined as a diffuse, uncomfortable, hazy, scared, or worried mood that involves neurological signs such as headache, perspiration, palpitations, tachycardia, and gastrointestinal distress (M. S. Islam et al., 2022). Anxiety and stress have an adverse effect on one's physical and mental health, leading to conditions including diabetes, cardiovascular disease, and hypertension also associated with some somatic disorders (Khan & Khan, 2020; Pahl, Barrett, & Gullo, 2012). Anxiety can be caused by many kinds of factors, including gender and age, mental health, urbanization, physical status, conflict, the negative effects of pharmaceuticals, trauma, heredity, and

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RESEARCH ARTICLE

DRUG DEVELOPMENT RESEARCH WILEY

Daidzin enhances memory and the antischizophrenia drug olanzapine's effects, possibly through the 5-HT_{2A} and D_2 receptor interaction pathways

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Abstract

Schizophrenia affects identification and disturbs our thinking and motivational capacity. Long-term use of daidzin (DZN) is evident to enhance attention and memory in experimental animals. This study aimed to investigate the effect of DZN on *Swiss* mice. To check animals' attention, identification, thinking, and motivational ability, we performed behavioral studies using marble burying, dust removal, and trained swimming protocols. For this, a total of 36 male *Swiss* albino mice were randomly divided into six groups, consisting of 6 animals in each group, as follows: control (vehicle), DZN-1.25, DZN-2.5, DZN-5 mg/kg, olanzapine (OLN)-2, and a combination of DZN-1.25 with OLN-2. Additionally, in silico studies are also performed to understand the possible molecular mechanisms behind this neurological effect. Findings suggest that DZN dose-dependently and significantly ($p < .05$) increased marble burying and removed dust while reducing the time to reach the target point. DZN-1.25 was found to enhance OLN's effect significantly ($p < .05$), possibly via agonizing its activity in animals. In silico findings suggest that DZN has strong binding affinities of -10.1 and -10.4 kcal/mol against human serotonin 2 A (5-HT_{2A}) and dopamine 2 (D_2) receptors, respectively. Additionally, DZN exhibits favorable pharmacokinetic and toxicity properties. We suppose that DZN may exert its attention- and memory-enhancing abilities by interacting with 5-HT_{2A} and D_2 receptors. It may exert a synergistic antischizophrenia-*like* effect with the standard drug, OLN. Further studies are required to discover the exact molecular mechanism for this neurological function in animals.

KEYWORDS
daidzin; memory-enhancing ability; schizophrenia; serotoninergic system, dopaminergic interaction

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Anti-inflammatory effects of thymol: an emphasis on the molecular interactions through *in vivo* approach and molecular dynamic simulations

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Thymol (THY), as the natural monoterpene phenol, acts against oxidative stress and inflammatory processes. This study aimed to evaluate the anti-inflammatory effects and possible molecular mechanisms of THY via formalin-induced mouse and egg albumin-induced chick models alongside molecular docking and molecular dynamic (MD) simulations. THY (7.5, 15, and 30 mg/kg) was investigated, compared to celecoxib and ketoprofen (42 mg/kg), as anti-inflammatory standards. THY dose-dependently and significantly ($p < 0.05$) decreased paw-licking and edema diameter parameters in formalin (phases I and II) and egg albumin-induced models. Moreover, THY (15 mg/kg) exerted better anti-inflammatory effects in combination with the standard drug ketoprofen than alone and with celecoxib. In silico studies demonstrated elevated binding affinities of THY with cyclooxygenase-2 (COX-2) than the COX-1 enzyme, and the ligand binds at a similar location where ketoprofen and celecoxib interact. The results of MD simulations confirmed the stability of the test ligand. THY exerted anti-inflammatory effects on Swiss mice and young chicks, possibly by interacting with COX-2. As a conclusion, THY might be a hopeful drug candidate for the management of inflammatory disorders.

KEYWORDS

cyclooxygenase, in silico studies, inflammation, oxidative stress, thymol

1 Introduction

Inflammation connects a wide variety of pathophysiological processes. Although inflammation plays many important physiological roles, it is one of the major drivers of many diseases, including cancer (Singh et al., 2019; El-Nashar et al., 2021). Pathogenic microbes such as bacteria, fungi, or viruses usually invade our bodies and result in infection

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RESEARCH

Unveiling the anxiolytic and analgesic effects of citronellal in *Swiss* mice: in vivo and in silico insights into COX and GABAA receptor pathways

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Abstract
This study aims to evaluate the analgesic and anxiolytic effects of citronellal (CTL) in *Swiss* mice using two new sensitive and economic mouse models along with possible molecular mechanisms through in silico studies. For this, we employed marble displacement and spiked-field apparatus to check the anxiolytic and analgesic effects, respectively. In silico studies were done against cyclooxygenase (COX) enzymes and $GABA_A$ receptor subunits. Findings suggest that the test sample CTL significantly reduced the number of marbles displaces (NMD), square crosses (NSC), paw massages (NPM), and escaping attempts (NEA) in animals than the control group. CTL exhibited better effects in the perforated-field study compared to the reference drug diclofenac sodium. In both cases, CTL (200 mg/kg) significantly reduced the test parameters when combined with the standard drugs (diazepam or diclofenac sodium). In in silico studies, CTL showed binding affinities of − 5.5, − 5.2, − 4.8, and − 4.8 kcal/mol with the COX1, COX2, and $GABA_A$ receptors (α2 and α3 subunits), respectively. Taken together, CTL may exert anxiolytic- analgesic-like effects on mice, possibly through the $GABA_A$ receptor and COXs interaction pathways. These new tools might be used to check the anxiolytic and analgesic properties of a wide variety of test substances.

Keywords Marble displacement · Spiked-field · Anxiety · Pain · Bioactive compound

Introduction

Screening of chemicals and biologicals is crucial to check their possible pharmacological and toxicological impacts in experimental animals. This identifies bioactive compounds from a vast number of substances from diverse sources, which offers possible installation of such bioactive principles into human bodies for the prevention and treatment of diseases and the improvement of health. Non-clinical and pre-clinical studies help to sort bioactives from various sources (e.g., plants, animals, microorganisms) for human consumption (Andrade et al. 2016). As these studies offer potential bioactive compounds for clinical trials, they should ensure optimum sensitivity, efficiency, applicability, economy, and reproducibility while their designing and usage.

Modern health science has been continuously chasing challenges to manage new diseases and disorders in humans and other animals (Braubach 2011). Thus, a continuous supply of new study protocols, apparatus, or equipment is essential in the field of drug discovery and development. Medical scientists play an important role in this case. Currently, we have hundreds of tools for testing the pharmacological and toxicological activities of drugs and chemicals (Pognan et al. 2023). However, some study tools are expensive, while others exert stress on the experimental animals, thereby limiting their suitability in animal studies. For example, a rotarod is a slightly expensive apparatus that is widely used in muscle strength studies in mice and rats (Schönfeld et al. 2017). On the other hand, hot or cold plates, chemical-induced analgesic or pain sensation, or convulsion tests, and forced-swimming test protocols exert significant physical stress on the experimental animals (Bousshine et al. 2022; Jiang et al. 2021; Chowdhury et al. 2024; Abbasi-Maleki et al. 2020). Some protocols require pre-trained animals to complete the study, such as the climbing test (Bordes et al. 2023). Moreover, some protocols offer only testing a single biological activity of test substances (Fontana et al. 2021).

Extended author information available on the last page of the article

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Research Square

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Sedative effects of daidzin possibly through GABA A receptor interaction pathway: In vivo approach with molecular dynamic simulations

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Phytol exerts sedative-*like* effects and modulates the diazepam and flumazenil's action, possibly through the $GABA_A$ receptor interaction pathway

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ABSTRACT

This study aimed at the evaluation of the sedative effect of phytol (PHY) with possible molecular mechanisms through *in vivo* and *in silico* studies. For this, adult male mice were randomly divided into six individual groups, namely control (vehicle), two standards (DZP: diazepam at 2 m/kg, FLU: flumazenil at 0.1 mg/kg), three test groups (PHY at 25, 50, and 75 mg/kg), and three combined groups with the DZP-2 and/or FLU-0.1 with PHY-75 mg/kg. After thirty minutes, each animal was treated with thiopental sodium (TS) at 40 mg/kg to produce sedation and observed for latency and duration of sleep up to 4 h. *In silico* studies were performed with the 6X3X protein of the $GABA_A$ receptor α1 and β2 subunits. The results demonstrate that PHY dose-dependently enhanced sleep duration in animals. However, it produced an insignificant sleep duration compared to the control and standard groups. It also significantly ($p < 0.05$) decreased the latency and increased the duration of sleep with DZP-2, while reducing these parameters with FLU-0.1. In *in silico* studies, DZP and FLU exhibited binding affinities with 6X3X by −6.8 and −6.9 kcal/mol, respectively, while PHY exhibited −6.9 kcal/mol. Taken together, PHY may exert a sedative-*like* effect in TS-induced sleeping mice and modulate the effects of DZP and FLU, possibly through interacting with the 6X3X protein of the $GABA_A$ receptor. PHY may be one of the good candidates for the management of sleep disturbances, such as insomnia.

Significance statement

The chlorophyll-derived diterpenoid phytol (PHY) is evident for its diverse biological activities along with some important practical applications. It has a number of neurobiological activities. However, its sedative potential is yet to be discovered. This study evaluated the sedative effect of PHY with possible molecular mechanisms through *in vivo* and *in silico* studies and suggests that PHY may exert a sedative-*like* effect in thiopental sodium-induced sleeping mice and modulate the effects of two GABAergic drugs called diazepam (agonist) and flumazenil (antagonist), possibly through interacting with the 6X3X protein of the $GABA_A$ receptor α1 and β2 subunits. We suppose PHY may be one of the good candidates for the management of sleep disturbances, such as insomnia.

1. Introduction

Insomnia is a neurological condition that is a type of sleep disorder normally treated with sedative agents [3]. Sleep disorders, including insomnia, are one of the major global burdens that require continuous new remedies. It is because these kinds of medical conditions cause some common adverse effects, such as tolerance and dependence on the

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Gaba$_A$ergic sedative prospection of sclareol-linalool co-treatment: An antagonistic intervention through *in vivo* and *in silico* studies

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ABSTRACT

Sleep disturbance causes many health problems in humans worldwide. This study evaluated the effects and possible mechanisms of sclareol (SCL) and/or linalool (LIN) through *in vivo* and *in silico* studies. For this, young chicks SCL (5, 10, and 20 mg/kg) and/or LIN (50 mg/kg) were orally administered thirty minutes before to the thiopental sodium (TS)-induced chicks with or without the standard drug diazepam (DZP: 3 mg/kg). Incidence, onset, and duration of sleep were then noted. The results suggest that SCL dose-dependently increased the onset and decreased the duration of sleep in animals. In contrast, LIN50 significantly ($p < 0.05$) decreased onset and increased sleep duration. SCL20 combined with LIN50 and/or DZP3 modulated the sleep parameters in animals. In combination, LIN50 showed better effects with DZP3, where the percentage decrease in latency and increase in sleep duration were 54.20 and 168.65 %, respectively. SCL20 when combined with LIN50 + DZP3 also modulated the onset and duration of sleep in animals. Further, *in silico* studies suggest that SCL and LIN have binding affinities with the 6X3X protein of the GABA$_A$ receptor (α1 and β2 subunits) of −6.9 and −6.8 kcal/mol, respectively. The standard drug DZP showed a binding affinity of −5.0 kcal/mol. Taken together, SCL may exert an angiogenic-*like* effect and antagonize LIN and/or DZP-mediated sedative effects in TS-induced chicks, possibly through the GABA$_A$ receptor α1 and β2 subunits interaction pathway.

Significance statement

The sclareol may exert an angiogenic-like effect and antagonize linalol and/or Diazepam-mediated sedative effects in TS-induced chicks, possibly through the GABAA receptor α1 and β2 subunits interaction pathway.

1. Introduction

Normal sleep is a crucial biological need which is commonly dependent on the pathophysiological conditions, environmental, social norms and demands, work and societal influences or pressures. Insomnia, sleep apnea, restless legs syndrome, and narcolepsy are now highly prevalent in some nations, including the US population [40].

Abbreviations: AA, Amino Acid; ADMET, Absorption, Distribution, Metabolism, Excretion, and Toxicity; ANOVA, Analysis of variance; BBB, Blood-brain barrier; BZD, Benzodiazepines; CNS, Central nervous system; DZP, Diazepam; GABA, Gamma-aminobutyric acid; GI, Gastrointestinal; HB, Hydrogen bonds; HBA, Hydrogen bond acceptors; HBD, Hydrogen bond donors; LIN, Linalool; MR, Molar refractivity; MW, Molecular weight; SCL, Sclareol; SEM, Standard error of mean; TPSA, Topological polar surface area; TS, Thiopental sodium.

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RESEARCH ARTICLE

Synergistic Anxiolytic Effects of Linalool and Sesamol Co-Treatment on Swiss Albino Mice: A Potential GABAergic Intervention

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Keywords: anxiety | $GABA_A$ receptor | linalool | molecular docking | sesamol

ABSTRACT

Sesamol (SES) and linalool (LIN) are aromatic compounds that have neuroprotective effects. The main purpose of this study is to evaluate the anxiolytic activity of LIN and SES co-treatment on Swiss albino mice and analyze its possible mechanism through in silico study. In this sense, the mice were given the gamma-aminobutyric acid type A receptors ($GABA_A$) agonist diazepam (DZP; 3 mg/kg, p.o.) as a positive control. A vehicle (10 mL/kg) was served as control. The tested chemicals, single-dose LIN (50 mg/kg) and SES (50 mg/kg), as well as a combination (LIN + SES) and (DZP + LIN + SES), were administered orally in order to conduct several behavioral tests, including open-field, swings box, hole-crossing, and dark-resident time tests. Further, molecular docking studies of LIN, SES, and DZP were carried out through different software. The results showed that LIN and SES individually have significant anxiolytic-like activity in mice. Further, when LIN was combined with SES and with (SES + DZP), it exhibited a relatively lower locomotor activity in mice compared to individual treatment groups, indicating a synergistic action. In addition, the molecular docking analysis revealed that LIN and SES have a moderate binding affinity (−5.0 and −5.1 kcal/mol) toward the $GABA_A$ receptor α3 subunit. In conclusion, our findings suggest that LIN and SES exerted synergistic anxiolytic activity on *Swiss* albino mice, possibly through the GABAergic interaction pathways.

1 | Introduction

Most often, anxiety is considered a symptom of psychiatric illness. It is invariably accompanied by a number of medical and surgical conditions. At first, the physicians try to motivate the patients to overcome the primary symptoms of anxiety; however, intolerable symptoms may interfere with the treatment of the underlying disease, leading to drug treatment to cope with the anxiety of this class of patients (Lader and Morton 1991). The primary use of anxiolytic drugs is to produce calmness in patients

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REVIEW ARTICLE

Coumarin derivatives as anticancer agents targeting PI3K-AKT-mTOR pathway: a comprehensive literature review

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Abstract
Coumarin is a natural benzopyrone compound known for its diverse pharmacological activities, including anticancer, anti-inflammatory, and antioxidant properties. But its derivatives' exploration in cancer, specially PI3K-AKT-mTOR pathways-based cancer activity not explored yet. This review aims to evaluate the anticancer potential of coumarin derivatives' by exploring their modulatory effects on the PI3K-AKT-mTOR signaling pathway across diverse cancer types. This review adopted a systematic literature approach, emphasizing studies across various cancer types and focusing on coumarin's mechanisms and therapeutic potential. Results reveal that coumarin derivatives suppress PI3K-AKT-mTOR pathway activity across cancers, such as liver, breast, and colorectal, with IC_{50} values ranging from 4 μM to > 200 μM in vitro and confirmed effects in vivo. The modulation of other pathways, including NF-κB and MAPK, underscores their multi-targeted anticancer action. Despite promising preclinical efficacy, challenges like low bioavailability, potential hepatotoxicity, and systemic toxicity persist. Structure–activity relationship (SAR) studies suggest that introducing specific functional groups can enhance selectivity, reduce toxicity, and improve therapeutic outcomes. The conclusion reinforces the potential of coumarin derivatives as novel anticancer agents, advocating for structural optimizations and clinical investigations to overcome pharmacokinetic barriers and maximize therapeutic benefits. This exploration offers a strategic perspective on utilizing coumarin-based molecules in advancing cancer therapeutics.

Keywords Cancer · Literature review · PI3K-AKT-mTOR pathway · Toxicological profile

Introduction

Cancer is one of the most common and deadly diseases worldwide, characterized by the uncontrolled growth of abnormal cells in affected tissues [1, 2]. According to the World Health Organization (WHO), around 10 million people died from cancer in 2020, accounting for one in every six deaths globally. Lung cancer, breast cancer, colorectal cancer, and liver cancer are some of the widely recorded forms of cancer across the world and by region [3]. Tumorigenesis is a complex process influenced by genetic and environmental factors, including mutations, inherited genes, and lifestyle choices such as smoking, diet, and physical inactivity [4]. Disruption of signaling pathways, particularly the phosphatidylinositol 3-kinase (PI3K) pathway, plays a key role in cancer progression. This pathway regulates crucial cellular processes such as growth, survival, and nutrient utilization [5, 6]. Receptor-activating tyrosine kinases and G-protein-coupled receptors are the two kinases that trigger PI3K and produce PIP3. Following then, PIP3 triggers other downstream effects including AKT, which promotes cell growth and survival [7]. The Mammalian PI3K signaling network is the most commonly dysregulated in various cancers, including endometrial, lung, liver, and colon cancer [5].

Cancer growth and progression involve multiple processes that enable abnormal cells to survive and spread. One of the most studied pathways linked to cancer development is the PI3K-AKT-mTOR signaling pathway [8]. The PI3K-AKT-mTOR pathway is crucial for various cellular functions, including cell division, survival, metabolism, and protein synthesis, all of which are often disrupted in cancer cells [9]. Alterations in this pathway are among the most common oncogenic changes, contributing to tumorigenesis, resistance to apoptosis, and metastasis [10]. This

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Assessment of antiemetic and modulatory activity of dihydrocoumarin on copper sulfate induced emetic chicks: An *in vivo* investigation

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Dopamine (D_2) receptor antagonists

ABSTRACT

Dihydrocoumarin (DHC) is a natural compound found in plants like sweet clover and tonka beans, commonly used as a flavoring agent in food and as a fragrance in cosmetics. This study investigates the potential antiemetic properties of DHC using a copper sulfate-induced emesis model using 2-day-old *Gallus domesticus* chicks. Administered at doses of 12.5, 25, and 50 mg/kg, DHC's impact was compared with standard antiemetics; domperidone (DOM, 7 mg/kg) and ondansetron (OND, 5 mg/kg) were administered orally as positive controls. Results demonstrated that DHC significantly ($p < 0.05$) reduced the frequency of retches and prolonged the latency period in a dose-dependent manner. At 50 mg/kg, DHC achieved the highest latency (54.92 ss) and maximum reduction in retches (24.38), highlighting its standalone efficacy. However, combination therapies revealed antagonistic effects when DHC (50 mg/kg) was co-administered with DOM or OND, emphasizing the complexity of potential drug interactions. Despite its moderate efficacy compared to standard drugs, acute toxicity testing, conducted according to OECD guidelines, revealed no adverse effects at doses up to 1000 mg/kg, suggesting an LD_{50} greater than 1 g/kg in chicks. DHC exhibited promise as a natural antiemetic with a milder profile.

Introduction

Emesis is a reflex action that involves the coordinated contraction of inspiratory and expiratory muscles, resulting in the involuntary and forceful expulsion of stomach contents through the mouth and sometimes, through the nose (Popa et al., 2019). The medullary vomiting center accounts for the coordination of the emesis reflex, which is influenced directly by afferent innervation, the chemoreceptor trigger zone (CTZ), and other central nervous system centers. The most frequent causes of emesis are gastrointestinal disorders (Popa et al., 2020). In addition to the ingestion of toxins or irritants, numerous conditions such as food poisoning, gastroenteritis (diarrhea), and motion sickness can also precipitate vomiting (Wilson et al., 2019). There is substantial evidence that emesis and gastrointestinal disturbances can be instigated by microbial agents and their secretions (Zhong et al., 2021). Furthermore, various adverse reactions to radiation therapy and cancer treatments are known to induce emesis (Wang et al., 2022).

In the treatment of emesis, the most commonly used antiemetic drugs are 5-HT_3 receptor antagonists (ondansetron, granisetron, tropisetron), dopamine receptor antagonists (prochlorperazine, metoclopramide, domperidone), histamine receptor antagonists (cyclizine, diphenhydramine), muscarinic receptor antagonists, and neurokinin-1 receptor antagonists (Heckroth et al., 2021). Though some studies have found domperidone has been implicated in causing QT prolongation, ventricular arrhythmias, and sudden cardiac death (Field et al., 2019). Metoclopramide, a dopamine antagonist, is associated with drowsiness (Al-Saffar et al., 2019), fatigue (Radhakrishnan et al., 2020), and can cause extrapyramidal symptoms like tardive dyskinesia (Kalas et al., 2023) with long-term use. Despite the efficacy of existing therapies, many patients still experience refractory or breakthrough emesis,

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Quercetin modulates the anti-arthritic effects of indomethacin, possibly through COXs and TNF-α interaction pathways

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ABSTRACT

Quercetin (QUR) is a flavonoid compound with potent anti-oxidant and anti-inflammatory properties, commonly found in various fruits and vegetables. This study aims to evaluate the synergistic anti-arthritic effects of QUR in combination with indomethacin (INDO) in formaldehyde and turpentine oil-induced arthritis models in mice and to explore the underlying molecular mechanisms using in vivo and *in silico* approaches. Arthritis was induced in 60 male Swiss albino mice, divided into 12 groups. The animals were treated with QUR (12.5, 25, and 50 mg/kg), INDO (10 mg/kg), or a combination of QUR-25 and INDO-10, all administered per orally. Paw licking and edema were recorded at various intervals. Molecular docking studies assessed the binding of QUR and INDO to cyclooxygenase-1 (COX-1), COX-2, and tumor necrosis factor-alpha (TNF-α), while SwissADME and Protox-3.0 were used for drug-likeness, pharmacokinetics, and toxicity predictions. QUR significantly reduced paw edema and licking behavior in both models. QUR-50 mg/kg showed the most substantial anti-arthritic effects, comparable to or surpassing INDO, especially in the late phase. The combination of QUR and INDO exhibited enhanced efficacy, with a superior reduction in inflammation compared to either treatment alone. *In silico* docking revealed stronger binding affinities of QUR (-8.5, -8.9, -8.7 kcal/mol) for COX-1, COX-2, and TNF-α compared to INDO. QUR also showed better pharmacokinetic properties with lower toxicity. QUR demonstrates significant anti-arthritic potential, both alone and in combination with INDO, through COX and TNF-α interaction pathways. Further studies are needed to explore its long-term therapeutic efficacy.

Introduction

Rheumatoid arthritis (RA), a chronic inflammatory autoimmune disease, is a common joint disease that happens where two bones meet, like the wrist or hips (Drosos et al., 2019). In 2020, approximately 17.6 million people around the world were living with rheumatoid arthritis (Black et al., 2023). Symptoms of arthritis include pain, redness, heat, and swelling in the joints. It can be influenced by several factors,

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Computational analysis of *azadirachta indica*-derived phytochemicals targeting α-amylase and α-glucosidase for antidiabetic activity

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Keywords:
Antidiabetic phytochemicals
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Molecular docking

ABSTRACT

Azadirachta indica L. (*A. indica*, neem), has long been used in the treatment of diabetes in numerous countries. This study aims to explore the molecular interactions of bioactive phytochemicals isolated from *A. indica* with two key enzymes involved in diabetes, human pancreatic α-amylase (4W93) and α-glucosidase (3CTT), using *in silico* approaches. Molecular docking was conducted with various ligands to evaluate their potential as inhibitors. Molecular docking analyses revealed that 24-methylene cycloartanol (24-MCL), stigmasterol (SML), and β-sitosterol (BSL) exhibited strong binding affinities (−9.4 kcal/mol) to α-amylase, with SML forming one hydrogen bond (HB) along with multiple hydrophobic interactions. In contrast, montbretin A (MNA) showed a binding energy of −8.7 kcal/mol and formed several HBs. For α-glucosidase, gedunin (GN) showed the highest binding energy (−9.1 kcal/mol), while SML exhibited a binding energy of −8.6 kcal/mol with one HB. Drug-likeness assessment using Lipinski's Rule of 5 indicated that casuarine (CRE), catechin (CTN), and GN complied with the criteria without violations, while 24-MCL, SML, and BSL had one violation. Absorption, distribution, metabolism, excretion, and toxicity (ADMET) predictions highlighted favorable absorption profiles for 24-MCL, GN, and BSL, while MNA exhibited poor pharmacokinetic properties. Additionally, prediction of activity spectra for substances (PASS) prediction results further supported the antidiabetic potential of certain compounds. These findings warrant further *in vivo* and *in vitro* validation and clinical trials to assess 24-MCL and GN's antidiabetic potential, while structural optimization could enhance potency for developing safer, more effective plant-based antidiabetic drugs.

1. Introduction

Diabetes mellitus (DM) is a chronic metabolic disorder characterized by hyperglycemia resulting from defects in insulin secretion, insulin action, or both. It can be either acquired or inherited. Elevated blood glucose levels can damage various physiological systems, particularly the neurological and cardiovascular systems, and contribute to insulin deficiency (A.V.A. Mariadoss et al., 2022; Rahman et al., 2021). Approximately 422 million individuals globally are affected by DM, with the majority residing in low- and middle-income countries. Nearly half of those with diabetes remain undiagnosed, and the worldwide prevalence of the condition is estimated at 10.5 %. Projections suggest that by 2045, 783 million people, or 1 in 8 individuals, will experience diabetic complications (https://www.who.int/health-topics/diabetes#tab=tab_1). The primary causes include genetic predisposition, a sedentary lifestyle, and obesity, which can lead to insulin resistance or

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Biochemical, Molecular, and Genetic Mechanisms in Nutrition

Memory-Enhancing Effects of Daidzin, Possibly Through Dopaminergic and AChEergic Dependent Pathways

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A B S T R A C T

Background: The soy isoflavone daidzin (DZN) possesses cognitive-enhancing effects in animals.
Objectives: However, the mechanism for this effect is yet to be discovered.
Methods: For this, we investigate its memory-enhancing capacity using the mouse models of marble burying, dust removal, an open-field study, and in silico studies. Adult male Swiss albino mice were randomly assigned to different groups consisting of control (vehicle: 10 mL/kg), DZN 5, 10, and 20 mg/kg, dopamine (agonist: 22 mg/kg), galantamine (inhibitor: 3 mg/kg), and a combination of DZN-10 with standards.
Results: DZN dose-dependently and significantly ($P < 0.05$) increased marble burying and removed dust while decreasing the total distance in the open-field test (OFT). DZN-10 enhanced dopamine's effect significantly ($P < 0.05$). In silico findings suggest that DZN has strong binding capacities of –10.3, –7.5, –9.8, and –9.2 kcal/mol to the acetylcholinesterase (AChE), D_1, D_3, and D_5 receptors, respectively.
Conclusions: Taken together, DZN may exert its memory-enhancing ability by interacting with AChE and dopamine receptors.

Keywords: daidzin, memory-enhancing capacity, dopamine receptors, AChEergic interaction, molecular docking

Introduction

Learning and memory, or cognitive performance, are important functions of our brain. Generally, aging affects cognitive performance, especially learning and memory capability in animals [1]. Besides this, certain diseases or conditions also play an important role in memory deficits; for example, diabetes, particularly diabetes mellitus (DM), causes cognitive dysfunction and possibly enhances the chances of dementia and related complications, including Alzheimer's disease (AD) in humans [2].

Among the neurodegenerative diseases and disorders (NDDs), AD remains one of the biggest global public health challenges. On the other hand, Parkinson's disease (PD) remains the second

Abbreviations: 2D, two-dimensional; 3D, three-dimensional; ACh, acetylcholine; AChE, acetylcholinesterase; AD, Alzheimer's disease; ADME, absorption, distribution, metabolism, and excretion; ADR, amount of dust removed; ANOVA, analysis of variance; BDNF, brain-derived neurotrophic factor; DM, diabetes mellitus; DOP, 3, 4-dihydroxy phenethylamine; DOP, dopamine; DZN, daidzin; GLT, galantamine; HIA, human intestinal absorption; HPLC, high-pressure liquid chromatography; hTAAR1, human trace amine-associated receptor 1; i.p., intraperitoneally; LD_{50}, median lethal dose; MM2, Allinger's force field; NDD, neurodegenerative diseases and disorders; NAc, nucleus accumbens; NMB, number of buried marbles; OCD, obsessive-compulsive disorder; OFT, open-field test; PD, Parkinson's disease; PDB, RCSB Protein Data Bank; p.o., oral gavage; SD, standard deviation; TRP, time to reach the point; VEGF, vascular endothelial growth factor; VTA, ventral tegmental area.

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Neuroprotective potential of the methanolic leaf extract of *Cheilanthes tenuifolia* in Swiss albino mice

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ABSTRACT

Cheilanthes tenuifolia is a small evergreen fern that belongs to the Pteridaceae botanical family's taxonomic classification and is rich in bioactive chemicals. The present study was aimed at investigating the in vivo neuroprotective potential of the methanol leaf extract of C. tenuifolia (MCT). For this, firstly, methanol was used in the extraction process for removing dried coarse plant powder and collected after extraction. The anticonvulsant effect of the MCT was evaluated in mice using isoniazid-induced seizure models. Its anxiolytic activity was evaluated using the open field, hole cross, swing, and light-dark models in Swiss mice, while the thiopental sodium-induced sleeping model was used to investigate the sedative and exploratory activities in mice, respectively, and antidepressant activity was evaluated by the force swimming model. The animals were administered orally with different doses of MCT (125, 250, and 500 mg/kg). A vehicle group was used as the negative control (NC), and the positive controls (PC) were duloxetine (DUX) (15 mg/kg), carbamazepine (CAR) (80 mg/kg), and diazepam (2 mg/kg) given orally. The results demonstrated moderate to good anxiolytic properties of MCT across various mouse models. Both MCT extract and combination therapies induced dose-dependent sedation in the sedative test. Moreover, in the antidepressant test model, both MCT and combination groups of mice exhibited reduced immobility time. Notably, MCT extract dose-dependently demonstrated a significantly increased onset seizure frequency while reducing the frequency and duration of seizures in mice compared to the NC group ($p < 0.05$). In summary, MCT exhibits promising neuroprotective properties. Results from this study support that MCT exhibits anticonvulsant, anxiolytic, sedative, and antidepressant effects across different test methods.
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1. Introduction

Neurological disorders encompass a diverse collection of conditions that impact on the nervous system, which includes the spinal cord, brain, and the network of nerves distributed throughout the body (Borsook, 2012; Rao and Gershon, 2016). Within this broad category, neurodegenerative diseases represent a specific subset characterized by the gradual deterioration of the nervous system's

Abbreviation: ANOVA, One-way analysis of variance; BFRIH, Bangladesh Forest Research Institute Herbarium; CAR, Carbamazepine; CNS, Central Nervous System; DUX, Duloxetine; DW, Distilled Water; DZP, Diazepam; EURDEM, European Dementia Meta-Analysis; GABA, Gamma-Aminobutyric Acid; KG, Kilogram; MCT, Methanolic Leaf Extract of *Cheilanthes tenuifolia*; MG, Milligram; NC, Negative Control; NRT, Norepinephrine reuptake transporters; OECD, Organization for Economic Co-operation and Development; SEM, Mean deviation; SNRIs, Serotonin-norepinephrine reuptake inhibitors; SRT, Serotonin reuptake transporters; TPS, Thiopental sodium; WHO, World Health Organization

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Antipsychotic effect of *Aegiceras corniculatum* (L.) Blanco: Evidence from murine behavioral assays and computational studies

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ABSTRACT

Introduction: Antipsychotic therapy targets the mesolimbic dopaminergic hyperactivity observed in schizophrenia. Drugs such as olanzapine (Zyprexa) alleviate positive symptoms by suppressing this pathway, although they are often associated with adverse effects, including psychomotor slowing. Notably, In Traditional Chinese Medicine (TCM), *Aegiceras corniculatum* (蠟燭果;桐花樹) is documented in classical materia medica for treating pain, swelling, rheumatism, asthma, and diabetes. Its traditional role in analgesia and nociception suggests engagement of central pain-modulating pathways, and together with reported neuromodulatory properties, provides a rationale for evaluating its relevance in schizophrenia.

Methods: Ethanolic leaf extract of *A. corniculatum* (ACEE) was evaluated in dopamine-induced mouse models using marble burying, dust removal, and trained swim tests. Effects were compared with olanzapine (Zyprexa) (OLN-2) and combination treatments. Phytoconstituents were identified via GC–MS, while molecular docking and ADMET profiling assessed interactions with dopamine D_2 receptors, pharmacokinetics, and safety.

Results: Dopamine (DOP-22) significantly increased compulsive behaviors (marble burying: 13.8 ± 1.5 vs. 10.8 ± 1.9 in controls; dust removal: 141.4 ± 9.3 g vs. 107.1 ± 14.3 g, $p < 0.05$). OLN-2 reduced both (6.0 ± 0.6 marbles; 42.5 ± 4.9 g). ACEE produced dose-dependent reductions (9.3 ± 1.8 and 8.0 ± 1.8 marbles; 87.3 ± 8.4 g and 64.4 ± 11.2 g). Combined ACEE-250 and OLN-2 yielded stronger suppression (5.7 ± 0.8 marbles; 54.2 ± 6.8 g). In the trained swim test, dopamine improved performance (6.8 ± 2.1 s vs. 10.3 ± 1.7 s), while OLN-2 impaired it (18.7 ± 2.4 s). ACEE caused moderate slowing (15.4 ± 1.3 s), suggesting partial preservation of psychomotor function. Docking revealed BOPC as the strongest D_2 ligand (-9.1 kcal/mol), while more abundant compounds (PPD, BEA, MDT) showed moderate affinities with favorable ADMET characteristics.

Conclusion: ACEE demonstrated antipsychotic-like activity through dopaminergic modulation, with an additive effect when combined with OLN-2, and showed a milder impact on psychomotor performance. Supported by traditional use and preliminary modern analyses, *A. corniculatum* warrants further investigation as a potential complementary source of dopaminergically active compounds.

1. Introduction

Traditional Chinese Medicine (TCM) has long utilized plant-based remedies for the management of a wide spectrum of physiological and neurological disorders, relying on empirical knowledge of herbal pharmacology to modulate complex biological pathways [1]. Among these, *Aegiceras corniculatum* (Linn.) Blanco (*A. corniculatum*), commonly known as black mangrove or river mangrove, and Khalsi, is also referred to in Chinese as 蠟燭果 (Là zhú guǒ, "candle fruit") and 桐花樹 (Tóng huā shù, "tung-flower tree"). This species has been historically applied

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Antimicrobial potentials and challenges of paracetamol: A comprehensive reassessment based on database reports

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Toxicological profile

ABSTRACT

Paracetamol (PMCL) is an analgesic-antipyretic drug. It is frequently used as an over-the-counter (OTC) drug in many countries around the world, especially for headaches, mild pain, and fever. Knowing its toxic effects on the nervous and hepatic systems, it has been combined with the psychoactive drug caffeine. However, PMCL's antipyretic action during fevers caused by various pathogens might be due to its antimicrobial power. Therefore, we have a question about whether PMCL can be used as an OTC medication or not. This review aimed to summarize the antimicrobial activity, facts behind it, possible action mechanisms, and causes of resistance growth, along with the antimicrobial and toxicological impacts of its metabolites, derived products, and combination products, on the basis of database reports. Numerous pieces of evidence suggest that both PMCL and caffeine have broad-spectrum antimicrobial effects. PMCL is evidently effective against gram-positive and gram-negative bacteria, fungi, viruses, and protozoa. Its major toxic metabolite, *N*-acetyl-p-benzoquinone imine (NAPQI), also has antimicrobial potential. Despite its antimicrobial effects, PMCL has contributed to antimicrobial resistance. In conclusion, according to the findings from database reports, PMCL is not only an analgesic-antipyretic drug, but it also has broad-spectrum antimicrobial potential against many pathogenic gram-positive and gram-negative bacteria and fungi as well as some viruses and protozoa. The use of PMCL as an OTC medication might bring a dangerous health issue in the future among the population, for example, growing microbial resistance and harmful toxicological impacts in different organs in humans.

1. Introduction

Paracetamol (recognized in this article as PMCL) is a popular and frequently used antipyretic-analgesic drug worldwide. Joseph von Mering synthesized PMCL in 1893, later recognized for its antipyretic and analgesic properties and marketed as the OTC drug acetaminophen (1955) in the U.S. and paracetamol (1956) in the U.K. as an aspirin alternative [1]. PMCL is primarily used as an alternative to non-steroidal anti-inflammatory drugs (NSAIDs) for headaches, fevers, bronchial asthma, peptic ulcers, hemophilia, salicylate sensitivity, children under 12, and pregnant or breastfeeding women and as a first-line treatment for osteoarthritis pain. Besides these, PMCL is used in mild migraine, dental and other post-surgical pain, low back pain, cancer pain, neuropathic pain, musculoskeletal pain, procedural pain in newborn babies, peripheral pain, ductal closure in the patent ductus arteriosus, and so on. PMCL's mechanism of action involves inhibiting cyclooxygenase enzymes (COX-1 and COX-2) in both the peripheral and central nervous systems, reducing prostaglandin synthesis at low concentrations of arachidonic acid and peroxides, with a preference for COX-2. It exerts anti-inflammatory effects via COX inhibition in the CNS and acts as an antinociceptive through a "redox" mechanism. Its active metabolite, N-arachidonoylphenolamine (AM404), is a weak agonist of cannabinoid receptors CB1 and CB2, inhibits the endocannabinoid transporter, and

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RESEARCH

Succinic acid enhances sedative activity of diazepam through GABAergic receptor modulation: Evidence from behavioral approach and computational insights

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Abstract

Insomnia, a widespread neurological condition, is often managed with diazepam (DZP), a gamma-aminobutyric acid A ($GABA_A$) receptor agonist, though prolonged use raises concerns about dependence and cognitive impairment. This study investigated the sedative and locomotor-suppressive effects of succinic acid (SUC), alone and in combination with DZP, supported by behavioral and computational analyses. *Swiss* albino mice were treated intraperitoneally (i.p.) with SUC (5, 10, 15 mg/kg), DZP (2 mg/kg), and their combination (SUC 10 + DZP 2 mg/kg), followed by thiopental sodium (TS)-induced sleep and locomotor activity tests. SUC significantly reduced sleep latency and extended sleep duration in a dose-dependent manner, with the combination group showing the most potent synergistic effect (sleep duration: 185.14 ± 2.73 min). In the open-field and light–dark tests, SUC suppressed locomotor activity and enhanced dark residence time (DRT), further confirming central nervous system (CNS) depressant effects. In silico docking to the $GABA_A$ receptor (PDB: 6X3X) revealed that SUC, despite having lower binding affinity (–4.1 kcal/mol) than DZP (–8.4 kcal/mol), formed more hydrogen bonds with key residues, suggesting stable and supportive receptor engagement. Pharmacokinetic (PK) profiling showed SUC is highly water-soluble, moderately absorbed (71.75%), poorly blood–brain barrier (BBB)-penetrant, and exhibits low toxicity (lethal dose 50 (LD_{50}) = 2260 mg/kg). These findings support SUC's potential as a safe, effective sedative agent, capable of enhancing DZP efficacy while possibly reducing its side effects. Future directions include exploring SUC derivatives with better brain penetration and validating these effects in clinical models.

Keywords $GABA_A$ receptor modulation · GABAergic pathway · Pharmacokinetic profiling · Succinic acid · Synergistic sedation

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Assessment of sedative activity of Chrysin: Behavioral approach with pharmacokinetics, toxicological profile and molecular docking

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ARTICLE INFO

Keywords:
Insomnia
Chrysin
$GABA_A$ receptor
Pharmacokinetics
Molecular docking

ABSTRACT

The purpose of this study was to investigate the sedative effects of Chrysin (CHR) along with modulatory effects on diazepam (DZP) and flumazenil (FLU) in an animal sleep model produced by thiopental sodium (TS). Additionally, we explored the pharmacokinetics and potential $GABA_A$ receptor interactions of CHR through computational studies. Swiss albino mice were treated with intraperitoneal administration of CHR (5 and 10 mg/kg), DZP (2 mg/kg), and FLU (0.1 mg/kg) either alone or in combination. Sleeping onset and duration were measured following TS administration. Molecular docking was performed to investigate CHR's binding affinity with $GABA_A$ (PDB: 6X3X) receptors. Results found that CHR significantly ($p < 0.05$) reduced sleep latency and increased sleep duration in a dose-dependent manner compared to the control group. The highest dose (CHR-10) exhibited the most potent significant sedative effect with onset (11.57 ± 1.74 min) and duration (172.86 ± 7.37 min). Combination therapy of CHR-10 with DZP resulted in synergistic effects, further enhancing sleep duration. In molecular docking, CHR demonstrated a higher binding affinity (−8.9 kcal/mol) for $GABA_A$ receptors compared to DZP (−8.7 kcal/mol) and FLU (−6.6 kcal/mol). CHR also showed favorable pharmacokinetic properties with high intestinal absorption and low toxicity. CHR exhibits promising sedative activity, with the potential to enhance the effects of traditional sedatives like DZP. However, further research, including clinical trials and detailed mechanistic studies, is warranted to explore its full therapeutic potential.

1. Introduction

Insomnia is a condition of impaired daytime functioning due to difficulty in falling or staying asleep, despite being in a conducive sleep environment [1]. Various factors are connected with an increased possibility of insomnia, which includes severe stress and environmental changes [2]. About 60–80 % of depressed individuals in the general population experience sleeplessness as a contributing factor to their depression [3]. Due to the devastating impact of COVID-19 statewide, people have been dealing with a variety of insomniac issues in recent years [4]. In addition, a number of other conditions, such as somatic disorders, sexual dysfunction, hypertension, type 2 diabetes, acute myocardial infarction, and schizophrenia, can cause insomnia [5]. A few factors that contribute to insomnia are the existence of long-term conditions including cancer, sense organ diseases, respiratory diseases, heart disease, stressful situations in life, and elevated levels of anxiety and sadness [6]; [7].

A key inhibitory neurotransmitter in the brain, gamma-aminobutyric

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Shikonin enhances hypnotic effect and synergistic properties of diazepam, possibly through GABAergic interaction pathway: In vivo and in silico studies

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Keywords:
Computational study
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ABSTRACT

Introduction: Shikonin is a natural naphthoquinone from Lithospermum erythrorhizon with diverse pharmacological activities, including neuroprotective, anti-inflammatory, and hypnotic effects.
Methods: The current study was focused on investigating the hypnotic effect and combination characteristics of shikonin with diazepam through in vivo and in silico studies. Swiss albino mice received shikonin (SKN-10 and SKN-20 mg/kg), diazepam (DZP-2 mg/kg) as a positive control, and a vehicle as a negative control (NC). Two combinations of SKN-10 and SKN-20 with DZP-2 were also administered before thiopental sodium-induced sleep to assess hypnosis and sedation. Different computational tools were utilized for molecular interaction and pharmacokinetics.
Results: In vivo study demonstrated that shikonin significantly ($p < 0.05$) increased sleep duration and reduced sleep latency in animals compared to the NC group. In addition to combination therapy, SKN-10 significantly enhanced the effect of diazepam compared to DZP-2 + SKN-20, resulting in the longest sleep duration and shortest latency, indicating the strongest hypnotic effects compared to the other groups. Moreover, molecular docking indicated that the shikonin showed strong binding affinity (BA) (−8.9 kcal/mol) compared to diazepam for the $GABA_A$ receptor.
Conclusion: In summary, shikonin showed significant hypnotic and synergistic effects along with diazepam. Acute toxicity studies showed shikonin caused no behavioral changes, toxicity, or mortality in mice up to 20 mg/kg, suggesting a high safety margin, with the oral LD_{50} likely exceeding 1g/kg. Future research should explore shikonin's long-term effects, safety, and optimal dosage, particularly in clinical settings. In vitro studies on $GABA_A$ interactions, combination therapy with diazepam, and cognitive, behavioral, and toxicity assessments are crucial for its safe use in CNS disorders.

Abbreviations: AA, Amino Acid; BBB, Blood-Brain Barrier; BA, Binding affinity; DW, Distilled Water; ER, Endoplasmic Reticulum; SKN, Shikonin; DZP, Diazepam; NC, Negative Control; GABA, Gamma-Aminobutyric Acid; CNS, Central Nervous System; b.w., Body Weight; i.p., Intraperitoneal.

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Assessment of clot-lysing and membrane-stabilizing capacity of ascorbic acid: *In vitro* approach with molecular docking

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ARTICLE INFO

Keywords:
Ascorbic acid
Cyclooxygenase-1
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ABSTRACT

This study aimed to evaluate the clot-lysing and membrane stabilizing capacities of ascorbic acid (AA) using *in vitro* and *in silico* methods. For this, we used *in vitro* clot lysis and hemolyzing tests to check the anti-atherothrombosis and membrane-stabilizing properties of AA, respectively. Additionally, molecular docking studies were performed to investigate AA's interactions with cyclooxygenase-1 (COX-1) and plasminogen enzymes. Findings suggest that AA exhibited a concentration-dependent effect, with 43.95 ± 1.27 % clot lysis and 64.46 ± 0.01 % membrane stabilization at 100 μg/mL. The IC_{50} values for clot lysis and membrane stabilization were 215.19 ± 1.09 and 57.21 ± 2.11 μg/mL, respectively. *In silico* analysis showed strong binding affinities of AA with COX-1 (−6.2 kcal/mol) and plasminogen (−5.8 kcal/mol), supporting its observed clot lysis and membrane protection activities. Taken together, AA showed moderate clot-lysing and robust membrane-stabilizing effects, which may be due to its strong antioxidant and anti-inflammatory properties. AA might be a good therapeutic agent for atherothrombosis and membrane damage, highlighting the need for further investigation into its underlying molecular mechanisms and potential clinical applications. AA shows promising clot-lysing and membrane-stabilizing effects, highlighting its therapeutic potential for atherothrombosis and membrane damage.

1. Introduction

Atherothrombosis is a significant and escalating global health concern that serves as a primary cause of cardiovascular diseases, such as coronary artery disease, stroke, and peripheral arterial disease [43]. This condition arises when thrombi develop at sites of ruptured or eroded atherosclerotic plaques [5]. Cardiovascular diseases account for approximately 17.9 million deaths annually, establishing them as the leading cause of death worldwide [26]. Key risk factors for atherothrombosis include hypertension, diabetes, dyslipidemia, and smoking [52]. Thrombolysis is a medical therapy designed to dissolve dangerous blood clots, improve circulation, and protect vital organs and tissues

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REVIEW ARTICLE

Unveiling the anticancer potential of Pinostrobin: mechanisms of action, pharmacokinetic insights, and therapeutic prospects

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Abstract

Pinostrobin (PIN), a natural flavonoid found in *Boesenbergia rotunda*, *Alpinia zerumbet*, and other botanicals, has shown promising anticancer potential due to its multitargeted mechanisms and favorable safety profile. This review consolidates current evidence on PIN's anticancer properties, focusing on its molecular mechanisms, pharmacokinetics (PKs), and therapeutic potential. A systematic literature search was conducted using PubMed, Scopus, ScienceDirect, and Google Scholar to identify preclinical studies on PIN's bioactivity, PK, and toxicity. PIN exerts potent anticancer effects by inducing ROS-mediated apoptosis, cell cycle arrest via p21 upregulation and cyclin D1 suppression, and reducing proliferation and inducing cytotoxicity. It also inhibits metastasis by targeting migration, adhesion, and angiogenesis. PK data reveal good intestinal absorption and metabolic transformation primarily, although limited solubility and brain penetration remain challenges. Toxicity studies show no adverse effects at therapeutic doses ($\leq$100 mg/kg), with selective cytotoxicity against cancer cells and protective antioxidant effects in normal tissues. Beyond oncology, PIN also exhibits several pharmacological properties. PIN's ability to target key cancer pathways, along with its low toxicity and broad pharmacological potential, makes it a strong candidate for adjuvant therapy. The novelty of this study is its integrated analysis of PIN's anticancer mechanisms, PK, and safety, along with proposed strategies to bridge the gap toward clinical application. Clinical trials remain essential to confirm its efficacy.

Keywords Anticancer mechanisms · Apoptosis · Natural flavonoids · Pinostrobin

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Anticancer activity of *Nigella sativa* and its bioactive compounds: An update

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Keywords:
Nigella sativa
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Cytotoxic

ABSTRACT

Nigella sativa (black cumin) is a widely recognized medicinal plant in traditional medicine, and its seeds and seed oil are used in the treatment of various diseases. This plant and its bioactive compounds exhibit numerous biological activities such as anti-diabetic, anticancer, antimicrobial, and anti-inflammatory, among others. *N. sativa* contains many bioactive compounds, including important antineoplastic agents such as thymoquinone, α-hederin, carvacrol, and thymol. This review focuses on and discusses the medicinal and health-promoting effects of *N. sativa and* covers the recent developments that deal with the anticancer activity of this medicinal plant and its bioactive compounds, with an emphasis on the mechanism of action. The findings demonstrated that the preventive effect of *N. sativa*and its bioactive phytochemicals are associated with its ability to decrease inflammation and exert immune-enhancing actions. The plant and its phytochemicals also enhance natural killer (NK) cell cytotoxicity, apoptotic effects on carcinoma cells, and control signal transduction pathways including caspases, p53, ROS, AMPK/mTOR, NF-κB, JAK2/STAT3, and PI3K/Akt in suppressing cancer and tumorigenesis. However, this suggests the use of the plant as a chemotherapeutic agent and further clinical assessment of the bioactive phytochemicals to establish a reliable anticancer drug.

1. Introduction

Cancer has dramatically increased in recent decades. This is likely due to our dynamic survival lifestyles, habits, and accumulated longevity [1]. Asian countries register over eleven large integer new cases of cancer each year, whereas this figure is on top of fourteen million worldwide [2]. Cancer, considered the second most common cause of death worldwide, is surpassed only by cardiovascular diseases. It is characterized by unregulated cell multiplication and loss of cell death, producing tumors alongside abnormal cell masses. Additionally, cancer is the result of damage or mutations within a cell's genetic material due to environmental or genetic factors [3,4]. The cell cycle is deranged, and irregular or injured cells can develop, proliferate, and form clumps of tissue (tumors) [5]. Cancerous tumors easily metastasize to the surrounding tissue and also affect the remote parts and organs of the body, which is known as metastasis. Cancerous tumors are also termed malignant tumors. Although several cancers create solid lumps, hematologic malignancies, including blood cancer, generally do not

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Allium cepa bioactive phytochemicals as potent ALK (Anaplastic lymphoma kinase) inhibitors and therapeutic agents against non-small cell lung cancer (NSCLC): A computational study

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ABSTRACT

Anaplastic lymphoma kinase (ALK) inhibitors go after and stop the ALK protein, which is very important for cancer growth, especially in ALK-positive cancers like non-small cell lung cancer (NSCLC). Lung cancer, particularly ALK-positive NSCLC prone to metastasis, is treated with ALK inhibitors targeting the cancer-driving ALK protein. This study explored the potential of onion (*Allium cepa*) phytochemicals as inhibitors of ALK for NSCLC treatment using computational methods. The *in silico* study evaluated the binding affinity of all phytochemicals of *A. cepa* and also predicted pharmacokinetics, ADMET parameters, drug-likeness, anti-carcinogenic properties, and acute toxicity prediction to find reliable and safe ALK inhibitor agents for the treatment of NSCLC. The findings revealed that three phytochemicals, fisetin, quercetin, and tricetin demonstrated promising results with favorable drug-likeness profiles and strong binding affinities for the ALK receptors. Specifically, their binding affinities were –7.6, –7.7, and –7.8 kcal/mol for the 4ANQ receptor; –7.6, –7.6, and –8.0 kcal/mol for the 4ANS receptor, and –7.7, –7.6, and –7.7 kcal/mol for the 6MX8 receptor, respectively. Additionally, these compounds showed hydrogen bond formation, which is crucial for drug discovery against ALK and is comparable to the known ALK inhibitors crizotinib and alectinib. These findings also suggest their potential as therapeutic agents. Further, *in vitro* and *in vivo* studies are warranted to validate these results and elucidate their mechanisms of action. This study highlights the potential of natural compounds from *A. cepa* for the development of novel NSCLC therapies.

1. Introduction

Cancer refers to the unregulated development and dispersion of abnormal cells in the body [58]. NSCLC is a kind of lung cancer distinguished by slower-growing, bigger cells as opposed to small cell lung cancer [65]. In 2020, 19.3 million new instances of cancer and nearly 10 million deaths were reported worldwide, with lung cancer being the main cause of cancer deaths and NSCLC accounting for 85 % of the 2.2 million lung cancer cases, illustrating cancer's devastating global impact [46]. Cancer develops as a result of genetic abnormalities produced by lifestyle choices, exposure to pollutants, infections, and hereditary predisposition, which result in unregulated cell expansion and division [53]. These mutations cause malignant tumors that infiltrate surrounding tissues and spread to other regions of the body via metastasis [41]. ALK aids cancer cell formation through genetic changes like mutations, amplifications, or rearrangements, resulting in abnormal

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Anticancer activity of reserpine: A comprehensive review of mechanisms, chemistry and botanical sources

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Keywords:
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ABSTRACT

Reserpine (RSP), an alkaloid derived from *Rauvolfia* species. It is a well-established antipsychotic and antihypertensive drug which has demonstrated promising anticancer properties across various studies. This study aims to provide a short, comprehensive overview of RSP's anticancer properties. A literature review was conducted, searching database, such as PubMed, Springer Link, Scopus up to February 15, 2025. The review included studies that reported RSP's activity on various *in vitro* cancer cell lines and in vivo models, excluding those with data duplication or lacking full text. RSP demonstrated potent anticancer activity across multiple cancer types, such as lung, breast, prostate, and skin cancers, through mechanisms like increased reactive oxygen species (ROS) generation, apoptosis induction, and inhibition of DNA synthesis. These findings suggest RSP's potential as an anticancer agent, though further research is needed to fully understand its therapeutic capabilities.

1. Introduction

Cancer is a condition where malignant cells divide uncontrollably, invading tissues and potentially spreading to other parts of the body [1,2]. It is one of the major problems in the modern world as well as in third-world countries [3]. According to the American Cancer Society (ACS), 20 million new cancer cases were found in 2022, which is expected to rise to 35 million in 2050. The death toll in 2022 rose to 9.7 million [4]. Cancer can be caused by genetic mutations (both inherited and acquired), numerous environmental factors, lifestyle factors, or some microbial infections [5,6]. Cancer development involves several mechanisms, including DNA damage, genomic instability, cell cycle dysregulation, a tumor-promoting microenvironment, and metastasis, which enables the spread of cancer cells [7].

Traditional cancer treatments, including surgery, chemotherapy, radiation therapy, and targeted therapy, have several limitations. Surgery is invasive and can lead to significant recovery times and complications [8]. Chemotherapy causes severe side effects such as nausea, fatigue, and hair loss, and cancer cells can develop resistance to the drugs [9,10]. Radiation therapy can damage nearby healthy tissues, causing skin irritation and long-term organ damage [11]. Immunotherapy can cause the immune system to attack healthy cells, leading to autoimmune reactions, and its effectiveness can vary widely among patients [12]. Stem cell transplant is a complex and risky procedure that can lead to complications such as infections and graft-versus-host disease, and it is also expensive and requires a long recovery period [13]. This is why we need to develop a new anticancer drug.

Since ancient times, natural products have been used to treat various diseases [14,15]. In modern times, natural sources such as plants and animals are also utilized to isolate various bioactive compounds that show potential as therapeutic agents for a range of diseases [16] [17]. For example, Taxus brevifolia bark contains paclitaxel, which showed anticancer activity against ovarian, breast, and lung cancer [18]. Furthermore, Catharanthus roseus contains vincristine and vinblastine, which are used to treat cancers such as leukemia and Hodgkin's lymphoma [19]. RSP is an alkaloid having a molecular formula of $C_{33}H_{40}N_2O_9$ and is extracted from certain species of the tropical plant Rauvolfia, particularly Rauvolfia serpentina (Indian snakeroot) and Rauvolfia vomitoria [20]. It is traditionally used to treat snake bites, hypertension, insomnia, etc. RSP exhibited various pharmacological

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Anticancer activity of *Abelmoschus esculentus* (L.) Moench against lung cancer cell: A literature review

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ABSTRACT

Abelmoschus esculentus L. Moench (okra), a member of the Malvaceae family, is gaining recognition for its potential as a natural anticancer agent due to its diverse bioactive constituents, including flavonoids, polysaccharides, and polyphenols. This review investigates its therapeutic potential in lung cancer prevention and treatment. A systematic literature search was conducted using databases such as Google Scholar, PubMed and Web of Science to identify studies published between 2000 and 2025. The inclusion criteria focused on research examining the effects of *A. esculentus* extracts on lung cancer cell lines, particularly A549, emphasizing on apoptosis and antiproliferative activities. Results demonstrate strong cytotoxic effects, with IC_{50} values as low as 1.74 μg/mL for flower extract, while bioactive compounds such as quercetin derivatives effectively inhibit proliferation and induce apoptosis. Despite these promising preclinical outcomes, the exploration of *A. esculentus* in cancer therapy is still in its early stages, with limited clinical data. These findings suggest its potential as an adjunct therapy, providing enhanced outcomes with minimal toxicity. However, further clinical trials are needed to confirm its therapeutic efficacy and safety in humans.

1. Introduction

Cancer refers to a collection of diseases marked by the unchecked growth and proliferation of abnormal cells that can spread throughout the body [1] and invasion (destruction of adjacent tissues) [2]. Lung cancer is among the most commonly diagnosed cancers and remains the leading cause of cancer-related deaths globally [3]. In 2020, approximately 2.2 million new cases of lung cancer were diagnosed, and 1.8 million deaths were attributed to the disease [4]. Projections for lung cancer deaths up to 2040 were made based on demographic trends, considering scenarios of annually rising, stable, or declining rates compared to the baseline year of 2020 [5].

Tobacco smoking plays a major role in causing lung cancer [6]. Lung cancer risk and death are also increased by other tobacco products, including pipes, cigars, and water pipes (like hookahs) [7]. However, other factors such as exposure to physical carcinogens including ultraviolet (UV) and ionizing radiation, biological agents like aflatoxins, and environmental or occupational exposure to heavy metals (e.g., arsenic, cadmium, chromium, and nickel) also contribute significantly to lung cancer development [8,9]. Radon exposure is considered the most common cause of lung cancer [10]. Air pollution is considered a major risk factor for lung cancer [11]. There is a vast correlation between lung cancer and Chronic Obstructive Pulmonary Disease (COPD). COP may contribute to the development of lung cancer [12]. Other correlated

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Anticancer activity of lignan compounds against breast cancer proteins (BRCA1 and BRCA2): A computational approach

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ABSTRACT

Breast cancer is a major global health concern, with breast cancer gene 1 (BRCA1) and BRCA2 mutations playing a key role in its development. This study used a computational approach to assess the potential of 24 lignan compounds, selected for their recent anticancer activity, as inhibitors of BRCA1 and BRCA2. Molecular docking was conducted to evaluate their binding affinities and interactions with the target proteins, using 5-fluorouracil (5FL) as a reference. Additionally, prediction of Activity Spectra for Substances (PASS) prediction, toxicity, and pharmacokinetics predictions were performed. Findings revealed that hydnocarpin (HCN), silibinin (SBN), and silicristin (SCN) exhibited the strongest binding affinities of –7.7, –7.4, and –7.7 kcal/mol against BRCA1, respectively, and –8.9, –8.4, and –8.5 kcal/mol against BRCA2. These compounds demonstrated stable interactions through hydrogen bonds (HBs) and hydrophobic interactions with critical amino acid residues. PASS predictions revealed high anticancer potential for HCN, SBN, and SCN with P_a values of 0.877, 0.704, and 0.763, respectively, indicating their promise as anticancer agents. Additionally, toxicity and pharmacokinetics predictions further confirmed their safety profiles, with HCN, SBN, and SCN showing no carcinogenic, mutagenic, or hepatotoxic effects and satisfying drug-likeness criteria. In conclusion, HCN, SBN, and SCN show promising inhibitory potential against BRCA1 and BRCA2 proteins and represent viable candidates for breast cancer management. Future work should focus on validating these findings through *in vitro* and *in vivo* models, elucidating the precise mechanisms of action, and exploring formulation strategies to enhance bioavailability and clinical applicability.

1. Introduction

Breast cancer is one of the most prevalent tumors endangering women's health globally, with its incidence steadily increasing over recent decades [1]. In 2022, an estimated 2.3 million women worldwide were diagnosed with breast cancer, and tragically, the disease claimed the lives of approximately 670,000 women across the globe (https://www.who.int/news-room/fact-sheets/detail/breast-cancer).

Breast cancer arises from a mix of genetic, hormonal, and environmental influences [2]. A woman's personal risk of developing breast cancer is elevated if she has a family history of the disease [3]. Again, an early onset of menstruation, a late onset of menopause, never having given birth, and delaying the first childbirth all slightly, but consistently, raise the risk [3]. There is a positive correlation between height and postmenopausal BMI (body mass index) and the occurrence of breast cancer, particularly in Western countries [4]. Hormonal imbalances,

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Sedative potential of palmatine chloride in thiopental sodium-induced chicks: evidence from in vivo and in Silico studies

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The aim of this study is to assess the sedative impact of palmatine chloride (PME) in thiopental sodium-induced sleeping chicks and its underlying molecular mechanism by using in vivo and in silico approaches. Chicks received PME per orally (p.o.) at doses of 1.25, 2.5, and 5 mg/kg per body weight (b.w.), while diazepam (DZP) (2 mg/kg) served as a positive control and vehicle as a negative control. For the purpose of evaluating the experimental compounds synergistic or antagonistic effects, a combination of PME and DZP was administered to the chicks. After thirty minutes, thiopental sodium (40 mg/kg, intraperitoneal (i.p.)) was administered to induce sleep, and latency to sleep onset and sleep duration were measured. In vivo results showed that PME reduced sleep latency and prolonged sleep duration in a dose-dependent manner, with the combination therapy producing a significant enhancement of these effects. In silico docking revealed PME binding to gamma-aminobutyric acid A ($GABA_A$) receptor α1 and β2 subunits (–7.2 kcal/mol) with shared amino acids. Pharmacokinetic and toxicity analyses suggested favorable drug-like properties. These results indicate PME's sedative potential, alone or with DZP, likely via GABAergic modulation, warranting further functional validation.

Keywords $GABA_A$ receptor, In silico, Insomnia, Palmatine, Thiopental sodium

Insomnia, characterized by persistent difficulty in initiating or maintaining sleep, is one of the most prevalent neurological disorders worldwide, impairing cognitive performance, emotional stability, and overall quality of life[1,2]. The neurobiology of sleep regulation is strongly governed by the GABA system, the principal inhibitory neurotransmitter pathway in the central nervous system. Within this network, the $GABA_A$ receptor plays a pivotal role, serving as the major molecular target of sedative-hypnotic drugs[3,4].

Currently available therapies, including benzodiazepines, barbiturates, and related agents, are effective but remain clinically constrained by rapid tolerance, dependence, and severe adverse reactions such as psychomotor impairment, cardiovascular complications, and cognitive deficits[5,6]. These limitations underscore the necessity of identifying safer, mechanism-based alternatives.

Natural products continue to represent a powerful source of therapeutic innovation, offering structurally diverse molecules with central nervous system activity. Phytochemicals such as flavonoids, terpenes, and alkaloids have demonstrated the capacity to modulate GABAergic transmission, thereby exerting anxiolytic and sedative effects[7,8]. Among them, palmatine chloride (PME), a protoberberine isoquinoline alkaloid, has attracted growing attention. PME is a quaternary ammonium salt form of palmatine that exhibits superior solubility and stability, making it more suitable for pharmacological evaluation than the free base[9,10]. In addition to its wide

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Review Article

Therapeutic Efficacy of Quercetin and Its Nanoformulation Both the Mono- or Combination Therapies in the Management of Cancer: An Update with Molecular Mechanisms

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Quercetin, a major representative of the flavonol subclass found abundantly in almost all edible vegetables and fruits, showed remarkable therapeutic properties and was beneficial in numerous degenerative diseases by preventing lipid peroxidation. Quercetin is beneficial in different diseases, such as atherosclerosis and chronic inflammation. This study aims to find out the anticancer activities of quercetin and to determine different mechanisms and pathways which are responsible for the anticancer effect. It also revealed the biopharmaceutical, toxicological characteristics, and clinical utilization of quercetin to evaluate its suitability for further investigations as a reliable anticancer drug. All of the relevant data concerning this compound with cancer was collected using different scientific search engines, including PubMed, Springer Link, Wiley Online, Web of Science, SciFinder, ScienceDirect, and Google Scholar. This review demonstrated that quercetin showed strong anticancer properties, including apoptosis, inhibition of cell proliferation, autophagy, cell cycle arrest, inhibition of angiogenesis, and inhibition of invasion and migration against various types of cancer. Findings also revealed that quercetin could significantly moderate and regulate different pathways, including PI3K/AKT-mTORC1 pathway, JAK/STAT signaling system, MAPK signaling pathway, MMP signaling pathway, NF-κB pathway, and p-Camk2/p-DRP1 pathway. However, this study found that quercetin showed poor oral bioavailability due to reduced absorption; this limitation is overcome by applying nanotechnology (nanoformulation of quercetin). Moreover, different investigations revealed that quercetin expressed no toxic effect in the investigated subjects. Based on the view of these findings, it is demonstrated that quercetin might be considered a reliable chemotherapeutic drug candidate in the treatment of different cancers. However, more clinical studies are suggested to establish the proper therapeutic efficacy, safety, and human dose.

1. Introduction

Cancer refers to the condition when tumor cells can proliferate and invade other tissues around the tumor cell by halting tumor-suppressing genes and upregulating oncogenes, genomic instability, and intracellular signaling cascades [1]. Cancer is a significant global health burden. Cancer is the second leading cause of death in many nations,

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Research article

Anxiogenic-*like* effects of coumarin, possibly through the GABAkine interaction pathway: Animal studies with *in silico* approaches

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ABSTRACT

Background: Anxiety disorder is the most common mental illness and a major contributor to impairment. Thus, there is an urgent need to find novel lead compounds to mitigate anxiety. It is widely recognized that the neurobiology of anxiety-related behavior involves GABAergic systems.
Objectives: This research aimed to examine the anxiogenic action of coumarin (CMN), a natural benzopyrone derived from plants, and determine its underlying mechanism through *in vivo* and *in silico* investigations.
Methods: This was accomplished by using a variety of behavioral procedures, including open field, swing, hole cross, and light-dark tests, on male and female *Swiss* albino mice that had been orally administered three experimental doses of CMN (1, 2, and 4 mg/kg). The CMN group was also examined with the $GABA_A$ receptor agonist diazepam (DZP, 2 mg/kg) and flumazenil antagonist (FLU, 0.1 mg/kg). Furthermore, CMN and standards were subjected to a molecular docking analysis to determine their binding affinities for the $GABA_A$ receptor subunits (α1, α4, β2, γ2, and δ). Several software programs were used to visualize the ligand-receptor interaction and analyze the pharmacokinetic profile.
Results: Compared to typical treatments, our results show that CMN (1 mg/kg) significantly ($p < 0.05$) increases the locomotor activity of animals. Furthermore, CMN exerted the highest binding affinity (−6.5 kcal/mol) with the GABA-α1 receptor compared to conventional DZP. Along with FLU, CMN displayed several hydrophobic and hydrogen bonds with $GABA_A$ receptor subunits. The pharmacokinetic and drug-*like* properties of CMN are also remarkable. In animal studies, CMN worked synergistically with FLU to provide anxiogenic-like effects.
Conclusion: We conclude that, based on *in vivo* and *in silico* data, CMN, alone or in combination with FLU, may be employed in future neurological clinical studies. However, further research is needed to confirm this behavioral activity and elucidate the possible mechanism of action.

1. Introduction

A class of very typical, persistent, and concurrent conditions known as anxiety disorders represent the ninth most predominant medical cause of disability worldwide [1]. Some of them include phobias, generalized anxiety disorder (GAD), selective mutism, separation anxiety disorder, panic attacks, social anxiety disorder, and anxiety that are not traditionally identified [2]. These widespread psychological disorders affect a person's cognitive, mood, and behavior patterns [3]. Based on US data gathered between 2001 and 2002, the average lifelong prevalence of anxiety disorders in adults was 40.4 % for women and 26.4 % for men [4]. They are the most severe mental health conditions,

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Assessment of clot-lysing and membrane-stabilizing activity of gallic acid through cyclooxygenase-1 and plasminogen interaction pathways

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ABSTRACT

Gallic acid (GA) is evident to inhibit the platelet activation process, which plays an important role in preventing and activating blood clots and clot lysis. Moreover, GA has antioxidant, anti-inflammatory, and membrane-protecting capacities. The purpose of this investigation is to determine the clot-lysing and membrane-protecting capacity of GA using *in vitro* and *in silico* approaches. For this, we used an *in vitro* clot lysis and hemolyzing test to check its anti-atherothrombosis and membrane-stabilizing properties, respectively. Additionally, docking inquiries were conducted against cyclooxygenase-1 (COX-1) and plasminogen enzymes. Results suggest that GA exhibited concentration-dependent clot-lysing and membrane-protecting potentials. The IC_{50} values for clot lysis and membrane stabilization were 136.17 ± 1.08 and 55.29 ± 1.09 μg/mL, respectively. It showed binding affinities with COX-1 (−6.8 kcal/mol) and plasminogen (−6.4 kcal/mol). Taken together, GA showed moderate clot-lysing and robust membrane-stabilizing effects, possibly through COX-1 and plasminogen interaction pathways. GA might be a good therapeutic agent for atherothrombosis and membrane damage, highlighting the need for additional researches into its underlying mechanisms in molecular level and potential clinical applications.

1. Introduction

Atherothrombosis is a situation characterized by the formation of a clot of blood on a rupture plaque of atherosclerosis within an artery, causing the restriction of blood flow (Badimon & Vilahur, 2014). The pathophysiology of cardiovascular diseases (CVDs) involved mechanisms like thrombosis, atherosclerosis, and oxidative stress-induced cellular damage, which contribute to severe conditions such as myocardial infarction, peripheral vascular disease, and stroke (Frąk et al., 2022; Jin & Kang, 2024). CVDs are the primary cause of death worldwide, accounting for approximately 31% of all fatalities, with an estimated 17.9 million deaths annually (Mendis et al., 2022; Jan et al., 2024). The prevalence of CVDs is exacerbated by lifestyle factors such as diabetes, smoking, poor diet, and physical inactivity, particularly in low- and middle-income countries (Bowry et al., 2015; Wurie & Cappuccio, 2012). Among the various strategies for managing and preventing CVDs, focusing on breaking down blood clots and protecting cells from oxidative damage is very important. Thrombolysis, the process of dissolving clots, is a vital therapy that improves circulation and safeguards essential organs and tissues (Murray et al., 2010). This process is

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RESEARCH ARTICLES

Chemical characterization and biological activity investigation of *Curculigo orchioides* Gaertn.

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Abstract
Curculigo orchioides Gaertn. is used in Ayurveda and Unani herbal medicines. Its rhizomes are sweet, cooling, aphrodiciac-viriligenic, diuretic, and tonic and are utilized in hemorrhoids, skin diseases, leucorrhoea, bronchitis, pruritis, and jaundice. The purpose of this study was to assess the preliminary phytochemical and pharmacological effects of the rhizome extracts of *C. orchioides*. For this, the dried rhizomes were extracted in ethanol, followed by fractionation with chloroform and n-hexane. All these fractions then underwent phytochemical screening and bioactivity investigation, including anti-bacterial, radical scavenging, anti-inflammatory, hypoglycemic, antidiarrheal, and anxiolytic activity using suitable in vitro and/or in vivo studies. Findings suggest that the plant rhizomes contain alkaloids, glycosides, steroids, saponins, tannins, gums, reducing sugar, flavonoids, and amides. The organic fractions of the plant inhibited tested bacteria within the zone of inhibition range 12.39 ± 0.67 and 15.61 ± 0.79 mm. The chloroform extract acted against all the test bacteria effectively. All the fractions showed significant concentration-dependent radical scavenging, protein denaturation inhibition, cytoprotective, and hypoglycemic, as well as significant dose-dependent antidiarrheal and anxiolytic effects. Ethanol extract showed a highest alpha-amylase inhibitory effect than the chloroform and n-hexane fractions. However, in other cases, the chloroform fraction exhibited better effects overall than the ethanol and n-hexane fractions. We suppose our observed bioactivities may link with the presence of important phytochemicals in *C. orchioides* rhizome extracts. Taken together, the *C. orchioides* rhizomes might be a good source of pharmacologically active lead compounds for oxidative stress and inflammatory diseases and disorders. Further studies are proposed to isolate its active principles and their mechanisms of action for each biological effect using in vivo studies.

Keywords *Curculigo orchioides* · Rhizome extracts · Phytochemical analysis · Bioactivity assessment

Introduction

Among the natural products, medicinal plants and their derivatives have supplied significant therapeutic compounds since ancient times (Lock et al. 2016). Studies suggest that plant-derived bioactives are readily available to almost all classes of people around the world, and these are also biocompatible (Wangensteen et al. 2015). To date, we have discovered approximately 25% of modern medicines from medicinal plants, which is considered significant

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CHEMISTRY & BIODIVERSITY

REVIEW

Therapeutic Efficacy Studies on the Monoterpenoid Hinokitiol in the Treatment of Different Types of Cancer

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Keywords: anticancer | hinokitiol | monoterpenoid | pharmacokinetics | toxicity

ABSTRACT

Hinokitiol (HK), a monoterpenoid that naturally occurs in plants belonging to the Cupressaceae family, possesses important biological activities, including an anticancer effect. This review summarizes its anticancer potential and draws possible molecular interventions. In addition, it evaluates the biopharmaceutical, toxicological properties, and clinical application of HK to establish its viability for future advancement as a dependable anticancer medication. The assessment is based on the most recent information available from various databases. Findings demonstrate that HK possesses substantial therapeutic advantages against diverse types of cancer (colon, cervical, breast, bone, endometrial, liver, prostate, oral, and skin) through various molecular mechanisms. HK induces oxidative stress, cytotoxicity, apoptosis, cell-cycle arrest at the G and S phases, and autophagy through modulation of phosphatidylinositol 3-kinase (PI3K)/Akt/mammalian target of rapamycin (mTOR), p38/ERK/MAPK, nuclear factor kappa B, and c-Jun N-terminal kinase signaling pathways. Furthermore, this compound exhibits good oral bioavailability with excellent plasma clearance. Clinical uses of HK demonstrate therapeutic advantages without any significant negative effects. A thorough study of the pertinent data suggests that HK may serve as a viable candidate for developing novel cancer therapies. Consequently, more extensive studies are necessary to evaluate its cancer treatment efficacy, safety, and possible long-term hazards.

1 | Introduction

Cancer is a disease characterized by uncontrolled cell growth, capable of invading organs and disrupting normal bodily processes [1]. It is a major cause of death and imposes a significant global health burden [2]. Each year, tens of millions are diagnosed with cancer, and over half of them die from the disease [3]. Cancer often results from gene mutations, radiation, smoking, and excessive alcohol consumption and is linked to chronic diseases associated with aging, such as chronic obstructive pulmonary disease (COPD), diabetes, heart disease, arthritis, and hypertension [4, 5]. Genetic mutations can disrupt regulators of cell division, apoptosis, and proliferation, leading to the development of oncogenes, which drive cancer progression by promoting cell

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RESEARCH

Assessments of protodioscin's antinociceptive and antidiarrheal properties: in vivo and in silico investigations on macromolecule binding affinity and modulatory effects

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Abstract
Protodioscin (PRO) is a furostanol saponin with antioxidant and anti-inflammatory properties. However, there is no proof against nociception and diarrhea. The study aims to investigate the antinociceptive and antidiarrheal effects of PRO, comparing its efficacy with diclofenac sodium (DFS) and loperamide (LOP) using in vivo and in silico methods. Antinociceptive activity was evaluated using the acetic acid-induced writhing and formalin-induced paw licking tests, and antidiarrheal effects were assessed via castor oil-induced diarrhea in mice. Mice were divided into groups receiving PRO (2.5 and 10 mg/kg, p.o.), DFS (25 mg/kg, p.o.), LOP (3 mg/kg, p.o.), or combinations. Molecular docking studies were conducted on COX-1, COX-2 enzymes, and the Mu-opioid receptor (MOR), with toxicity predictions performed for safety profiling. In vivo results demonstrated that PRO significantly ($p < 0.05$) reduced pain and diarrhea in animals. PRO at 10 mg/kg, showed comparable efficacy to DFS and LOP (25 and 3 mg/kg) in both models. Molecular docking revealed that PRO had stronger binding affinities with COX-1 (−10.0 kcal/mol), COX-2 (−9.6 kcal/mol) enzymes, and MOR (−7.7 kcal/mol) compared to standard drugs. Toxicity predictions indicate PRO is relatively safe in some toxicity parameters. PRO exhibits significant antinociceptive and antidiarrheal activities comparable to DFS and LOP, making it a promising natural alternative for managing pain and diarrhea. Additional clinical trials and pharmacokinetic assessments are required to evaluate its long-term safety for use.

Keywords Protodioscin · Natural product · Saponin · Antinociceptive · Antidiarrheal · In silico

Introduction

Pain is an unpleasant sensory and complex emotional experience arising from various sources such as injuries, surgery, chronic conditions like arthritis and cancer, and neurological disorders (Clauw et al. 2019; Raja et al. 2020). For example, a broken bone causes sharp pain from injury and swelling, while osteoarthritis leads to persistent pain from joint wear (Hoenig et al. 2022; Devor 2024). Nerve damage, like in diabetic neuropathy (Rosenberger et al. 2020), and autoimmune diseases, such as rheumatoid arthritis (Simon et al. 2021), also contribute to pain through inflammation or nerve issues. Globally, pain imposes a significant burden, affecting millions by reducing quality of life, impairing daily activities, and increasing healthcare costs (Lo et al. 2021). In particular, chronic pain is a leading cause of disability and loss of productivity (Carregaro et al. 2020). Chronic pain imposes a significant human and economic burden, impacting about 30% of the global population (Cohen et al. 2021).

Current pain treatments include non-steroidal anti-inflammatory drugs (NSAIDs) like diclofenac sodium (DFS), which help with pain and inflammation but can upset the stomach (Zádori et al. 2023). However, DFS showed several adverse effects, including gastrointestinal issues, cardiovascular risks, liver or kidney damage, allergic reactions, and bleeding disorders (El-Shafei and Saleh 2016; Simon and Evan Prince 2017; Bindu et al. 2020). On the other hand, opioids, such as morphine and oxycodone, are strong for severe pain but can be addictive and have side effects (Paul et al. 2021). Other medicines, such as amitriptyline and gabapentin, are used for certain kinds of pain, like nerve

Pompa Rani Ghosh and Md. Sakib Al Hasan contributed equally to this work.

Extended author information available on the last page of the article

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DRUG DEVELOPMENT RESEARCH

RESEARCH ARTICLE

Assessment of Antidiarrheal Effect of Oleuropein Through μ-Oopioid Receptor Interaction Pathway: In Vivo and in Silico Studies

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Keywords: μ-opioid receptor | antidiarrheal effect | oleuropein

ABSTRACT

Oleuropein (OLP), a compound predominantly found in olive leaves, has been known for its numerous biological activities, including antioxidant, anti-inflammatory, and antimicrobial properties. Despite its established therapeutic potential, its role in treating diarrhea has not been extensively explored. This study aimed to evaluate the antidiarrheal effects of OLP in an in vivo model and to investigate its molecular interactions using *in silico* docking studies, pharmacokinetic predictions, and toxicity analysis. In the in vivo study, castor oil was used to induce diarrhea in 3-day-old chicks, and the antidiarrheal effect of OLP was tested at doses of 10 and 20 mg/kg. The standard drug, loperamide (LOP) at 3 mg/kg, was used for comparison. The results showed that OLP at both doses significantly ($p < 0.05$) reduced diarrheal secretions and increased latency, with the 20 mg/kg dose demonstrating the most effective results. The combination of OLP (20 mg/kg) with LOP (3 mg/kg) further enhanced the antidiarrheal effect. In the *in silico* study, molecular docking revealed that both OLP and LOP exhibited strong binding affinities (BAs) to the key receptor, μ-opioid receptor associated with diarrhea, while OLP showed higher BA (−8.9 kcal/mol) compared to LOP (−8.7 kcal/mol). Pharmacokinetic analysis of OLP revealed favorable properties and toxicity studies revealed no acute toxicity, with an LD_{50} of 2000 mg/kg. In conclusion, the findings suggest that OLP possesses significant antidiarrheal potential both in vivo and through receptor interaction, positioning it as a promising natural therapeutic agent for managing diarrhea. Further studies are warranted to fully elucidate its mechanisms of action and clinical applicability.

1 | Introduction

The movement of loose stools and a rise in the frequency, weight, or amount of feces are known as diarrhea (Sokic-Milutinovic et al. 2022). Diarrhea is caused by infections from bacteria, viruses, or parasites, as well as food intolerances or medications (Yeung 2021). It is also caused by taking contaminated food and water (Siciliano et al. 2020). The main signs of diarrhea are

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ORIGINAL ARTICLE

Modulatory Anxiolytic Effect of Aucubin on Diazepam in Swiss Albino Mice: Possible Mechanisms Through *In Vivo* Approach with Receptor Binding Affinity

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Abstract

Aucubin is an iridoid glycosidic natural compound that is extracted from various plants, including *Aucuba japonica*, *Veronica persica*, and *Eucommia ulmoides*. This *in vivo* investigation was performed to evaluate the anxiolytic-*like* activity of aucubin on Swiss albino mice. For this, aucubin (2.5 and 5 mg/kg, *p.o.*) were ingested into the experimental animals, followed by various studies such as open field, swing, hole cross, and light–dark residence tests. In this research, diazepam served as a positive control, while the vehicle served as a negative control. In addition, a combination group (aucubin-5 + diazepam) was taken to determine the modulatory effect of aucubin on the standard drug diazepam. Furthermore, molecular docking was conducted to assess the binding intersection of aucubin and diazepam towards the α2 and α3 subunits of the $GABA_A$ receptor, liable for the anxiolytic effect. Different computational methods were used to visualize the interaction between the ligands and receptors. The outcome of our investigation suggests that aucubin decreases the locomotor activity of the animals when compared to the control group, resulting in a calming effect on their behaviors. Moreover, aucubin demonstrated the potent binding value (–6.5 kcal/mol) to the α3 subunit of the $GABA_A$ receptor via the formation of many hydrogen and hydrophobic interactions. Collectively, our results indicate that aucubin has a comparable impact on diazepam, and the molecule has an insignificant anxiolytic effect via interacting with the GABAergic system. We suggest conducting more clinical trials to establish the efficacy of aucubin as a dependable anxiolytic medication.

Keywords Neurological disorder · Neurotransmitter · Molecular docking · Pharmacokinetics

Dipu Bishwas and Rubel Hasan have equally contributed to the study.

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Antiemetic activity of Sesamol possibly through serotonergic and dopaminergic receptor interaction pathways: *In vivo* and *in silico* studies

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ARTICLE INFO

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In silico studies
Serotonin

ABSTRACT

Sesamol (SEL) is 3,4-methylenedioxyphenol isolated from sesame seeds. This study aimed to evaluate the antiemetic activity of SEL, supported by *in vivo* and *in silico* studies. Further, molecular docking was carried out to understand the molecular interaction between selected ligands and different receptors liable for mediating emesis. SEL (25 and 50 mg/kg) showed dose-dependent elevation in latency (133.20 ± 2.19 and 293.00 ± 5.27 s) and diminishment in the retching number (16.40 ± 1.15 and 9.40 ± 1.04 times), compared to control. Additionally, SEL can antagonize the activity of ondansetron (OND; 5 mg/kg) and domperidone (DOM; 7 mg/kg), resulting in a decrease in latency (256.00 ± 9.59 and 253.00 ± 2.79 s) and enhancing the number of retches (11.80 ± 0.82 and 12.60 ± 1.04) in combination rather than OND and DOM alone. An *in-silico* study showed SEL has moderate binding activity (−5.9 and − 5.7 kcal/mol) for serotonin ($5HT_3$) and dopaminergic (D_2) receptors, respectively, *via* hydrogen and hydrophobic bonds with specific amino acid residues.

1. Introduction

Emesis is defined clinically as the oral eradication of gastrointestinal substances due to constriction of the intestine and the muscles of the thoracoabdominal wall (Terregino et al., 2008). Emesis can be triggered by ingestion of toxic substances such as poisons, which activate sensory nerves that travel to brain medullary centers *via* sympathetic and vagal afferent pathways (Miller & Nonaka, 1992). Besides, toxin consumption, several other conditions can lead to emesis, such as allergic food, food poisoning, migraine, severe pain, motion sickness, morning sickness during pregnancy, and excessive use of marijuana (Bhuia, Islam, et al., 2023). Moreover, any emetic drug can affect the vestibular inputs in the lateral tegmental field and parabrachial nucleus in the gastrointestinal (GI) system, thereby causing emesis (Yates et al., 2014). Studies suggest that patients with symptoms of emesis have a very low quality of life in comparison to healthy people (Lacy et al., 2018). In children, emesis can be caused by numerous neurological disorders such as dysautonomia, epilepsy, and migraine (Raucci et al., 2020). Emesis can also be provoked by anticipatory or emotional causes (Molassiotis et al., 2016). There are many global burdens of emesis, as it is one of the most vital

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CNS Neuroscience & Therapeutics

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ORIGINAL ARTICLE OPEN ACCESS

Anxiolytic Activity of Morellic Acid: Modulation of Diazepam's Anxiolytic Effects, Possibly Through GABAergic Interventions

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Keywords: anxiety | GABAergic transmission | molecular docking | morellic acid | neuroprotective | xanthones 3

ABSTRACT

Background: Numerous studies suggest that morellic acid (MOR), highly available in Garcinia plants, has different physiological activities, including anti-cancer, anti-oxidant, and anti-microbial activity.

Aim: In this investigation, we aimed to demonstrate the anxiolytic activity, along with the mechanism behind this activity of MOR, using in vivo and *in silico* studies.

Methods: For this, we used different doses of MOR (5 and 10 mg/kg) and administered this drug intraperitoneally to *Swiss* albino mice (male and female). Diazepam (DZP), a positive allosteric modulator of the $GABA_A$ receptor, was used as a positive control at a dose of 2 mg/kg (i.p), and vehicle was used as a control group. In this test, various test protocols are used to assess the behavioral patterns of mice, including swing, hole cross, light–dark testing, and open field testing.

Results: This investigation revealed that MOR remarkably reduced the locomotor activity of mice in a dose-dependent manner and produced calming behaviors like DZP. However, the findings showed that the combination of MOR and DZP synergistically reduced the locomotion of mice compared to the single therapy. On the other hand, from the computational study, the result demonstrated that MOR exhibited the highest binding scores (−9.2 kcal/mol) towards the $GABA_A$ receptor α3 subunit and −7.6 kcal/mol towards the $GABA_A$ α2 receptor. Whereas, DZP showed −6.6 and −7.3 kcal/mol docking affinity and FLU exerted −6.2 and −6.3 kcal/mol docking scores towards the $GABA_A$ receptor α2 and α3 subunits, respectively. The ligand interacted with the receptor by forming different hydrogen and hydrophobic bonds.

Conclusion: However, it is recommended that more precise and comprehensive preclinical investigations be required to demonstrate the exact mechanism behind the anxiolytic effects and conduct clinical trials to determine efficacy and safety.

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Phytochemical screening and evaluation for the antioxidant and hypoglycemic effects of *Diospyros malabarica* (Desr.) Kostel root bark extracts

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ARTICLE INFO

Keywords:
Diospyros malabarica
Root bark extracts
Phytochemicals
Antioxidant potential
Hypoglycemic effect

ABSTRACT

Oxidative stress can trigger many diseases, including diabetes. This study investigated the phytochemical composition, antioxidant, and anti-diabetic activity of crude extracts of *Diospyros malabarica* root bark. Phytochemical analysis revealed saponins, tannins, glycosides, steroids, alkaloids, phenols, and flavonoids as major phytochemicals in the extracts. Antioxidant potentials of extracts were measured using *in vitro* total phenolic content, total flavonoid content, DPPH radical scavenging, and ferric reducing power assays. The anti-diabetic potential was measured by *in vitro* α-amylase inhibitory and *in vivo* oral glucose tolerance tests in mice. Findings suggest that hydroalcoholic extract (CHE) possessed a higher amount of phenolic and flavonoid contents together with substantial DPPH radical scavenging and ferric reducing capacity compared to other fractions. It also showed 29.59 ± 2.04 % of α-amylase inhibitory capacity at 2 mg/mL and reduced blood glucose by 59.04 ± 1.67 % at 120 minutes. In all cases, CHE exhibited better activities than the petroleum ether fraction (PEF), chloroform fraction (CHF), ethyl acetate fraction (EAF), and aqueous fraction (AQF) of the plant. Taken together, *Diospyros malabarica* root bark might be a good source of antioxidant and anti-diabetic phytoconstituents and may be useful for reducing oxidative stress and relevant complications, for example, diabetes.

1. Introduction

The ROS (reactive oxygen species), produced within the body due to metabolism and several biochemical processes, is responsible for causing oxidative stress. An imbalanced ROS production and ROS neutralization by the body's own antioxidant systems leads to a disproportion between oxidizing agents and their equilibrium, which is responsible for impairing important biological molecules like DNA, proteins, lipids, etc. [1]. ROS damage the unsaturated fats within cell membranes. This leads to lipid peroxidation, reduced membrane fluidity, loss of enzyme function, impaired receptor activity, and damage to the membrane protein, which ultimately leads to cell death [2]. Free radicals like hydroxyl, superoxide, and peroxyl radicals cause oxidative damage, which is believed to be a primary factor in the development of serious health conditions such as diabetes, neurodegenerative disease, cancer, and heart disease [3]. In some circumstances, the occurrence of diabetes has been attributed to a low level of antioxidant potential [4]. Insulin, a hormone produced by beta cells in the pancreas, helps regulate

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WILEY

ORIGINAL ARTICLE

trans-Ferulic Acid Antagonizes the Anti-Inflammatory Activity of Etoricoxib: Possible Interaction of COX-1 and NOS

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Keywords: cyclooxygenase activity inhibition | edema | inflammation | licking test | *trans*-ferulic acid (TFA)

ABSTRACT

This study emphasizes to investigate the modulatory activity of *trans*-ferulic acid (TFA) on anti-inflammatory activity of etoricoxib (ETO) and underlying mechanisms via formalin-induced licking and paw edema model and in silico study. Inflammation was induced by injecting formalin (50 μL) into the right hind paw of mice. The animals were treated with different doses of TFA (25, 50, and 75 mg/kg, p.o.). The vehicle and ETO (35 mg/kg, p.o.) were provided as positive and negative control, respectively. ETO also served combined with TFA to evaluate the modulatory activity. The licking behavior was counted for the early and late phases, whereas the paw edema diameter was measured by using a slide caliper. All treatment was continued for 7 days until the edema was totally minimized to determine the inflammation's recovery capability for a specific group. Different computed and web tools were used to estimate molecular binding affinity, binding interactions, and pharmacokinetics. The findings demonstrated that TFA significantly ($p < 0.05$) enhanced the onset of licking and reduced the number of licks compared to vehicle group. TFA also showed a significant ($p < 0.05$) diminished in paw edema and complete recovered of the edema after 5 days of treatment indicating the anti-inflammatory effects. However, TFA with ETO notably diminished the anti-inflammatory effects of ETO by enhancing paw edema diameter and licking number. TFA also expressed elevated binding affinity of −7.5 and −6.5 kcal/mol toward nitric oxide (NO) synthase and COX-1, respectively. In conclusion, TFA exerted anti-inflammatory effects and reduces anti-inflammatory capability of ETO.

1 | Introduction

Inflammation is an innate immune system reaction that can be initiated by several stimuli, such as infections, cellular injury, and toxic substances. Various causes have the potential to elicit acute and/or chronic inflammatory reactions in multiple organs, including the heart, kidney, pancreas, lung, digestive tract, brain, eye, liver, and reproductive system. Such responses may result in tissue damage or the development of diseases [1–5]. It is classified into two types: chronic and acute. Acute

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RESEARCH

Memory-Enhancing Effects of Dauricine in *Swiss* Mice: Possible Molecular Interventions Through In Vivo and In Silico Studies

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Abstract
The bisbenzylisoquinoline alkaloid dauricine (DAU) is known for its neuroprotective effects in animals. This study investigates the memory-enhancing effects of DAU in Swiss albino mice using both in vivo and in silico approaches, focusing on its interaction with the D2 dopamine (DOP) receptor. Behavioral tests, including marble burying, dust removal, and trained swimming, were used to assess cognitive performance, anxiety, and motor coordination. Molecular docking studies revealed that DAU binds strongly to the D2 DOP receptor (6CM4 protein), with a binding affinity of − 7.9 kcal/mol, forming significant hydrogen and hydrophobic bonds. Additionally, the pharmacokinetics and toxicity profiles of DAU were also evaluated. In vivo results showed that DAU improved behavioral performance in a dose-dependent manner, with the DAU-10 group showing significant ($p < 0.05$) enhancement compared to the control and standard groups. The DAU-10 + DOP-22 combination group also showed remarkable results compared to the standard alone. Pharmacokinetics and toxicity profiles were also assessed, revealing favorable properties but some concerns regarding mutagenicity and immunotoxicity. These findings suggest that DAU, especially when combined with D2 DOP receptor agonists, holds significant potential for memory enhancement and warrants further investigation.

Keywords Dauricine · Memory-enhancing effect · Dopamine receptor · Combination therapy

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RESEARCH

Caffeine and sclareol take the edge off the sedative effects of linalool, possibly through the GABAA interaction pathway: molecular insights through in vivo and in silico studies

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Abstract
Linalool (LIN) has some important neuropharmacological activities, including anxiolytic and sedative effects. It is also clear that it protects experimental animals from convulsions and Alzheimer's disease. On the other hand, caffeine (CAF) and sclareol (SCL) have neurostimulatory potential. This study evaluates the sedative effect and possible molecular mechanisms of CAF with LIN and/or SCL through in vivo and in silico studies. For this, CAF (10 mg/kg) alone or with LIN (50 mg/kg) and/or SCL (10 mg/kg) was intraperitoneally (i.p.) treated before thirty minutes of thiopental sodium (TS) injection (40 mg/kg, i.p.) to the mice and observed for latency and duration of sleep up to 4 h. To understand the possible action mechanisms of these drugs, we also performed molecular docking and pharmacokinetics profile studies with gamma-aminobutyric acid ($GABA_A$) receptor respective subunits. Findings suggest that LIN exerted significant ($p < 0.05$) sedative effects on the animals. CAF and SCL alone or in their combinations significantly reduced LIN's effects in mice. CAF, LIN, and SCL showed binding affinities of −6.2, −5.5, and −7.3 kcal/mol with 6X3X of the $GABA_A$ receptor (α1 and β2 subunits), respectively. Taken together, LIN exerted significant sedative effects, whereas CAF and SCL, either alone or in combination, attenuated this effect in mice. These findings suggest that LIN, CAF, and SCL modulate sedation through interactions with the $GABA_A$ receptor pathway. Further clinical studies are required to confirm these results.

Keywords Sedative effects · Caffeine · Sclareol · Linalool · $GABA_A$ receptor interaction

Introduction

Sedation is the process of calming or inducing a state of sleep or drowsiness in a person (Simeon et al. 2020). However, excessive sedation may lead to the need for mechanical ventilation, a major risk of prolonged ICU stays (Treggiari et al. 2009). Barbiturates, benzodiazepines, and opioids are frequently used sedative drugs worldwide. Besides these, some sleep-inducing medications, such as zolpidem and eszopiclone, are also used to treat sleep disturbances in humans. All these drugs act as central nervous system (CNS) depressants and are available in different forms (e.g., pill, liquid). These drugs are known for their abusive potential, and they are evident to result in dependence and addiction among the users. Common side effects include low physical sensations, lightheadedness, drowsiness, slurred speech, slow breathing and heart rate, muscle incoordination, low dexterity, impaired learning and memory, and sometimes anxiety, nightmares, and hostility (Pagel 2005).

Many of our currently used drugs have been isolated from natural products, providing a rich source of bioactive compounds for therapeutic applications and contributing a vast amount of therapeutic agents (Bhuia et al. 2024a; Ferdous et al. 2024). This is due to the fact that 80% of the global population in developed and developing nations is still dependent on herbal medicines for their primary healthcare (WHO 2013). These compounds, alone or in combination with other suitable active moieties, are evidently effective in fighting diverse diseases and disorders in humans (Bhuia et al. 2023a). The combination of therapeutic strategies with two or more drugs is invaluable for treating many human diseases. This strategy can reduce the dose size and overall therapeutic cost, along

Md. Sakib Al Hasan and Jannatul Ferdous contributed equally to this work

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RESEARCH

Anti-arthritic potential of linalool: in vitro, in vivo, and in silico mechanistic insights for safer therapeutic applications

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Abstract
Linalool (LIN), a monoterpene alcohol from lavender and coriander essential oils, is known for its anti-inflammatory and analgesic properties. However, its potential in arthritis management, combining in vitro, in vivo, and in silico studies; pharmacokinetics; and toxicity management, remains unexplored. This study investigated LIN's anti-arthritis activity through various approaches: in vitro (egg albumin test), in vivo (terpene oil, formaldehyde-induced, and Freund's complete adjuvant (FCA)–induced models), and in silico analyses. In the in vivo study, LIN (25, 50, and 75 mg/kg, p.o.) and the combination of LIN-50 with indomethacin (INDO, 10 mg/kg, p.o.) were evaluated. LIN-75 significantly reduced paw licking, inhibited paw edema in the terpene oil and formaldehyde-induced models, and showed significant inhibition in the FCA-induced arthritis model. The combination therapy of LIN-50 + INDO-10 demonstrated enhanced anti-arthritis activity compared to individual treatments. In the in vitro egg albumin test, LIN-75 exhibited the highest membrane-stabilizing activity, and its combination with INDO-10 resulted in a synergistic effect. In silico studies revealed significant binding affinities of LIN with COX-1, COX-2, and TNF-α (−5.5, −5.1, and −5.0 kcal/mol, respectively), suggesting its potential mechanism of action. Additionally, LIN showed favorable pharmacokinetics with lower toxicity than INDO. In conclusion, LIN exhibited dose-dependent anti-arthritic effects across various models, highlighting its potential as a therapeutic agent for rheumatoid arthritis (RA). Its efficacy suggests promising clinical relevance, warranting further research on its pharmacokinetics, toxicity management, and clinical applicability to fully establish its therapeutic benefits.

Keywords Rheumatoid arthritis · Indomethacin · In vivo · Molecular docking · Pharmacokinetics

Introduction

RA, a chronic degenerative disease of the joints, includes cartilage degradation, infiltration of inflammatory cells into the synovial tissue of joints, and persistent proliferative synovitis (Lin et al. 2014). A person's capacity to do daily activities may be severely impaired by arthritis, which also lowers quality of life and increases the risk of early mortality (Choudhary et al. 2014). RA is caused by a mix of genetic factors and environmental triggers, including genetic predisposition, smoking, and infections, which lead to abnormal immune responses and joint inflammation (Arleevskaya et al. 2022). Pain, swelling, stiffness in the morning, warmth, redness, and limitations in joint function are all signs of active RA (Stack et al. 2014). People of any age can develop arthritis; however, it often manifests between the ages of 25 and 50, peaking in the 40s and 50s. In India, arthritis affects around 20% of the population overall (Baranwal et al. 2012). Related diseases to rheumatoid arthritis include osteoarthritis, lupus, and psoriatic arthritis, as they all involve inflammatory and autoimmune mechanisms affecting the joints (Pabón-Porras et al. 2019; Rose 2022; Coates et al. 2016).

Current treatments for RA include disease-modifying anti-rheumatic drugs (DMARDs) like methotrexate, which helps manage inflammation but can have liver and stomach side effects (Akram et al. 2021). There are many inhibitors to treat arthritis. For example, TNF-α inhibitors, such as adalimumab (humira) and etanercept (enbrel), target inflammation but may increase infection and cancer risks (Scheinfeld 2004). Nonsteroidal anti-inflammatory drugs (NSAIDs)

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REVIEW ARTICLE

Botanical sources, biopharmaceutical profile, anticancer effects with mechanistic insight, toxicological and clinical evidence of prunetin: a literature review

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Abstract
Prunetin (PRU), a naturally occurring flavonoid, has gained recognition for its wide-ranging therapeutic benefits, though its anticancer properties have yet to be extensively reviewed. This study explores the potential of PRU in targeting critical molecular pathways involved in tumor progression, including oxidative stress, apoptosis, cell cycle regulation, and metastasis. Data were compiled from reputable sources, including PubMed, Springer Link, Scopus, Wiley Online, Web of Science, ScienceDirect, and Google Scholar. The findings emphasize PRU's ability to mitigate oxidative stress, promote apoptosis, and regulate the cell cycle in cancer cells. Its anti-inflammatory and anti-angiogenic properties further enhance its effectiveness against cancer. Mechanistic studies reveal that PRU suppresses oncogenic pathways such as PI3K/Akt/mTOR (Phosphoinositide 3-kinase/Protein kinase B/Mammalian target of rapamycin) while activating tumor-suppressor mechanisms. Experimental models show that PRU effectively inhibits cancer cell proliferation and metastasis. Additionally, PRU exhibits favorable pharmacokinetics, demonstrating high intestinal absorption (95.5%), good Caco-2 permeability, and metabolism via CYP1A2, CYP2C19, CYP2C9, and CYP3A4, though it has poor blood–brain barrier (BBB) permeability and limited aqueous solubility, posing challenges for systemic bioavailability. Beyond its anticancer properties, PRU displays broad pharmacological relevance, including anti-inflammatory, cardioprotective, neuroprotective, anti-obesity, and osteoprotective effects, mediated through pathways, such as NF-κB, MAPK, and AMPK. Toxicological studies indicate a favorable safety profile, with low cytotoxicity in normal cells and no significant toxicity at high doses in preclinical models. While clinical evidence on PRU remains limited, studies on structurally related isoflavones suggest promising therapeutic potential, necessitating further clinical trials to establish its efficacy and safety in humans.

Keywords Prunetin · Flavonoid · Cancer review · Cytotoxicity · Oxidative stress · Botanical sources

Introduction

Cancer is a disease characterized by changes in the genetic makeup or gene expression in body cells, leading to uncontrolled cell growth that can spread to other parts of the body [1]. It is classified as a neoplasm, which refers to abnormal masses of cells that grow uncontrollably and may form lumps or tumors that can potentially spread throughout the body [2]. According to global estimates, in 2018, approximately 18 million people were diagnosed with cancer worldwide, with around 9.5 million cases in men and 8.5 million in women. In 2022, there were nearly 20 million new cancer cases and 9.7 million deaths globally, with lung cancer being the most diagnosed and leading cause of death, and projections indicate that new cancer cases will rise to 35 million by 2050 [3]. In 2024, it is estimated that there will be 2,001,140 new cancer diagnoses and 611,720 cancer-related deaths in the United States [4].

Cancer treatment methods are classified as progressive, new or modern, and traditional [5]. Nowadays, cancer medicines account for more than half of all current medical treatment trials globally [6]. The selection of cancer treatment is influenced by factors such as the type, location, and stage of

Sumaya Akter Bithi and Sakib Al Hasan have contributed equally to this work.

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Research Article

Tangeretin enhances sedative activity of diazepam in Swiss mice through $GABA_A$ receptor interaction: *In vivo* and *in silico* approaches

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ARTICLE INFO

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Sedative effect
GABAkine interaction pathway

ABSTRACT

The citrus peel flavonoid tangeretin (TAN) has diverse biological activities, including antioxidant, anti-inflammatory, antitumor, hepatoprotective, and neuroprotective effects. This study investigates the sedative effects of TAN, in Swiss albino mice using *in vivo* and *in silico* approaches. TAN (10 and 20 mg/kg, i.p.) was administered alone and in combination with diazepam (DZP, 2 mg/kg, i.p.) and flumazenil (FLU, 0.1 mg/kg, i.p.) to evaluate its impact on thiopental sodium (TS)-induced sleep, locomotor activity, and dark-light behavior. Results demonstrated that TAN at 10 mg/kg significantly ($p < 0.05$) reduced sleep onset latency and increased sleep duration, with a synergistic effect observed when combined with DZP. In locomotor activity tests, TAN dose-dependently decreased the distance traveled, while the combination with DZP further enhanced this effect. Dark-light tests revealed that TAN increased dark residence time, indicating potential anxiolytic properties. Molecular docking studies showed that TAN binds to the $GABA_A$ receptor (α1 and β2 subunits) with a binding affinity of –6.6 kcal/mol, suggesting its interaction with GABAergic pathways. Pharmacokinetic analysis indicated high intestinal absorption and compliance with Lipinski's rule of five, with a favorable safety profile (LD_{50} = 5000 mg/kg). Overall, TAN enhances the sedative effects of DZP through $GABA_A$ receptor modulation, highlighting its potential as a natural sedative agent. Further research should explore the long-term effects, bioavailability, blood–brain barrier permeability, and synergistic interactions of TAN, with comprehensive in vitro studies and clinical trials needed to validate its potential as a natural sedative.

Introduction

Sedatives and hypnotics promote calmness and sleep, leading to drowsiness, relaxation, and slowed reflexes (Sivagourounadin, 2021). Indicators of sedative and hypnotic use include lethargy, calmness, and reduced reflexes, while larger doses can result in disorientation, clumsiness, and slurred speech (Milhorn, 2018). Approximately 10 % of adults suffer from sleep disorders, while another 20 % occasionally encounter insomnia symptoms (Morin and Jarrin, 2022). The origins of these disorders are influenced by a complex interaction of psychological,

Abbreviations: ADMET, Absorption, distribution, metabolism, excretion, and toxicity; AMES, *Salmonella typhimurium* reverse mutation assay; ANOVA, Analysis of variance; BBB, Blood-brain barrier; BZDs, Benzodiazepines; CNS, Central nervous system; CYP, Cytochrome P450; DZP, Diazepam; FLU, Flumazenil; GABA, Gamma-aminobutyric acid; HIA, Human intestinal absorption; HPLC, High-performance liquid chromatography; LD_{50}, Median lethal dose; PDB, Protein data bank; SD, Standard deviation; TAN, Tangeretin; TS, Thiopental sodium.

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Anticancer activity of *Jasminum sambac* and its bioactive phytochemicals against the PI3K-AKT-mTOR pathway: A literature-based *in silico* study

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ABSTRACT

Jasminum sambac, commonly known as Arabian jasmine, is a traditional medicinal plant with a broad spectrum of therapeutic properties. Recent studies have focused on its potential anticancer activities, particularly through the inhibition of the PI3K-AKT-mTOR pathway, a critical signaling cascade involved in cell growth, proliferation, survival, and metabolism. This review explores the anticancer properties of *J. sambac* and its bioactive phytochemicals, utilizing molecular docking and ADMET (absorption, distribution, metabolism, excretion, and toxicity) analyses to evaluate their efficacy and safety. For this, literature review data were collected as of August 6, 2024, and further molecular docking was done with the selected phytochemicals against PI3K, AKT, and mTOR (PDB ID: 5DXT, 6HHF, and 8PPZ, respectively) proteins. The results indicated that *J. sambac* and its bioactive compounds, particularly hesperidin (HPN) and quercetin (QRN), demonstrated significantly inhibited PI3K-AKT-mTOR pathways and showed high binding affinity against PI3 K and AKT, with values of −10.5 and −10.9 kcal/mol for HPN and −8.2 and −9.5 kcal/mol for QRN, respectively. In comparison, co-crystal ligands exhibited binding energies of −8.2 and −13.5 kcal/mol. Additionally, all compounds demonstrated higher binding affinity for mTOR compared to the co-crystal ligands, with oleanolic acid (OA) exhibiting the highest affinity. The ADMET analyses suggest favorable pharmacokinetic properties and low toxicity profiles, making *J. sambac* phytochemicals a promising candidate for developing anticancer therapies. This review and *in silico* studies highlight the importance of further clinical research to validate these findings and also *J. sambac* and its bioactive compounds as effective as well as safe anticancer agents.
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1. Introduction

Considered a complex and difficult disease to treat, cancer is a group of disorders in which a person's cells proliferate inappropriately and uncontrollably, with the potential to spread and invade nearby tissues and organs. Cancer is responsible for a significant number of deaths worldwide each year (Norton et al., 2023). In wealthy nations, cancer is becoming the leading cause of death. Anyway, there are more than 20 million new instances of cancer diagnosed globally each year; in 2020 (https://www.who.int/news/item/01–02–2024-global-cancer-burden-growing–amidst-mounting-need-for-services). According to predictions made by Thun et al. (2010), there would be 8.9 billion cancer diagnoses worldwide by 2050, with the number of new cases rising daily to about 8.3 billion by 2030 (Thun et al., 2010). Cancer is believed to arise via a complex series of processes at the molecular level, including mutation, selection for cells with enhanced invasion, proliferation, metastasis, and survival capabilities, and multiple individual pathways (Bhuia et al., 2023).

However, cancer develops when a set of genetic mutations and behavioral changes in cells lead normal cells to become carcinogenic (Vineis et al., 2010). Additionally, several pathways are involved in cancer progression, and one of the key pathways implicated in cancer development is the PI3K-AKT-mTOR pathway (Noorolyai et al., 2019;

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Full Length Article

Sesamol exerts' anti-inflammatory effect and synergistic properties with celecoxib and ketoprofen in broiler chicks possibly through COXs interaction pathway

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ABSTRACT

Background: Inflammation is a complex process with significant implications for animal health. Sesamol (SEL), a phenolic lignan from *Sesamum indicum* L., possesses various health benefits.
Objective: To assess the anti-inflammatory effects of SEL alone and in combination with celecoxib (CXB) and ketoprofen (KPN) in a broiler chick model of inflammation, and to explore the molecular interactions of SEL with cyclooxygenase (COX) enzymes using *in silico* analysis.
Methods: Inflammation was induced in broiler chicks via sub-plantar injection of 0.5% formaldehyde. Animals were treated orally with SEL (25 mg/kg, 50 mg/kg, and 100 mg/kg), CXB (42 mg/kg), KPN (42 mg/kg), or combinations of SEL either with CXB or KPN. Paw licking frequency and edema size were measured. Computational docking studies were performed to investigate SEL's binding affinity to COX-1 and COX-2.
Results: SEL significantly ($P < 0.05$) and dose-dependently reduced paw licking frequency and edema size. The combination of SEL with CXB showed a greater anti-inflammatory effect than the combination with KPN. *In silico* analysis revealed a higher binding affinity of SEL for COX-2 (-6.1 kcal/mol) compared to COX-1 (-5.8 kcal/mol).
Conclusion: SEL exhibits anti-inflammatory activity and demonstrates synergistic effects with CXB and KPN *in vivo*. These effects are likely mediated through interactions with both COX-1 and COX-2 enzymes, with a preference for COX-2. These findings suggest SEL as a potential therapeutic agent for inflammation.

1. Introduction

Inflammation is the biological reaction of a living cell that is connected to blood vessels in response to an injury (John and Shobana, 2012). Inflammation can induce symptoms in the affected area, including erythema, edema, discomfort, and elevated temperature, due to a surge in blood flow and a proliferation of immune cells and fluids (Turner et al., 2014). Generally, the emergence of inflammation often results from the simultaneous stimulation of both the inherent immune system's response and the evolved immune system's re-

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ORIGINAL ARTICLE OPEN ACCESS

Citronellal Exerts Sedative-*Like* Effects and Augments Diazepam's Action in *Swiss* Mice, Possibly Through the GABAergic Pathway

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Keywords: citronellal | GABAkine pathway | monoterpene aldehyde | sedative effect

ABSTRACT

Introduction: Citronellal (CTL), a monoterpenoid, exhibits notable neurological activity, including anxiolytic, and anticonvulsant effects, primarily through GABAergic pathways. Our current study aimed to explore CTL's sedative potential using in vitro, in vivo, and in silico approaches through the GABAergic pathway.

Methods: The in vitro GABAergic activity of CTL was assessed via colorimetric assay, while acute toxicity was evaluated in *Swiss* mice per OECD guidelines with doses up to 2000 mg/kg to establish safety margins. Sedative effects were assessed in *Swiss* mice using thiopental sodium (TS, 40 mg/kg)-induced sleep protocols. CTL was administered at 62.5, 125, and 250 mg/kg doses, alone or combined with diazepam (DZP, 2 mg/kg) or flumazenil (FLU, 0.1 mg/kg). The in silico studies were also performed with $GABA_A$ receptors (α1 and β2 subunits) to investigate the possible molecular mechanism.

Results: The results demonstrated that in vitro, CTL exhibited significantly concentration-dependent GABAergic activity. Acute toxicity tests indicated a high safety margin (no behavioral or physiological abnormalities at 2000 mg/kg dose). Additionally, CTL significantly ($p < 0.05$) and dose-dependently reduced the latency and augmented sleep duration in animals, compared to the control group. It also significantly ($p < 0.05$) decreased the latency and increased the duration of sleep with DZP-2 while reducing this parameter with FLU-0.1. In in silico studies, CTL exhibited binding affinities (BAs) with the $GABA_A$ receptor (α1 and β2 subunits) of −5.6 kcal/mol.

Conclusion: CTL demonstrated potent sedative effects in vitro and in vivo, with a strong safety profile and interaction with the $GABA_A$ receptor (α1 and β2 subunits).

Abbreviations: ADMET, absorption, distribution, metabolism, excretion, and toxicity; ANOVA, analysis of variance; BA, binding affinity; CAN, central nervous system; CTL, citronellal; DZP, diazepam; FLU, flumazenil; GABA, gamma-aminobutyric acid; LD50, median lethal dose; SCN, suprachiasmatic nucleus; SD, standard deviation.

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ORIGINAL ARTICLE

Modulatory Sedative Activity of Helicide on Diazepam in Thiopental Sodium Mediated Sleeping Mice: An *In Vivo* Approach With Molecular Docking

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Abstract
Insomnia is a common sleep disorder characterized by difficulties in falling asleep, staying asleep, or getting restful sleep. This study aimed to assess the sedative properties of helicide using thiopental sodium-induced sleep mice model. Helicide (5 and 10 mg/kg) and diazepam (2 mg/kg) were administered to the animals. After 30 min, thiopental sodium (20 mg/kg) was given (*i.p.*) to induce sleep, and onset and duration of their sleep were recorded over a 4-h period. Molecular docking was also performed to investigate the potential interactions of helicide with $GABA_A$ (PDB: 6X3X, containing α1 and β2 subunits) receptors and assess its pharmacokinetics and toxicity. The results demonstrated that helicide significantly ($p > 0.05$) extended the duration of sleep (174.8 ± 10.47 min) and provided fast sleeping onset (9.40 ± 1.71 min) compared to control. The combination of helicide and diazepam elevated sedation duration (191.40 ± 3.86 min) and lowered onset (5.20 ± 0.58 min), indicating a synergistic effect. Helicide exerted binding affinity of − 7.7 kcal/mol, while diazepam had a slightly higher affinity of − 8.7 kcal/mol with 6X3X. Helicide also displayed favorable pharmacokinetics and drug-likeness. Overall, Helicide exhibited a moderate sedative effect in the mice model, likely through its interaction with the GABAergic system.

Keywords Sedation · Insomnia · Molecular docking · GABA agonist · Toxicity · Pharmacokinetics

Introduction

Insomnia is a major public health concern characterized by difficulty falling or staying asleep, early morning awakenings, non-restorative sleep, and daytime impairments (Agu et al. 2023). About 25% of people worldwide suffer from sleep disturbances at the moment. Individuals who experience sleep disturbances all year round are more vulnerable to mental health conditions like depression, bipolar disorder, generalized anxiety disorder, and suicidal thoughts. Depression-related disorders constitute one of the most often diagnosed mental conditions, with a lifetime frequency of around 16% (Ohayon 2002; Morin et al. 2006). According to the Centers for Disease Control and Prevention, around 14.5% of adults struggle with falling asleep, while 17.8% have trouble staying asleep. Insomnia prevalence varies by age, gender, and ethnicity, with women being more affected than men (https://www.cdc.gov/nchs/data/databriefs/db436.pdf, accessed on February 9, 2025). Insomnia arises from neurodegenerative, inflammatory, traumatic, or ischemic

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REVIEW

Broad-Spectrum Therapeutic Potentials of the Multifaceted Triterpene Lupeol and Its Derivatives

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ABSTRACT

Lupeol (LUP), a naturally occurring pentacyclic triterpene, is found in various fruits, vegetables, and medicinal plants and is evident to possess diverse pharmacological activities. This study aimed to consolidate its findings based on updated database reports. Findings suggest that LUP and some of its derivatives have promising biological roles, including anticancer effects. Notably, LUP induces apoptosis and cell cycle arrest in cancer cells while sparing normal cells, highlighting its selective cytotoxicity. By modifying pathways such as NF-κB and phosphatidyl inositol 3-kinase (PI3K)/Akt, LUP demonstrates anticancer activity, reducing LDL oxidation by 34.4% and causing cancer cells to undergo apoptosis while leaving healthy cells unaffected. Moreover, it has strong antioxidant and anti-inflammatory properties; thus, it may act against conditions like arthritis, asthma, and cardiovascular diseases. It has broad-spectrum antimicrobial activities and can be used as an alternative to conventional antibiotics. LUP and its nanoformulations (PEGylated liposomes) improved biopharmaceutical profiles in test systems. It also showed neuroprotective effects, particularly against Alzheimer's and Parkinson's diseases. Taken together, LUP has multi-target therapeutic approaches against various diseases and pathological conditions, advocating for its inclusion in future clinical trials.

Abbreviations: ACC, acetyl CoA carboxylase; ALP, alkaline phosphatase; ALT, alanine transaminase; AML, acute myeloid leukemia; AST, aspartate aminotransferase; Bax, BCL-2-associated X protein; BCS, biopharmaceutical classification system; cFLIP, cellular FLICE (FADD-like-IL-1β-converting enzyme) inhibitory protein; c-GT, c-glutamyl transferase; DMAPP, dimethylallyl pyrophosphate; ECDC, European Centre for Disease Prevention and Control; FAS, fatty acid synthase; FPP, farnesyl pyrophosphate; GSH, growth-stimulating hormone; HCC, hepatocellular carcinoma; HIV, human immunodeficiency virus; HMGCR, HMG-CoA reductase; HO-1, heme oxygenase-1; HPLC, high-performance liquid chromatography; IGF-1R, insulin-like growth factor 1; IL-2, interleukin-2; IPP, isopentenyl pyrophosphate; IRS-1, insulin receptor substrate 1; LPS, lipopolysaccharide; LUP, lupeol; MAPK, mitogen-activated protein kinases; MASLD, metabolic-associated steatotic liver disease; MBC, minimum bactericidal concentration; MDA, 3,4-Methylenedioxyamphetamine; MFC, minimum fungal concentration; MIC, minimum inhibitory concentration; MRSA, methicillin-resistant *Staphylococcus aureus*; MS, mass spectroscopy; mTOR, mammalian target of rapamycin; NF-κB, nuclear factor kappa-light-chain-enhancer of activated B cells; Nrf-2, nuclear factor erythroid 2-related factor-2; NSCLC, non–small lung cancer cell; OSC, oxidosqualene cyclase; PI3K, phosphatidyl inositol 3-kinase; PDI, potential dispersion index; PIP2, phosphatidylinositol 4,5-bisphosphate; PIP3, phosphatidylinositol 3,4,5-trisphosphate; ROS, reactive oxygen species; SOD, superoxide dismutase; SQS, squalene synthase; SREBP, sterol regulatory element-binding protein; STZ, streptozotocin; TCA, tricyclic antidepressant; TLR, toll-like receptor; TNF-α, tissue necrosis factor-alpha; TPA, tetradecanoyl-phorbol acetate; UV, ultraviolet; VEGF, vascular endothelial growth factor; WHO, World Health Organization.

Anwar Parvez and Md. Anisur Rahman contributed equally to this article.

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ORIGINAL ARTICLE OPEN ACCESS

Possible GABAkine-Mediated Sedative-Like Antidepressant Effects of Phytol: Molecular Interventions Through In Vitro, In Vivo and In Silico Approaches

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Keywords: antidepressant effect | GABAkine pathway | molecular docking | phytol

ABSTRACT

Background: A previous report suggests that phytol (PHY) may exert its antidepressant effects in mice, possibly through $GABA_A$ receptor interaction pathways.

Aim: We aimed to check its antidepressant effect with possible molecular mechanisms through behavioral and *in silico* studies.

Methods: For this, adult mice were randomly divided into different groups ($n = 6$), namely control (vehicle), standards (DZP: diazepam at 2 mg/kg, FLU: flumazenil at 0.1 mg/kg, FLUX: fluoxetine at 20 mg/kg), PHY (25, 50, and 75 mg/kg), and combined groups (PHY-75 with DZP-2 and/or FLU-0.1, and FLUX-20). Thirty minutes after treatment, each animal was subjected to tail suspension and forced swimming tests, and their immobility time (IMT) was counted for 5 min. In silico studies were performed with the $GABA_A$ receptor α1, α2, α3, α5, and γ2 subunits and $5HT_{1A}$ to investigate possible molecular mechanisms. Additionally, in vitro GABA activity of PHY and/or reference drugs was also performed by using the colorimetric method.

Results: The results demonstrated that PHY and/or DZP significantly ($p < 0.05$) and concentration-dependently inhibited GABA, while FLU alone or its combination with PHY reversed it. In mice, PHY dose-dependently reduced the IMT in both protocols, while FLUX-20 showed lower IMT compared to the control and DZP, indicating elevated locomotion in mice. It showed a reduced IMT value in male animals than in female animals. In both sexes, PHY at 75 mg/kg significantly ($p < 0.05$) increased the IMT values with DZP-2, while reducing this parameter with FLU-0.1. *In silico* studies demonstrated that PHY exhibited higher binding affinities with the α2 and α3 subunits of the $GABA_A$ and $5HT_{1A}$ receptors by −6.5, −7.2 and 6.7 kcal/mol, respectively.

Conclusion: Taken together, PHY exerted sedative-*like* antidepressant effects in mice and modulated the effects of GABAergic drugs DZP and FLU and serotonergic drug FLUX. PHY may be a potential candidate for the management of depression.

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Quercetin promises anticancer activity through PI3K-AKT-mTOR pathway: A literature review

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Quercetin

ABSTRACT

The PI3K-AKT-mTOR pathway plays a critical role in regulating cellular growth, proliferation, and survival, with its dysregulation being a hallmark of various cancers. Quercetin (QUR), a natural flavonoid, exhibits significant anticancer activity by modulating this pathway. This review examines the anticancer potential of QUR through the PI3K-AKT-mTOR pathway, emphasizing its mechanisms, pharmacokinetics, toxicological profile, clinical relevance, and therapeutic applications. A systematic search of databases, including PubMed and ScienceDirect, was conducted. *In vitro* and *in vivo* studies across multiple cancer models were analyzed. QUR inhibits PI3K-AKT-mTOR signaling across cancers, including breast, prostate, pancreatic, brain, and colon. In breast cancer (MCF-7, MDA-MB-231), QUR reduced Akt/mTOR activity at 0.5–100 μM concentrations and 50 mg/kg doses *in vivo*. Prostate cancer models (LNCaP, PC-3) showed suppression at 200 μM, with efficacy *in vivo* at 75–200 mg/kg. Pancreatic (MIA PaCa-2), colon (HT-29), and brain cancer (U87) models exhibited similar effects. Despite its promising anticancer effects, QUR's toxicological profile reveals dose-dependent hepatotoxicity, nephrotoxicity, and potential drug interactions due to cytochrome P450 enzyme inhibition. Clinical evidence suggests QUR possesses antioxidative, anti-inflammatory, and cardioprotective benefits, but its limited bioavailability and safety concerns necessitate further pharmacokinetic optimization. Future research should focus on clinical trials, combination therapies, and advanced delivery systems to enhance therapeutic efficacy while mitigating toxicity.

1. Introduction

Cancer is a group of diseases involving the cells that are not behaving as they should: cells do not die when they are supposed to and instead divide and grow in an uncontrolled manner, may intrude on other tissues, and can spread to other organs in the body [1]. GLOBOCAN reports that cancer is still a major cause of human mortality globally; in 2020, over 19.3 million new cases and nearly 10 million deaths were recorded. Cancer risks are polygenic hereditary, environmental, lifestyle and infectious agents, as some may know [2]. At the molecular level, interference with cell cycle regulation by means of genetic instability and changes in cell signaling options, resistance to apoptosis, and thus leading to cell proliferation characteristic of cancer [1].

The PI3K-AKT-mTOR is an important molecular signaling pathway that is involved in such cellular processes as cell growth, proliferation, survival, and metabolism. This pathway is initiated by numerous extracellular stimuli, including growth factors and cytokines, which target phosphoinositide 3-kinase (PI3K), then activate AKT, activate

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Review

Anticancer Efficacy of Decursin: A Comprehensive Review with Mechanistic Insights

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Abstract: Introduction: Decursin is a pyranocoumarin natural phytochemical found in the *Angelica gigas* Nakai herb, which shows various therapeutic properties and beneficial effects against various diseases. Objective: The aim of this study was to find the anticancer potential of decursin and its molecular mechanisms involved with different anticancer effects. Methodology: All of the relevant data concerning this compound and cancer were collected using different scientific search engines, including PubMed, Scopus, Springer Link, Wiley Online, Web of Science, Scifinder, ScienceDirect, and Google Scholar. Results: This study found that decursin shows anticancer properties through various mechanisms, such as apoptosis, cell cycle arrest, inhibition of cell proliferation, autophagy, inhibition of angiogenesis, cytotoxicity, and the inhibition of invasion and migration against a number of cancers, including breast, bladder, lung, colon, skin, ovarian, prostate, pancreatic, and bone cancers. This study also discovered that decursin has the ability to affect several signaling pathways in the molecular anticancer mechanisms, such as the PI3K/AKT/mTOR, JAK/STAT, and MAPK signaling pathways. Findings also revealed that decursin expresses poor oral bioavailability. Conclusions: Based on the data analysis from this literature-based study, decursin has properties to be considered as a potential candidate in the treatment of cancer. However, more clinical research is suggested to establish proper efficacy, safety, and human dosage.

Keywords: cancer; decursin; pharmacokinetics; anticancer mechanisms; apoptosis

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1. Introduction

Cancer encompasses numerous medical conditions characterized by the unregulated division of cells and the ability to infiltrate surrounding tissues, which can metastasize to different body regions via the circulatory and lymphatic systems, which also aid in flushing harmful substances [1,2]. Cancer is a remarkable global health burden because it is the second major cause of mortality in numerous countries, after heart disease [3]. The majority of cancer, about 70% of the burden, is shouldered by developing countries [4]. Significant advancements have been established over the past few years, but the incidence

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Tangeretin Improves the Memory of *Swiss* Mice, Suggesting Potential Molecular Interventions Through Animal Behavior Assessments and In Silico Studies

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Keywords: dopamine receptor | memory-enhancing effect | molecular interactions | tangeretin

ABSTRACT

Introduction: Tangeretin (TAN), a polymethoxylated flavone from citrus peels, exhibits neuroprotective, anti-inflammatory, and antioxidant properties. This study aims to evaluate the memory-enhancing effects of TAN in *Swiss* mice and explore its potential molecular interactions with the D_2 dopamine (DOP) receptor through in vivo behavioral assessments and in silico approaches.

Methods: *Swiss* mice were administered TAN (10 and 20 mg/kg), DOP (22 mg/kg), and olanzapine (OLN) (2 mg/kg), alone and in combinations per orally (p.o.), followed by cognitive assessments using marble burying, dust removal, and trained swimming tests. In silico studies included molecular docking against the D_2 receptor (PDB: 6CM4), pharmacokinetics (SwissADME, pkCSM), and toxicity predictions (ProTox-3).

Results: TAN significantly ($p < 0.05$) improved cognitive functions, including memory, anxiety, and motor coordination, in a dose-dependent manner, with 20 mg/kg showing the most notable effect. The combination of TAN-10 with DOP-22 enhanced these benefits, whereas TAN-10 with OLN-2 reduced cognitive improvements. TAN-treated Swiss mice showed better performance in marble burying, dust removal, and trained swimming tests, indicating enhanced memory, problem-solving, and motor coordination. These results suggest TAN's potential in cognitive enhancement, particularly with DOP-22. No deaths were observed in any treatment group, and all treated animals exhibited normal physiological activity with no signs of acute toxicity. In silico studies revealed that TAN exhibited the strongest binding affinity (BA) (−6.6 kcal/mol) with the D_2 receptor, forming multiple hydrogen bonds (HBs), which indicates its potential mechanism for memory enhancement via dopaminergic modulation.

Abbreviations: ADMET, absorption, distribution, metabolism, excretion, and toxicity; AMES, *Salmonella typhimurium* reverse mutation assay; ANOVA, analysis of variance; AZD, Alzheimer's disease; BA, binding affinity; BBB, blood–brain barrier; BZDs, benzodiazepines; CNS, central nervous system; CYP P450, cytochrome P450; DOP, dopamine; HB, hydrogen bond; HIA, human intestinal absorption; HPLC, high-performance liquid chromatography; LD_{50}, median lethal dose; OLN, olanzapine; PDB, protein data bank; SD, standard deviation; TAN, tangeretin.

Trial Registration: Not applicable.

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Hypoglycemic effects of dauricine, possibly through mitochondrial respiratory chain (complex I) and glycerol-3-phosphate dehydrogenase interaction pathways

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ABSTRACT

Two separate studies indicate that dauricine (DAU), an isoquinoline alkaloid derived from the Asian vine *Menispermum dauricum*, has shown anti-diabetic effects in laboratory animals. This study emphasizes evaluating the hypoglycemic effect against glucose-induced hyperglycemia animals *in vivo* along with possible molecular interventions of DAU through *in silico* studies. For this, adult male *Swiss* albino mice were treated with DAU (5 and 10 mg/kg) with or without the standard hypoglycemic drug metformin hydrochloride (MET) at 100 mg/kg via oral gavage and checked peripheral blood glucose levels (BGL) up to 3 hours from oral glucose administration (4 g/kg). The molecular docking study of DAU was conducted against MET-target proteins. Findings suggest that DAU dose-dependently and significantly ($p < 0.05$) decreased the BGL in animals from 60 minutes. At 180 minutes, it normalized BGL at both doses. With MET, it significantly ($p < 0.05$) and profoundly reduced the BGL compared to the individually treated groups. The molecular docking studies demonstrate that DAU has a strong binding affinity of –9.9 and –8.3 kcal/mol with the mitochondrial respiratory chain (complex I) receptor and mitochondrial glycerol-3-phosphate dehydrogenase receptor, respectively, whereas the standard drugs MET showed binding affinities between –4.9 and –4.3 kcal/mol for these subunits. Taken together, DAU dose-dependently reduced BGL and enhanced the hypoglycemic effect of MET in animals. We suppose that DAU may show its hypoglycemic effect on mice, possibly through mitochondrial respiratory chain (complex I) and glycerol-3-phosphate dehydrogenase receptor interaction pathways.

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Assessment of Sedative Activity of Lonicerin: In Vivo Approach With Pharmacokinetics and Molecular Docking

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Keywords: Insomnia | lonicerin | natural product | neuroprotective | pharmacokinetic | toxicity

ABSTRACT

Background:: Lonicerin (LON) has been identified to have different biological properties, such as anticancer, anti-inflammatory, immunomodulatory, antibacterial, antimicrobial, and neuroprotective. This study aims to assess the sedative effect of LON in Swiss albino mice, which is yet to be discovered.

Materials and Methods:: Mice were treated with two different doses of LON (5 and 10 mg/kg) and 2 mg/kg of diazepam (DZP), which is the referral GABAergic medication, and the latency time and sleeping duration of animals were observed. A computational study was also conducted to evaluate the docking scores and display the binding sites of LON and receptor ($GABA_A$ $\alpha 1$ and $\beta 2$ subunits). The study also investigated the pharmacokinetics and drug-likeness properties of LON along with toxicological analysis by using SwissADME and Protox-3 software, respectively.

Results:: Findings revealed that the higher concentration of LON reduced the latency (9.86 ± 1.44 min) and increased the sleep duration (191.29 ± 7.43 min) compared to the lower concentration. Besides, the combination group of LON and DZP showed the lowest latency (6.17 ± 0.82 min) and highest sleeping time (219.00 ± 6.39 min). In the in silico study, LON exhibited a strong docking score (−8.1 kcal/mol) with the macromolecules, which is closer to the binding affinity of DZP (−8.3 kcal/mol), indicating that LON could show strong sedative activity by binding with the $GABA_A$ receptor. Computational toxicity analysis revealed that LON is non-hepatotoxic, non-neurotoxic, noncarcinogenic, noncytotoxic, non-ecotoxic, and non-mutagenic.

Conclusion:: Therefore, LON may be effective for the treatment of insomnia in the near future.

Tanzila Akter Eity and Md. Shimul Bhuia contributed equally to this study.

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Review Article

Therapeutic Effects of Natural Food Additives Steviol Glycosides From *Stevia rebaudiana*: A Comprehensive Review With Mechanisms

Jannatul Ferdous,[1,2,3] **Md. Shimul Bhuia**,[2,4] **Raihan Chowdhury**,[2,4] **Salehin Sheikh**,[2,4] **and Muhammad Torequl Islam**[2,4,5]

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Stevia (*Stevia rebaudiana*), one of the perennial shrubs that are indigenous to South America, synthesizes diterpene glycosides. Stevia leaves comprise steviol glycosides (SGs) such as stevioside, isosteviol, steviolbioside, and rebaudioside (A–E). These components are low-calorie calories and used as a sugar substitute in foods, beverages, and medications. The goal of the current investigation is to summarize the pharmacological activities with exposed fundamental molecular processes against different diseases. Additionally, we have encapsulated botanical sources, pharmacokinetics, and toxicological profiles of SGs. For this reason, the data (up to date as of July 10, 2024) was retrieved from a variety of credible and authoritative sources, such as Google Scholar, Wiley Online, PubMed, ScienceDirect, Springer Link, Scopus, and Web of Science. Our findings suggested that SGs have potent antidiabetic activity by mimicking insulin actions by regulating the PI3K/AKT pathway. Besides, SGs have a diverse range of pharmacological activities, including antioxidant, anti-inflammatory, antiobesity, antihypertensive, antimicrobial, antidiarrheal, gastroprotective, hepatoprotective, pulmoprotective, and renoprotective activities. Our findings also suggested that SGs have prospective anticancer properties through various molecular pathways. According to studies, SGs are neither mutagenic nor carcinogenic, not teratogenic, and do not provoke acute or subacute toxicity. Taken together, this investigation demonstrates that SGs have enormous promise as a curative agent for the medication of several diseases and disorders.

Keywords: pharmacokinetics; pharmacological effects; *Stevia rebaudiana*; steviol glycosides

1. Introduction

For millennia, people have utilized plants and their derivatives to cure a wide range of illnesses. Plants, animals, and microbes are the primary sources of the compounds known as natural products (NPs) [1]. The application of plant medicines has elevated throughout the previous few decades [2]. Synthetic medications are made in laboratories, utilizing a variety of techniques that maximize the possibility of side effects or toxicity in addition to their medicinal advantages. However, herbal therapies are often seen to be less poisonous or have fewer adverse effects than synthetic pharmaceuticals, even if they might not always be as effective as synthetic ones [3, 4]. As a consequence, herbal remedies

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Review Article

Potential Therapeutic Efficacy of Ferulic Acid and Its Derivatives in the Management of Cancers: A Comprehensive Analysis With Mechanistic Insight

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Due to the increasing rate of cancer and the undesirable consequences of manufactured drugs, there is a growing interest in the development of natural products as potential remedies. Ferulic acid (FA), a phenolic substance, is found naturally present in the *Ferula foetida* plant's cell walls with therapeutic activities. The objective of this study is to determine the botanical sources, pharmacokinetics, and anticancer activity of FA and its derivatives, focusing on the molecular mechanism by using the data obtained from the literature database. The study's findings suggest that FA demonstrates promising anticancer effects in preclinical pharmacological test methods. The findings of the study exhibit that FA showed promising anticancer activity through underlying mechanisms, including induction of oxidative stress, cytotoxic effect, cell cycle arrest, apoptotic effect, suppression of invasion and migration, antiproliferative effect, autophagy, and genotoxic and mutagenic effect by regulating different molecular pathways like PI3K/AKT, p38/MAPK/ERK, AKT/mTOR, and NF-κB signaling pathways which are involved in cancer development and cell growth. Additionally, this review indicated the pharmacokinetic properties of FA, indicating lower oral bioavailability is affected by the liver's fast conjugation process; this limitation is overcome by applying a nanoformulation of FA. However, additional clinical investigations are recommended to determine the appropriate therapeutic effectiveness, safety, and human dosage.

Keywords: anticancer; ferulic acid; molecular mechanisms; pharmacokinetics; phenolic substance

1. Introduction

Cancer is primarily caused by genetic abnormalities resulting in uncontrolled replication and excessive cellular proliferation of normal cells, surpassing the healthy tissue in the surrounding area [1, 2]. After heart disease, cancer is currently the second most common cause of death globally, as reported by the World Health Organization (WHO) [3, 4]. The estimated population of Asia will increase from 6.1 million in 2008 to 10.6 million in 2030 due to aging populations and alterations in lifestyle caused by economic growth in the area [5]. It is projected that there were 20 million incidents of cancer and 10 million deaths directly attributable to cancer across the world. Over the next 20 years, cancer prevalence is expected to rise by 60%, straining health systems, individuals, and communities. By 2040, 30

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Evaluation of the Sedative Activity of Naringenin: In Vivo Study with Pharmacokinetics and Molecular Docking Insights

Dipu Bishwas, Md. Shimul Bhuia,* Salehin Sheikh,* Mohammed Alfaifi, Abdul Malik, Nikhat J. Siddiqui, Divya Jain, Mehedi Hasan Bappi, and Muhammad Torequl Islam

This research is designed to investigate the sedative effects of naringenin (NAR) and diazepam against thiopental sodium-induced sleeping mice. NAR (5 and 10 mg kg), diazepam (DZP) (2 mg kg), flumazenil (FLN) (0.1 mg kg), and their combinations are administered intraperitoneally to mice. After 30 min, sleep is induced with intraperitoneal thiopental sodium (20 mg kg), and sleep latency and duration are measured. In silico analysis investigates the role of GABA receptors. NAR significantly reduces sleep latency and prolongs sleep duration in a dose-dependent manner, with the combination of NAR-10 and DZP-2 showing a synergistic effect. The combination of the antagonist (FLN) (NAR-10 and FLN-0.1) indicates that latency increases and sleep duration decreases compared to NAR-10 alone. Furthermore, in silico docking studies corroborates these results, demonstrating a significant binding affinity of NAR (−8.3 kcal mol), which is comparable to the standard ligand DZP (−8.7 kcal mol) and FLN (−7.0 kcal mol) for the $GABA_A$ (6X3X) receptor, indicating a GABAergic mechanism. Pharmacokinetics and toxicity evaluations confirm NAR's potential as a safe therapeutic agent, with a high LD50 (2000 mg kg) and minimal toxicity. These findings highlight NAR's potential as a GABAergic sedative agent, requiring further research before being used clinically to treat sleep disorders.

1. Introduction

Insomnia is defined as difficulty going to sleep, remaining asleep, or having nonrestorative sleep while having ample chance for sleep, combined with accompanying impairment of daily activities, with indications appearing for at least 4 weeks.[1] In addition, insomnia is one of the most common complaints in psychiatric populations, which include adults with severe depression, and is reported in 50%–70% of those receiving primary care.[2] In addition to increasing evidence that indicates, it affects not only psychological disorders but also medical issues such as hypertension, coronary heart disease, compromised immune systems, and inflammatory disease.[3] According to the National Council on Aging (NCOA), roughly 30% of individuals suffer symptoms of insomnia, with 10% experiencing insomnia that impairs their daily activities. Sleep difficulties are typically related to neurodegenerative illnesses, including those originating from Alzheimer's disease, schizophrenia, bipolar disorder, and severe depression.[4] Various factors, such as anxiety, depression, stress, lifestyle choices, pregnancy, age, cancer, allergies, nocturia, migraines,

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RESEARCH

Oleuropein modulates anti-inflammatory activity of celecoxib and ketoprofen through cyclooxygenase pathway: in vivo, in silico and pharmacokinetics approaches

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Abstract

Oleuropein (OLP), a bioactive compound mainly found in olive leaves, is recognized for its wide range of biological effects, such as antioxidant, anti-inflammatory, and antimicrobial activities. This study aimed to assess the anti-inflammatory effects of OLP in an in vivo model and explore its molecular interactions through in silico docking studies. We investigated the individual and combined effects of OLP (10 and 20 mg/kg) alongside standard anti-inflammatory drugs, celecoxib (CXB) and ketoprofen (KPN), at 42 mg/kg (p.o.) in a formalin-induced inflammatory chick model. In addition, an in silico analysis was conducted to examine how OLP and the standard drugs interact with cyclooxygenase (COX)-1 and COX-2 enzymes. The results indicated that OLP exhibited a dose-dependent anti-inflammatory effect in chicks, with OLP-20 mg/kg significantly reducing paw-licking frequency and paw edema diameters. Furthermore, the combination of OLP-20 mg/kg with CXB-42 mg/kg and KPN-42 mg/kg showed enhanced anti-inflammatory efficacy. In the molecular docking analysis, OLP demonstrated comparable binding interactions with both COX-1 (−7.6 kcal/mol) and COX-2 (−7.7 kcal/mol) enzymes, similar to the standard drugs. Pharmacokinetic (PK) analysis revealed that OLP has favorable properties and a safe toxicity profile, with an LD_{50} of 2000 mg/kg. In conclusion, OLP effectively and dose-dependently reduced paw licks and edema in animals, suggesting that its anti-inflammatory effects are mediated through interactions with COX-1 and COX-2 enzymes. Additional research is essential to comprehensively uncover the underlying mechanisms of its action and evaluate its potential for clinical use.

Keywords Oleuropein · Anti-inflammatory effect · Cyclooxygenase pathway

Introduction

Inflammation, a defensive immunovascular response involving diverse cell types, can be activated by both intrinsic and extrinsic factors (Köhler-Forsberg and Benros 2018). The impact of inflammatory bowel disease (IBD) among seniors expanded substantially from 1990 to 2021, with cases increasing from 573,500 to 1,278,190. During this period, the incidence rate grew from 8.01 to 8.77 per 100,000, while mortality rates decreased; yet, the total deaths rose from 14,400 to 33,490, and disability-adjusted life years doubled from 324,100 to 683,750 (Liu et al. 2024). The immune system's reaction to an infection, trauma, or irritants such as poisons or allergens results in inflammation. Disease-causing organisms' physical trauma, autoimmune conditions, and ongoing stress are common triggers. The cardinal indicators of acute inflammation—redness, swelling, heat, pain, and loss of function—are symptoms of inflammation syndromes (Megha et al. 2021; Ansar et al. 2016). Chronic inflammation, characterized by the infiltration of damaged tissue by mononuclear cells like macrophages, lymphocytes, and plasma cells, often leads to chronic illnesses like cancer, arthritis, arteriosclerosis, neurological disorders, liver diseases, and renal disorders, which may progress if the harmful agent persists (Rajendran et al. 2018).

By blocking COX-1 and COX-2, non-steroidal anti-inflammatory medications (NSAIDs) might lessen heat, discomfort, and inflammation. However, prolonged use can damage the stomach mucosa and kidneys since PGE2's cytoprotection is reduced. Neurodegenerative diseases including multiple sclerosis, Parkinson's, and Alzheimer's are

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Review Article

Ethnopharmacological Profile, Phytochemistry and Therapeutic Potential of *Aegle marmelos* L. for the Treatment of Neurological Disorders

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Aegle marmelos (L.) Corrêa, commonly known as the bael fruit tree, is a member of the Rutaceae family and holds significance in Ayurvedic herbal medicine due to its myriad therapeutic properties. This paper seeks to delve into the diverse benefits offered by the bael fruit tree, exploring various plant parts, including leaves, fruit, bark, and seeds, all of which contain bioactive compounds with therapeutic potential. The bael fruit, with its diverse phytochemical profile, exhibits potential health benefits ranging from radioprotection and antibacterial properties to antioxidant and hepatoprotective effects. Additionally, this review highlights the limited preclinical studies on AMs' efficacy in treating neurological disorders, emphasizing the need for more clinical trials to validate its potency and safety. Specifically, the effects and mechanisms of AM extract in addressing Alzheimer's disease, anxiety, depression, epilepsy and Parkinson's disease are explored. In conclusion, AM emerges as a plant of considerable nutritional and pharmacological value, with the potential to contribute significantly to the treatment of neurological disorders. Despite its promising attributes, the limited preclinical studies necessitate further clinical trials to confirm its efficacy. This review consolidates relevant studies, offering insights into AMs' ethnobotany, chemical constituents, pharmacological properties and potential application in neurological disorders. The comprehensive examination underscores the need for continued research to unlock the full therapeutic potential of this versatile plant.

Keywords: *Aegle marmelos*; Alzheimer's disease; depression; epilepsy; Parkinson's disease

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REVIEW ARTICLE

Anticancer potential of daidzin: a comprehensive literature review

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Abstract
Daidzin (DZN), a naturally occurring isoflavone extracted from leguminous plants such as soybeans, has gained significant attention for its anticancer properties. This study provides a comprehensive overview of the pharmacokinetics (PKs), botanical sources, and therapeutic potentials of DZN, focusing on its mechanistic insights into cancer prevention and treatment. For the study, data were collected from databases such as PubMed, Google Scholar, Web of Science, and other reputable sources. In results, DZN induces oxidative stress, apoptosis, cytotoxicity, and cell cycle arrest while inhibiting proliferation, migration, invasion, and angiogenesis across various cancer cell lines, including breast, prostate, cervical, hepatocellular, and colon cancers. Its anticancer efficacy is mediated through modulation of key pathways: Nuclear Factor kappa-light-chain-enhancer of activated B cells (NF-κB), which promotes inflammation and survival; Janus Kinase/Signal Transducer and Activator of Transcription (JAK/STAT), essential for proliferation and immune evasion; and Rat Sarcoma virus/Rapidly Accelerated Fibrosarcoma (RAS/RAF), a critical regulator of cell growth and chemoresistance. By inhibiting these pathways, DZN enhances apoptosis and chemotherapy sensitivity. Additionally, DZN's pharmacokinetic profile reveals favorable absorption, distribution, metabolism, and excretion (ADME) properties, with minimal toxicity in preclinical studies. Its ability to modulate pathways and enhance chemotherapy sensitivity positions DZN as a potential therapeutic candidate. Despite promising preclinical findings, the lack of clinical validation underscores the need for well-designed human trials to confirm its efficacy and safety, paving the way for its translational application in oncology.

Keywords Cancer · Daidzin · Pharmacokinetics · Apoptosis · Reactive oxidative stress

Abbreviations

ADME:	Absorption, distribution, metabolism, and excretion
ALDH2:	Aldehyde dehydrogenase 2
AMPKα:	AMP-activated protein kinase alpha
AUC:	Area under the curve
BAX:	Bcl-2-associated X protein
BBB:	Blood–brain barrier
BCL2:	B-cell lymphoma 2
BPH:	Benign prostate hyperplasia
CDK1:	Cyclin-dependent kinase 1
C_{max}:	Maximum concentration
CNS:	Central nervous system
COX-2:	Cyclooxygenase2
DNA:	Deoxyribonucleic acid
DZN:	Daidzin
DZP:	Diazepam
ERK:	Extracellular signal-regulated kinase
FGBT:	Fibroglandular breast tissue
FLU:	Flumazenil
HCC:	Hepatocellular carcinoma
HPV:	Human papillomavirus
IC_{50}:	Half-maximal inhibitory concentration
JAK2:	Janus kinase 2
Ki67:	Ki-67 antigen (cell proliferation marker)
MDA:	Malondialdehyde
MYC:	Myelocytomatosis oncogene
NF-κB:	Nuclear factor kappa-light-chain-enhancer of activated B cells
NSCLC:	Non-small cell lung cancer
PARP:	Poly (ADP-ribose) polymerase
PK:	Pharmacokinetics
PTZ:	Pentylenetetrazole
RAS/RAF:	Rat sarcoma/rapidly accelerated fibrosarcoma
ROS:	Reactive oxygen species

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ORIGINAL ARTICLE OPEN ACCESS

Phytochemical Profiling and Anti-Bacterial Activity of Red Delicious Apple Pomace With Integrated Hydrolysis to Obtain Fermentable Sugars: A Biorefinery Approach

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Keywords: antioxidant | apple pomace | biorefinery | enzymatic hydrolysis | polyphenols

ABSTRACT

Apple pomace (AP) is a byproduct of juice processing, rich in nutritionally important compounds like carbohydrates, phenolic compounds, dietary fiber, and minerals. It is a potential feedstock for sugar-based biorefineries. This study explored AP physico-chemical and bioactive compounds and their hydrolysis to extract fermentable sugar. Results showed that AP had a below-neutral pH, moisture, acidity, and ash. The AP contained crude fiber (27.22%), total sugar (36.75%), and reduced sugar (12.22%). The extracts contained minerals like potassium, calcium, magnesium, aluminum, iron, boron, and zinc. A GC–MS study analyzed the phytochemicals present in AP extracts, revealing prominent antibacterial activity. The optimal conditions for enzymatic hydrolysis were found to be 1 mg/g substrate of cellulase and pectinase at 50°C and pH 5.0 at 24 h of incubation. Enzymatically hydrolyzed AP showed a high yield of reducing sugar (38.33%) compared to non-hydrolyzed AP (12.22%). The study suggests that AP, currently discarded as industrial bio-waste, is still a source of phytochemicals with significant antioxidant and antibacterial activities.

1 | Introduction

The apple processing industry primarily generates apple pomace (AP) as its main byproduct. It is mainly composed of the skin, seeds, and stems that remain after the juice extraction from the fruit. AP is a solid leftover that is generated after the separation of apple juice and comprises about 25%–30% of the total processed apples (Zaky et al. 2024). Every day, millions of tons of AP are produced throughout the world. AP comprises a wide range of phytochemicals, including simple sugars, pectin, dietary fibers, natural antioxidants, and essential nutrients (Bhushan et al. 2008). Among its many constituents are

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RESEARCH

Synergistic Sedative Activity of Indirubin on Diazepam in Thiopental Sodium-induced Sleeping Mice: A Potential GABAergic Transmission

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Abstract

Insomnia remains one of the most common sleep disorders and causes significant discomfort as well as impairment in social, interpersonal, and vocational aspects of life. This study focuses on assessing the sedative activity of indigo naturalis indirubin (IND) on thiopental sodium (TS)-induced sleeping mice and evaluating the underlying molecular mechanisms through an in silico study. The adult male *Swiss* albino mice were used and given IND (5 and 10 mg/kg, i.p.), and diazepam (DZP) (2 mg/kg) in the respective groups individually and in combination to investigate modulatory effects. After 30 min, the treated mice were given TS (20 mg/kg, i.p.) to promote sleep, and the latency and duration of sleep were recorded manually. The in vivo study revealed that a higher dose of test sample (IND-10 mg/kg) showed lower latency and higher sleeping duration than a lower dose. Furthermore, an in silico study was performed to predict the involvement of gamma-aminobutyric acid (GABA) receptors in the sleep mechanism and assess pharmacokinetics and toxicity. Findings revealed that IND increased the duration of sleeping and decreased the latency of sleep induction. Additionally. the combination therapy of IND and DZP demonstrated synergistic sedative activity, as indicated by a greater reduction in locomotor activity and increased duration of sedation compared to either drug alone. IND exhibited a higher binding affinity (–9.1 kcal/mol) than DZP (–8.3 kcal/mol) at the identical binding site in the in silico study. The pharmacokinetic analysis of IND indicated acceptable drug-likeness and good pharmacokinetic properties. In conclusion, IND produced a potent sedative effect in the mouse model, possibly through the $GABA_A$ receptor interaction pathways.

Keywords Sedation · Insomnia · Indirubin · Synergistic effect · GABA receptor · Molecular docking

Abbreviations

5-HT	5-Hydroxytriptamine
AA	Amino acid
BBB	Blood-brain barrier
BZD	Benzodiazepines
CNS	Central nervous system
DA	Dopamine
DW	Distilled water
DZP	Diazepam
GABA	Gamma-aminobutyric acid
GIA	Gastrointestinal absorption
HBA	Hydrogen bond acceptor
HBD	Hydrogen bond
IND	Indirubin
MF	Molecular formula
MR	Molar refractivity
MW	Molecular weight
NE	Norepinephrine
PC	Positive control
TCA	Tricyclic antidepressant
WFI	Water for injection

Introduction

Insomnia is a medical condition characterized by persistent dissatisfaction with the quantity or quality of sleep that is often experienced as difficulty falling asleep, frequent awakenings during the night with difficulty restoring sleep, or waking up earlier than expected even when there is enough time and suitable conditions for rest [35, 50]. Currently, a global population of around 10–30% encounters either temporary or persistent insomnia, with older people experiencing insomnia at a rate ranging from 30 to 48% [37, 53].

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Salvianolic acid A enhances sedative effect of diazepam through the GABAergic pathway: In vivo, molecular docking, and pharmacokinetics approaches

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ABSTRACT

Salvianolic acid A (SAL A), a polyphenolic compound derived from *Salvia miltiorrhiza*, exhibits several neuroprotective effects, but its sedative potential is unexamined. This study explores the sedative effects of SAL A and its potential to modulate the impacts of diazepam (DZP) in a thiopental sodium (TS)-induced sleep model in *Swiss* albino mice. Mice received intraperitoneal (i.p.) doses of SAL A (5 and 10 mg/kg) and DZP (2 mg/kg), followed by TS (20 mg/kg), with sleep latency and duration recorded. Molecular docking and in silico analyses evaluated SAL A's interaction with the $GABA_A$ receptor (α1 and β2 subunits) (PDB ID: 6X3X) and its pharmacokinetic properties. Results revealed that SAL A significantly ($p < 0.05$) reduced sleep latency and prolonged sleep duration dose-dependently, with 10 mg/kg showing the strongest effect (latency: 14.29 ± 3.09 min; duration: 175.71 ± 18.97 min; Cohen's d = 4.37 and 1.60, respectively). Combined therapy with SAL A-10 and DZP-2 synergistically enhanced sleep duration, with the highest effect sizes observed ($d = 5.45$ for latency; 4.36 for duration). Molecular docking studies revealed that SAL A showed similar binding affinity (−8.7 kcal/mol) with 6X3X, comparable to DZP. SAL A also exhibited favorable pharmacokinetic properties and low toxicity. These findings suggest SAL A as a potential novel sedative agent with synergistic effects alongside DZP. However, SAL A's poor blood-brain barrier permeability and need for structural optimization highlight the necessity for future mechanistic studies, enhanced delivery methods, and clinical validation to confirm its therapeutic potential for sleep disorders.

1. Introduction

Insomnia is a common sleep disorder characterized by difficulty initiating or maintaining sleep, often leading to impaired daily functioning and reduced quality of life (Riemann et al., 2020). It affects approximately 10 % of adults chronically, with intermittent symptoms reported in up to 20 % (Morin and Buysse, 2024). Higher prevalence is observed among older adults, women, and individuals facing socioeconomic challenges (Reynolds 3rd et al., 2022). Contributing factors include psychological disorders such as anxiety and depression, physical conditions like chronic pain and cardiovascular disease, and lifestyle habits such as excessive screen time before bed (Foster, 2020; Mukherjee et al., 2024). If left untreated, insomnia can result in cognitive deficits, immune dysfunction, and increased risk for metabolic disorders, including obesity and diabetes (Mukherjee et al., 2024).

Gamma-aminobutyric acid (GABA) is the brain's primary inhibitory

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ORIGINAL ARTICLE OPEN ACCESS

Thymol as a Potential Natural Antiemetic: Insights From In Vivo and In Silico Studies

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ABSTRACT

Nausea and vomiting are common and distressing responses to toxins, chemotherapy, and gastrointestinal disturbances. Although antiemetic medications are available, their adverse effects make safer substitutes necessary. In our study, Thymol (THY), a phenolic monoterpene from essential oils, was evaluated for its antiemetic potential using in vivo and *in silico* methods. In the in vivo study, emesis was induced in 2-day-old chicks by oral administration of copper sulfate pentahydrate (50 mg/kg). THY was administered orally at doses of 10, 20, and 40 mg/kg, alone or in combination with standard antiemetics ondansetron (ODN), domperidone (DPD), hyoscine butyl bromide (HYS), and promethazine hydrochloride (PRO). The 20 mg/kg dose (THY-20) showed the highest efficacy, significantly ($p < 0.0001$) reducing the number of retches (24.6 ± 2.7; 67.2% reduction) and increasing latency to first retch (52.6 ± 4.2 s; 77.18% increase) compared to the negative control (NC). The THY + ODN combination further enhanced effects (68.53% retch reduction). Molecular docking showed strong binding of THY to 5-HT_{3A} (−6.4 kcal/mol), D_2 (−7.1 kcal/mol), M_3 (−6.2 kcal/mol), and H_1 (−7.1 kcal/mol) receptors, comparable to standard drugs. Absorption, distribution, metabolism, excretion, and toxicity (ADMET) profiling revealed THY's compliance with Lipinski's Rule, high gastrointestinal absorption, blood–brain barrier permeability, and low toxicity risk. The multi-target binding profile and synergistic potential of THY suggest its promise as a natural, broad-spectrum antiemetic. Further receptor-specific studies and trials in chemotherapy-induced emesis models are recommended to validate its clinical potential.

1 | Introduction

Nausea and vomiting are crucial protective defenses generally occurring by uncomfortable action that causes the evacuation of stomach contents via the mouth or, occasionally, the nose and are unmistakably related to gastrointestinal motor activity (Zhong et al. 2021). It is a biological system's response to adverse drug effects, excessive motion stimuli, visceral-originated functional stimuli, chemical stimuli, illness co-morbidities, and defense against food poisoning (Ahmed et al. 2014; Eghbali et al. 2016). The causes of vomiting and nausea can be toxic or infectious (bacteria, bacterial toxins, viruses, food-borne

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RESEARCH

Linalool exerts antiemetic effects via dopaminergic and serotonergic pathways: Evidence from chick model and molecular docking

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Abstract

Linalool (LIN), a naturally occurring monoterpene alcohol found in aromatic plants, exhibits diverse pharmacological properties, yet its antiemetic potential remains underexplored. In this study, we investigated the antiemetic efficacy of LIN using both in vivo and in silico approaches. Emesis was induced in chicks via oral administration of copper sulfate pentahydrate (50 mg/kg), and LIN was tested at doses of 25, 50, and 100 mg/kg. Its effects were compared against the standard antiemetics domperidone (DOM, 7 mg/kg) and ondansetron (OND, 5 mg/kg). Results demonstrated that LIN at 100 mg/kg significantly prolonged the emetic latency and reduced the number of retches. Notably, co-administration of LIN (50 mg/kg) with DOM significantly ($p < 0.05$) produced the most potent effect, yielding the highest latency and lowest number of retches, reflecting a synergistic interaction. Molecular docking studies revealed a strong binding affinity of LIN to the dopamine D2 receptor (−6.4 kcal/mol) and moderate binding to the 5-HT3 receptor (−5.3 kcal/mol), suggesting involvement of both dopaminergic and serotonergic mechanisms. These findings collectively indicate that LIN possesses significant antiemetic activity and may offer a plant-derived alternative for emesis control.

Keywords Linalool · D_2 receptor · $5HT_3$ receptor · Antiemetic activity · Molecular docking

Introduction

A complicated reaction called emesis, which typically involves increased salivation before it starts with involuntary retching, permits an animal or human to expel poisons or toxins from their system (Popa et al. 2020). It is a typically unpleasant condition that causes the stomach contents to be expelled via the mouth and is unmistakably related to gastrointestinal motor activity (Hall and Driscoll 2005). The emesis reflex, which is coordinated

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ORIGINAL PAPER

Antiemetic Efficacy of Nodakenin Through Muscarinic, Dopaminergic, and Serotonergic Receptor Modulation: Combined Experimental and Computational Approach

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Abstract
The goal of this study was to assess the antiemetic activity of nodakenin (NOD) in a chick model using $CuSO_4.5H_2O$ (50 mg/kg; per orally (p.o.)) to induce emesis and to assess the underlying mechanism via in vivo and *silico* approaches. NOD was administered orally at three doses of 5, 10, and 20 mg/kg body weight. Conversely, hyoscine (HYO-21), ondansetron (OND-5), and domperidone (DOM-6) were supplied orally as positive controls (PCs). Distilled water (DW) containing 0.9% NaCl and 0.5% Tween 80 was utilized as a negative control (NC) group. PCs and NOD-10 were given to the chicks either separately or in combination to determine whether they had antagonistic or synergistic effects. Molecular docking and visualization of ligand-receptor interactions against D_2, D_3, 5-HT_3, and M_1-M_5 receptors were performed using computational tools, alongside pharmacokinetic (PK) and drug-likeness assessments of the selected ligands. In vivo results displayed that NOD reduced retches (8±2.09 times) and enhanced latency (106.2±4.46 s) in chicks at middle doses, with better antiemetic effects in combination therapy with HYO. In silico results showed that NOD has the strongest binding affinity (BA) against the D_2, 5-HT_3, and M_4 receptors with scores of −9.6, −7.8, and −9.8 kcal/mol through the creation of hydrogen bonds (HBs) and also showed an acceptable PK profile. In conclusion, NOD exhibits potent antiemetic effects through modulation of muscarinic receptors, warranting further investigation.

Keywords Anti-emetic · Molecular docking · Muscarinic receptor · Nodakenin

Introduction

A physiological reflex whereby respiratory muscles work together to release stomach contents orally is called emesis [1]. This process involves gastric relaxation, retroperistalsis, tightening of the abdominal muscles, and loosening of the upper esophageal sphincter, mediated by the coordinated activity of the gastrointestinal and vestibular systems [2]. In addition to the ingestion of toxic substances, emesis may be induced by diverse physiological and pathological conditions, such as food poisoning, head injuries, hormonal change, intestinal blockage, increased pressure within the skull, motion sickness, pregnancy, radiation therapy, cancer treatment, and adverse reactions to several medications [3, 4]. Acute vomiting led to several adverse conditions, like dehydration [5], electrolyte imbalance [6], esophageal perforation [7], epigastric pain [8], and increased levels of depression and anxiety in early pregnancy [9].

Emesis is controlled by the chemoreceptor trigger zone (CTZ) and vomiting center (VC) [2]. The CTZ is situated in the area postrema, which lies outside the blood-brain barrier [10]. It senses toxins in the bloodstream and cerebrospinal fluid, transmitting information to the VC via neurotransmitters, like dopamine (D_2 and D_3), serotonin (5-HT_3), muscarinic acetylcholine (M_1-M_5), opioid, and histamine (H_1) receptors [11]. Additionally, the VC received signals from the upper cerebral center, the vestibular system, and the GIT [12]. Upon activation of VC, nausea and vomiting arise from

Extended author information available on the last page of the article

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RESEARCH

Three Characterized Probiotics from Dairy Sources—Weissella confusa (ProY 5.1), Enterococcus lactis (ProY 5.3), and Leuconostoc lactis (RM 2.1)—Exhibit Potential for Antidiarrheal Effects

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Abstract
Probiotics are beneficial live microorganisms that may provide secure management of several diseases, such as diarrhea. The current research aims to assess the antidiarrheal activity of potential probiotics by utilizing in vitro and in vivo approaches. Bacterial strains were isolated from dairy products and screened for probiotic characterization, with four strains, viz., *Weissella confusa* (ProY 5.1), *Enterococcus lactis* (ProY 5.3), *Leuconostoc lactis* (RM 2.1), and *Bacillus subtilis* (ProY 11.3), selected based on in vitro approaches. These strains demonstrated non-hemolytic properties, acidic resistance, tolerance to bile salt and phenol, strong adherence rate, probiotic activity, and antimicrobial activity against six enteric pathogens. Potential strains were identified by applying molecular techniques: MALDI-TOF and whole genome sequencing. In vivo experiments on castor oil–induced diarrheal *Swiss* albino mice showed a positive impact when compared to loperamide and bismuth subsalicylate as positive controls, whereas the PBS + MRS broth was used as a negative control. Screened ProY 5.1, ProY 5.3, and RM 2.1 significantly lengthened latency periods and reduced diarrheal symptoms ($p < 0.005$). Comparatively low antidiarrheal activity was found in the ProY 11.3 isolate. The combination of candidate probiotics exhibited stronger activity compared to the individual ones. In conclusion, the three strains might be potential probiotic candidates for managing diarrhea.

Keywords Probiotics · Antidiarrheal activity · Castor oil · *Weissella confusa* · *Enterococcus lactis* · *Leuconostoc lactis*

Introduction

Probiotics, also known as beneficial dietary adjuvants, may boost both systemic and mucosal immunity in the host, enhance the nutritional status, and balance the gut microbiota [1]. Fermented and dairy beverages, enriched with probiotics, stand as integral components of Bangladesh's

Jannatul Ferdous and Md. Saddam Hossain contributed equally to this work.

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RESEARCH

Anxiolytic-Like Effects of Citronellal and Phytol, Possibly Through the GABAergic Interaction Pathway: In Vivo with Molecular Docking Studies

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Abstract

Citronellal (CTL), a natural monoterpenoid aldehyde, and phytol (PHY), a chlorophyll-derived diterpenoid, have been reported to exert neuropharmacological activities with possible GABAergic involvement. This study investigated their anxiolytic-like effects in Swiss albino mice, supported by molecular docking and pharmacokinetic evaluations. Animals received CTL (62.5, 125, and 250 mg/kg, per orally (p.o.)) or PHY (25, 50, and 75 mg/kg, p.o.) either alone or in combination with the gamma-aminobutyric acid (GABA) agonist diazepam (DZP, 2 mg/kg, p.o.) or the GABA antagonist flumazenil (FLU, 0.1 mg/kg, intraperitoneally (i.p.)). Behavioral analyses (open-field, hole-cross, swing, and light–dark tests) revealed that CTL significantly and dose-dependently reduced locomotor activity, while PHY produced variable responses, with higher doses enhancing exploratory behavior. Both compounds potentiated DZP-induced anxiolytic effects and counteracted FLU, suggesting GABAergic modulation. Molecular docking demonstrated stronger binding affinities of PHY (–4.9 and –4.2 kcal/mol) than CTL (–4.7 and –4.0 kcal/mol) at the α2 and α3 subunits of the $GABA_A$ receptor, with PHY forming hydrogen bonds (HBs) indicative of stable interactions. Pharmacokinetics and toxicity predictions confirmed favorable drug-likeness and higher LD_{50} values for CTL and PHY compared to DZP and FLU, with no major toxic liabilities. Collectively, these findings highlight that CTL may exert sedative-type anxiolytic-*like* effects, whereas PHY may show antidepressant-like anxiolytic properties, both mediated via the GABAergic pathway. These results support further investigation of CTL and PHY as potential natural anxiolytic candidates.

Keywords Anxiolytic · Natural products · Citronellal · GABAergic interaction · Phytol

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Review Article

Therapeutic Promises of Bioactive Linarin, a Glycosylated Flavonoid: A Comprehensive Review With Mechanistic Insight

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Linarin, a flavonoid glycoside found in the Asteraceae, Lamiaceae, and Scrophulariaceae families, shows diverse therapeutic benefits in laboratory studies. This study aims to evaluate the pharmacological effects of linarin through clinical and preclinical experiments, investigating its mechanisms against different diseases. To achieve this, data collection and search operations were carried out (current as of April 09, 2024) in several reliable online databases, such as PubMed/Medline, Scopus, Springer Link, ScienceDirect, Wiley Online, Web of Science, and Google Scholar, as part of this research. Studies revealed that linarin provides benefits against inflammation and various diseases, including osteoporosis, osteoarthritis, liver injuries, diabetes, hypertension, and neurodegenerative conditions, such as Alzheimer's, ischemia-reperfusion, convulsions, and depression. Our results further reveal that linarin displays remarkable anticancer potentials through multiple molecular pathways, including apoptotic cell death, oxidative stress induction, cytotoxic effect, antiproliferative effect, genotoxic effect, and mitigation of cancer cell migration and invasion and migration against a range of malignancies, including lung, brain, prostate, and glioma cell cancers. Database reports and the current literature-based study suggest that linarin might be a prospective lead chemical for treating a range of illnesses and ailments. For linarin to be proven as a medicine, further clinical and preclinical trials are required.

Keywords: flavonoid glycoside; linarin; molecular mechanism; pharmacological effects

1. Introduction

Natural products (NPs) are biologically active substances derived from natural sources such as plants, animals, and microbes [1]. Herbal remedies and folklore medicines have been used for a very long time to treat a wide range of diseases, both in developed and developing countries. In rural and impoverished areas, the majority of people have a strong belief in herbal remedies, medicinal plants, and home treatments. These alternatives are often more cost-effective than pharmaceutical medications [2, 3].

Around two centuries ago, the first pharmacologically potent compound isolated from a plant was morphine, obtained from poppy (Papaver somniferum) and discovered by a novice pharmacist (age 21) named Friedrich Sertürner. This ushered in a new era, in which medications derived

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REVIEW

Exploring the Anticancer Properties of Cinchonine: A Comprehensive Review of Cellular and Molecular Mechanisms With Botanical Source and Pharmacokinetics Property

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Keywords: alkaloid | apoptosis | cancer | cinchonine | cytotoxicity | literature review

ABSTRACT

Cinchonine (CCN), a bioactive natural compound from *Cinchona* species, has gained attention for its anticancer properties. This review aims to comprehensively evaluate the mechanisms underlying CCN's anticancer activity, along with its botanical sources and pharmacokinetic (PK) properties. Therefore, data has been collected through the use of many trustworthy and well-known search tools such as PubMed, Web of Science, Google Scholar, and other reputable sources. Our findings show that CCN promotes apoptosis in a variety of cancer cell lines by upregulating reactive oxygen species (ROS), caspase-3, caspase-9, the Bcl-2-associated X protein/B-cell lymphoma-2 (Bax/Bcl-2) ratio, and poly (ADP-Ribose) polymerase (PARP) cleavage, consequently preventing the growth of different cancer cell lines. Our results also revealed that CCN exhibits anticancer effects against various cancers, including uterine sarcoma and cervical, colon, liver, lung, prostate, pancreatic, and skin cancers. These effects are mediated through multiple mechanisms, such as inducing oxidative stress, promoting cytotoxicity, and inhibiting cancer progression by suppressing cell proliferation, migration, and invasion. Additionally, it modulates critical signaling pathways such as protein kinase B (AKT) and transforming growth factor-β-activated kinase 1 (TAK1), exhibiting efficacy against multiple cancer cell lines. Moreover, CCN exhibits a promising PK profile with optimal absorption, distribution, metabolism, and excretion (ADME) characteristics in preclinical models. These findings suggested that CCN holds significant promise as a novel anticancer agent due to its multifaceted mechanisms and favorable biopharmaceutical properties. However, further clinical trials are essential to validate its safety, efficacy, and potential as a therapeutic agent for cancer treatment.

Imam Hossen Rakib and Emon Mia have contributed equally.

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RESEARCH

Assessment of antiemetic potential of schaftoside through modulation of dopaminergic, serotonergic and muscarinic signaling pathways: in vivo and in silico investigations

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Abstract

Schaftoside (SCF), a natural flavonoid present in numerous plants, exhibits diverse physiological and pharmacological properties. This study explores the antiemetic effects of SCF in response to copper sulfate pentahydrate ($CuSO_4.5H_2O$)-induced vomiting, employing both in vivo and in silico methods. To induce emesis in chicks, $CuSO_4.5H_2O$ (50 mg/kg) was administered orally. SCF was tested at doses of 5, 10, and 20 mg/kg and compared to standard antiemetics domperidone (DOM-6 mg/kg), ondansetron (OND-5 mg/kg), and hyoscine (HYO-21 mg/kg). The control group received a vehicle, while additional groups received drug combinations to assess synergy or antagonism. Molecular docking and ligand-receptor interactions targeting D_2, D_3, $5HT_3$, and M_1–M_5 receptors were analyzed, and SCF's pharmacokinetics (PKs), drug-likeness, and toxicity were evaluated. SCF showed antiemetic effects at higher doses (20 mg/kg), reducing retching (1.8 ± 0.41) and increasing latency (67.6 ± 2.63 s) compared to the vehicle. SCF also enhanced the efficacy of DOM, OND and HYO. The molecular docking results indicated that SCF binds strongly, particularly at M_4 (-9.7 kcal/mol), with higher affinity than all reference drugs except D_3. Our findings indicate that SCF exerts potent antiemetic effects by modulating the D_2, $5HT_3$ and muscarinic receptor pathways. PKs and toxicity profiling revealed that SCF possesses favorable drug-likeness characteristics, good water solubility, moderate skin permeability, favorable metabolic and excretory characteristics as well as promising safety profile. Despite some lacking in PKs properties, its safety profile and efficacy in behavioral models support SCF as a promising candidate for antiemetic drug.

Keywords Emesis · Vomiting · Schaftoside · Molecular docking · Flavonoid

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REVIEW

A Comprehensive Analysis of Natural Bioactive Molecules for the Treatment and Control of Glioblastoma Multiforme (GBM) Targeting Underlying Molecular Mechanism

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Keywords: apoptosis | blood–brain barrier | glioblastoma | natural small molecules | novel drug delivery

ABSTRACT

Glioblastoma multiforme (GBM) is a highly aggressive brain tumor characterized by rapid cellular proliferation and invasion, making it difficult to achieve a complete cure. Despite therapies like surgery, radiotherapy, and chemotherapy, GBM results in poor survival rates, with a median survival of just 1 year. This has led to the need for more effective treatment options with fewer side effects. The study aims to explore the mechanisms behind GBM and highlight the potential of natural bioactive compounds, either alone or in combination with conventional therapies, to provide synergistic effects. Several small natural molecules, such as resveratrol, curcumin, rutin, and icariin, have shown promising anticancer and apoptotic properties in drug-resistant and p53-mutant GBM cell lines. These compounds enhance the antitumor effects of temozolomide (TMZ), targeting

Abbreviations: ADCs, antibody-drug conjugates; ADSCs, adipose-derived stem cells; ATP, adenosine triphosphate; ATRX, α-thalassemia x-linked intellectual disability; BBB, blood–brain barrier; CDK1, cyclin-dependent kinase 1; CED, convection-enhanced delivery; CNS, central nervous system; COX-2, cyclooxygenase-2 inhibitor; DMBA, 7,12-dimethylbenz[a]anthracene; EGCG, epigallocatechin gallate; EGF, epidermal growth factor; EPF, epidermal pattern factor; ETC, electron transportation chain in mitochondria; FAK, focal adhesion kinase; FDA, The Food and Drug Administration; FOXO, Forkhead box O protein; GBM, glioblastoma multiforme; GSC, glioma stem cell; hCG, chorionic gonadotropin; HDACIs, histone deacetylase; HIF-1, hypoxia-inducible factor 1; hTERT, telomerase reverse transcriptase; IDH, isocitrate dehydrogenase; IGF-1, insulin-like growth factor-I; IGFBP-3, insulin-like growth factor binding-protein-3; iPSCs, induced pluripotent stem cells; JNK, c-jun N-terminal kinase; KEAP1, kelch like ECH associated protein 1; LDL, low-density lipoproteins; MAPK, mitogen-activated protein kinase; MAPKs, mitogen-activated protein kinases; MDM2, mouse double minute 2 homolog; MGMT, methylguanine methyltransferase; MRgFUS, magnetic resonance imaging-guided focused ultrasound surgery; MRI, magnetic resonance imaging; MSN, mesoporous silica nanoparticle; mTOR, target of rapamycin; NPs, nanoparticles; Nrf2, nuclear factor erythroid 2–related factor 2; NSCs, neural stem cells; OVs, oncolytic viruses; PCNA, proliferating cell nuclear antigen; PDGF, platelet-derived growth factor; PEG-DMA, polyethylene glycol dimethacrylate; PET, positron emission tomography scan; PG, propylene glycol; PPP, pentose phosphate pathway; PTEN, phosphatase and TENsin homolog deleted on chromosome 10; RMS, rhabdomyosarcoma cells; ROS, reactive oxygen species; RSV, respiratory syncytial virus; SGK1, serum and glucocorticoid-regulated kinase 1; SLNs, solid lipid nanoparticles; SOD, superoxide dismutase; STAT3, signal transducer and activator of transcription 3; TCA, tricarboxylic acid; TGF, transforming growth factor; TKR, tyrosine kinase receptor; TMZ, temozolomide; TOP2, topoisomerase II; WHO, World Health Organization; LDLR, low-density lipoprotein receptors; PI3K, phosphatidylinositol 3-kinase and Akt (protein kinase B); VEGF, vascular endothelial growth factor.

Anwar Parvez and Md. Anisur Rahman contributed equally to this work.

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RESEARCH ARTICLE OPEN ACCESS

Vanillin Modulates the Sedative Effect of Diazepam, Possibly Through GABAergic Interaction Pathways in Thiopental Sodium-Induced Sleeping Mice

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Keywords: $GABA_A$receptor interaction | insomnia | molecular docking | phytochemical | vanillin

ABSTRACT

Insomnia is a common sleep disorder affecting approximately 10% of adults. This study aimed to evaluate the sedative effects of vanillin (VAN) and its combination with diazepam (DZP) in thiopental sodium (TS)-induced sleeping mice. Mice received VAN (25 and 50 mg/kg, i.p.) or DZP (2 mg/kg, i.p.), followed by TS (20 mg/kg, i.p.) after 30 min to assess sleep latency and duration over 3 h. Additionally, we also used molecular docking and visualization to assess the VAN and DZP's $GABA_A$ receptor binding affinities and interactions. VAN significantly reduced sleep latency and prolonged sleep duration in a dose-dependent manner. At 50 mg/kg, VAN decreased latency to 7.40 ± 1.44 min and increased sleep duration to 134.80 ± 6.82 min. When combined with DZP, VAN further enhanced sedative effects, reducing latency to 3.00 ± 0.83 min and extending sleep to 154.40 ± 7.4 min. Molecular docking showed that VAN binds to α1 and β2 subunits of the $GABA_A$ receptor with a −5.5 kcal/mol affinity and can cross the blood–brain barrier. These findings suggest that VAN has mild sedative effects and enhances the activity of DZP via GABAergic pathways, highlighting its potential as a complementary agent in sleep disorder management.

1 | Introduction

Insomnia, which refers to the undesirable condition of having trouble sleeping, is a prevalent issue that can manifest as acute, intermittent, or chronic sleeping disorders. It frequently serves as the initial symptom of various prevalent sleep disorders (Sutton 2021). The condition influences both physical and mental health (Bragg et al. 2019). Approximately 10% of the adult population suffers from an insomnia disorder and another 20% experience occasional insomnia symptoms (Morin and Jarrin 2022). It is associated with an increased risk of a variety of other diseases, including neurological (headaches, Parkinson's disease, epilepsy, neuromuscular disease, stroke, traumatic brain injury, multiple sclerosis, and dementia) and cardiovascular (coronary heart disease, heart failure, and hypertension) (Javaheri and Redline 2017; Mayer et al. 2021). It can be caused by various psychological, environmental, and lifestyle factors (Fernandez-Mendoza and Vgontzas 2013). Common causes include stress, life events, and poor sleep habits (Kalmbach et al. 2018). However, medical conditions, such as ongoing pain, cancer, and diabetes, as well as consuming caffeine, nicotine, and alcohol, which are stimulants, can also interfere with sleep (Garcia and Salloum 2015; Vernia et al. 2021).

Current treatments for insomnia have two approaches: pharmacological and cognitive behavioral therapy (Cunnington and Junge 2016). Pharmacological medications may be prescribed for short-term relief of insomnia symptoms or in cases where non-

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Research Square

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Abietic acid enhances the sedative activity of Diazepam: In vivo approach along with receptor binding affinity and molecular interaction with the GABAergic system

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Research Article

Keywords: Abietic acid, sedation, in vivo, molecular docking, GABAergic system

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Clinical Phytoscience

RESEARCH Open Access

Membrane-stabilizing and clot-lysing capacity of *Coriandrum sativum* ethanolic extract and one of its major components called linalool

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Abstract

Background *Coriandrum sativum* L. is well known for its usage in traditional medicine and cooking. This herb is commonly known as coriander as well as cilantro. *C. sativum* possesses many important phytochemical groups, including polyphenols, vitamins, and phytosterols, with promising biological activities such as antioxidant, anti-inflammatory, anticancer, anti-antidiabetic, neuropharmacological, and so on. This study aimed to assess the membrane-stabilizing and clot-lysis capacity of *C. sativum* ethanol extract (ECS) and its major component, linalool (LIN).

Methods In-vitro membrane-stabilizing action of ECS and LIN was performed by using hemolysis of human red blood cells (HRBCs) and egg albumin protein denaturation techniques, and clot lysis activity was observed by human clotted blood techniques. Further, we observed in-silico studies.

Results ECS and LIN showed significant ($p < 0.05$) membrane-stabilizing and clot-lysing capacity compared to the control group in a concentration-dependent manner. The highest inhibition of hemolysis by the ECS was observed at 160 µg/mL by 77.61 ± 0.01%, while LIN demonstrated 52.32 ± 0.01%. Further, in the egg-albumin protein denaturation test, ECS and LIN demonstrated 27.62 ± 0.01% and 46.74 ± 0.02% membrane protection, respectively. At 160 µg/mL, ECS and LIN showed clot lysis activity of 18.02 ± 3.968% and 52.32 ± 0.01%, respectively. In our in-silico studies, LIN exhibited significant binding interactions with different inflammatory mediators and clot lysis factors.

Conclusion ECS showed strong membrane-stabilizing and moderately clot-lysing activity in our studies, and it may be possible due to the presence of the major component LIN.

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RESEARCH PAPER

GABAergic Anticonvulsant Prospects of Thymol Through In Vivo and In Silico Studies

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Abstract
Thymol (THY), a naturally occurring monoterpenoid phenol, exhibits a broad spectrum of biological activities, including anticonvulsant properties. However, the possible action mechanism behind this fact has yet to be discovered. This study aimed to evaluate the anticonvulsant effects of THY with possible molecular insights through in vivo and in silico studies. For this, we performed isoniazid (INH) and pentylenetetrazole (PTZ)-induced convulsion studies in *Swiss* mice, along with molecular docking studies with the $GABA_A$ receptor subunits. Our in vivo study reveals that THY (especially at 25, and 50 mg/kg) significantly ($p<0.05$) and dose-dependently delayed the onset of convulsion and decreased the duration of convulsion along with the mortality rates, thereby increasing protection in animals alone and/or with the standard GABAergic anticonvulsant drug diazepam (DZP) (2 mg/kg). Interestingly, THY antagonized both INH and PTZ-induced convulsions more profoundly with DZP in animals. In silico studies demonstrate that THY showed a strong binding affinity against $GABA_A$ (−6.6 kcal/mol) by forming several bonds. THY may be a potential candidate for anticonvulsant therapy to manage convulsions and their associated comorbidities in animals.

Keywords Convulsion · GABAkine interaction · Molecular docking · Natural product · Thymol

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RESEARCH

Combining anxiolytic activity of thymol and *trans*-ferulic acid: a potential GABAergic intervention

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Abstract

Trans-ferulic acid (TFA), a phenolic acid abundant in fruits and cereals, and thymol (THY), a monoterpenoid phenol from thyme oils, are bioactive natural compounds with notable neuropharmacological potential. This study evaluated the combined anxiolytic effects of THY and TFA in Swiss albino mice, focusing on GABAergic mechanisms and pharmacokinetic profiles through in vivo and in silico methods. Mice received vehicle, diazepam (DZP, 2 mg/kg), TFA (50 mg/kg), THY (50 mg/kg), or their combination (THY + TFA; 50 + 50 mg/kg, p.o.). Behavioral assessments in open-field, swing, hole-cross, and light–dark tests indicated that the combined treatment produced more pronounced effects, markedly reducing locomotor and exploratory activity (e.g., square crosses: 25.8 ± 3.7 vs. 94.6 ± 6.2 in control; hole crosses: 3.4 ± 1.8 vs. 15.6 ± 1.9) and increasing time in the light chamber, consistent with anxiolytic-like activity comparable to DZP. Molecular docking targeted gamma-aminobutyric acid A ($GABA_A$) receptor subunits (α2, α3), and ADME/toxicity profiles were analyzed in silico. Docking analysis revealed moderate binding affinities (BAs) to $GABA_A$ receptor subunits AF-P26048-F1 (α2 subunit) (− 5.8 kcal/mol) and 8G4X (α3 subunit) (− 5.3 kcal/mol) for TFA and α2 (− 4.7 kcal/mol) and α3 (− 5.6 kcal/mol) for THY, relative to DZP (− 6.9 kcal/mol). These findings suggest that the THY + TFA combination elicits enhanced GABAergic modulation, offering a potential natural therapeutic strategy for anxiety management with reduced toxicity risk. However, formal interaction analyses (e.g., isobologram or two-way ANOVA) are warranted to confirm the combining effect.

Keywords Anxiolytic · Thymol · *Trans*-ferulic acid · $GABA_A$ · Combining effect · In vivo

Introduction

Anxiety disorders are among the most prevalent mental health conditions globally, characterized by excessive fear, apprehension, and physiological hyperarousal that interfere with daily functioning (Stein et al. 2021; Haque 2021; Lin et al. 2021). Common symptoms include restlessness, muscle tension, palpitations, and difficulty concentrating, reflecting both psychological and somatic manifestations (Hacke et al. 2020). Prolonged anxiety impairs quality of life and increases the risk of comorbid conditions, including depression and cardiovascular disease (Veskovic et al. 2023). According to the World Health Organization (WHO), anxiety disorders affect approximately 301 million people worldwide, making them a major contributor to the global burden of mental illness (Depressive disorder (depression) (who.int); https://www.who.int/newsroom/fact-sheets/detail/mental-disorders, accessed on 20 April 2023).

GABA serves as the principal inhibitory neurotransmitter in the central nervous system (CNS), maintaining the balance between neuronal excitation and inhibition (Ströhle et al. 2018). Reduced GABAergic transmission has been implicated in the pathogenesis of anxiety and related mood disorders (Cutler et al. 2023). GABA receptors have three subtypes: $GABA_A$, $GABA_B$, and $GABA_C$ (Zizzo et al. 2022). The $GABA_A$ receptor, a ligand-gated chloride ion channel, plays a crucial role in mediating anxiolytic and sedative actions, with the α2 and α3 subunits primarily responsible for anxiolytic activity (Ghit et al. 2021; Qian et al. 2023).

Benzodiazepines such as DZP and alprazolam are well-established $GABA_A$ receptor modulators and remain the standard pharmacotherapy for anxiety (Hozack et al. 2022). When overdosed, they often only show mild to severe toxicity signs (Bhuia et al. 2023b). However, chronic use often

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Antipsychotic effect of *Aegiceras corniculatum* (L.) Blanco: Evidence from murine behavioral assays and computational studies

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ABSTRACT

Introduction: Antipsychotic therapy targets the mesolimbic dopaminergic hyperactivity observed in schizophrenia. Drugs such as olanzapine (Zyprexa) alleviate positive symptoms by suppressing this pathway, although they are often associated with adverse effects, including psychomotor slowing. Notably, In Traditional Chinese Medicine (TCM), *Aegiceras corniculatum* (蠟燭果;桐花樹) is documented in classical materia medica for treating pain, swelling, rheumatism, asthma, and diabetes. Its traditional role in analgesia and nociception suggests engagement of central pain-modulating pathways, and together with reported neuromodulatory properties, provides a rationale for evaluating its relevance in schizophrenia.

Methods: Ethanolic leaf extract of *A. corniculatum* (ACEE) was evaluated in dopamine-induced mouse models using marble burying, dust removal, and trained swim tests. Effects were compared with olanzapine (Zyprexa) (OLN-2) and combination treatments. Phytoconstituents were identified via GC–MS, while molecular docking and ADMET profiling assessed interactions with dopamine D_2 receptors, pharmacokinetics, and safety.

Results: Dopamine (DOP-22) significantly increased compulsive behaviors (marble burying: 13.8 ± 1.5 vs. 10.8 ± 1.9 in controls; dust removal: 141.4 ± 9.3 g vs. 107.1 ± 14.3 g, $p < 0.05$). OLN-2 reduced both (6.0 ± 0.6 marbles; 42.5 ± 4.9 g). ACEE produced dose-dependent reductions (9.3 ± 1.8 and 8.0 ± 1.8 marbles; 87.3 ± 8.4 g and 64.4 ± 11.2 g). Combined ACEE-250 and OLN-2 yielded stronger suppression (5.7 ± 0.8 marbles; 54.2 ± 6.8 g). In the trained swim test, dopamine improved performance (6.8 ± 2.1 s vs. 10.3 ± 1.7 s), while OLN-2 impaired it (18.7 ± 2.4 s). ACEE caused moderate slowing (15.4 ± 1.3 s), suggesting partial preservation of psychomotor function. Docking revealed BOPC as the strongest D_2 ligand (-9.1 kcal/mol), while more abundant compounds (PPD, BEA, MDT) showed moderate affinities with favorable ADMET characteristics.

Conclusion: ACEE demonstrated antipsychotic-like activity through dopaminergic modulation, with an additive effect when combined with OLN-2, and showed a milder impact on psychomotor performance. Supported by traditional use and preliminary modern analyses, *A. corniculatum* warrants further investigation as a potential complementary source of dopaminergically active compounds.

1. Introduction

Traditional Chinese Medicine (TCM) has long utilized plant-based remedies for the management of a wide spectrum of physiological and neurological disorders, relying on empirical knowledge of herbal pharmacology to modulate complex biological pathways [1]. Among these, *Aegiceras corniculatum* (Linn.) Blanco (*A. corniculatum*), commonly known as black mangrove or river mangrove, and Khalsi, is also referred to in Chinese as 蠟燭果 (Là zhú guǒ, "candle fruit") and 桐花樹 (Tóng huā shù, "tung-flower tree"). This species has been historically applied

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Research Article

Polyphenol-Standardized *Aphanamixis polystachya* Leaf Extract Ameliorates Diabetes, Oxidative Stress, Inflammation, and Fibrosis in Streptozotocin-Induced Diabetic Rats

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Background. Diabetes is a rising disorder that affects millions of people annually. It also creates more complications, such as neuropathy, oxidative stress, and hepatic and kidney impairment. *Aphanamixis polystachya* plant, which possesses multiple medicinal values, is used in this study to explore its potential in treating diabetes. *Methods*. A single dose (65 mg/kg) of intraperitoneal streptozotocin injection was utilized to mediate diabetes in Sprague-Dawley rats. Diabetic animals were treated orally with 250 or 500 mg/kg of standardized leaves' extract of *A. polystachya* (AP) for 28 days to evaluate the antidiabetic and organ-protective effects of the plant. Different biochemical and histological markers are measured according to the established protocol. *Results*. Our results demonstrated a significant decrease in blood glucose ($p < 0.001$) and HbA1c ($p < 0.05$) levels in the diabetic animal after administering AP (250 and 500 mg/kg doses) compared to the control groups. AP can also regularize lipids, glycogen, alanine aminotransferase, and aspartate aminotransferase. Furthermore, serum urea nitrogen and creatinine decreased after treatment with AP in diabetic rats. AP also reduced oxidative stress markers and showed a substantial elevation in antioxidant enzymes in diabetic animals. Overall, AP at 500 mg/kg revealed comparable results against the standard antidiabetic drug glyburide. Besides, the histological investigation showed the AP's efficacy in attenuating kidney tissue inflammation and damage. HPLC data elucidated that the AP leaf extract contains polyphenols with potential antioxidant, antidiabetic, and organ protective agents: gallic acid, rutin hydrate, and quercetin hydrate. *Conclusion*. Taken together, AP may be one of the potential sources of antidiabetic agents.

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Anti-diarrheal effect of piperine possibly through the interaction with inflammation inducing enzymes: *In vivo* and *in silico* studies

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Diarrhea
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ABSTRACT

Piperine is a natural alkaloid that possesses a variety of therapeutic properties, including anti-inflammatory, antioxidant, antibacterial, and anticarcinogenic activities. The present study aims to assess the medicinal benefits of piperine as an anti-diarrheal agent in a chick model by utilizing *in vivo* and *in silico* techniques. For this, castor oil was administered orally to 2-day-old chicks to cause diarrhea. Bismuth subsalicylate (10 mg/kg), loperamide (3 mg/kg), and nifedipine (2.5 mg/kg) were used as positive controls, while the vehicle was utilized as a negative control. Two different doses (25 and 50 mg/kg b.w.) of the test sample (piperine) were administered orally, and the highest dose was tested with standards to investigate the synergistic activity of the test sample. In our findings, piperine prolonged the latent period while reducing the number of diarrheal feces in the experimental chicks during the monitoring period (4 h). At higher doses, piperine appears to reduce diarrheal secretion while increasing latency in chicks. Throughout the combined pharmacotherapy, piperine outperformed bismuth subsalicylate and nifedipine in terms of anti-diarrheal effects with loperamide. In molecular docking, piperine exhibited higher binding affinities towards different inflammatory enzymes such as cyclooxygenase 1 (−7.9 kcal/mol), cyclooxygenase 2 (−8.4 kcal/mol), nitric oxide synthases (−8.9 kcal/mol), and L-type calcium channel (−8.8 kcal/mol), indicating better interaction of PP with these proteins. In conclusion, piperine showed a potent anti-diarrheal effect in castor oil-induced diarrheal chicks by suppressing the inflammation and calcium ion influx induced by castor oil.

1. Introduction

A digestive illness marked by an unusual frequency and fluidity of bowel evacuation is described as diarrhea in the pathology (Schiller et al., 2014). The fundamental sign of diarrhea is assumed to be an upsurge in stool fluidity (Schiller, 2000). It normally takes a few days for diarrheal symptoms to go away, but the loss of too much water, salt, and nutrition from the body during severe or prolonged diarrhea can result in dehydration and even death (Ejemot-Nwadiaro et al., 2021). Acute diarrhea is a general intestinal reaction to a number of various illnesses, such as infections, pharmacological side effects, inflammatory bowel disease, and ischemia, that typically lasts for less than four weeks (Aranda-Michel and Giannella, 1999). Contrarily, chronic diarrhea is less frequent; 3–5% of the population may experience it at any point during the course of a year (Schiller et al., 2014). Infant mortality and morbidity are largely brought on by diarrheal illnesses that place a tremendous strain on world health (Thiagarajah et al., 2014). Diarrheal illness in children under the age of five affects roughly 1.7 billion people

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Natural Isatin Derivatives Against Black Fungus: In Silico Studies

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Abstract
During this coronavirus pandemic, when a lot of people are already severely afflicted with SARS-CoV-19, the dispersion of black fungus is making it worse, especially in the Indian subcontinent. Considering this situation, the idea for an in silico study to identify the potential inhibitor against black fungal infection is envisioned and computational analysis has been conducted with isatin derivatives that exhibit considerable antifungal activity. Through this in silico study, several pharmacokinetics properties like absorption, distribution, metabolism, excretion, and toxicity (ADMET) are estimated for various derivatives. Lipinski rules have been used to observe the drug likeliness property, and to study the electronic properties of the molecules, quantum mechanism was analyzed using the density functional theory (DFT). After applying molecular docking of the isatin derivatives with sterol 14-alpha demethylase enzyme of black fungus, a far higher docking affinity score has been observed for the isatin sulfonamide-34 (derivative 1) than the standard fluconazole. Lastly, molecular dynamic (MD) simulation has been performed for 100 ns to examine the stability of the proposed drug complex by estimating Root Mean Square Deviation (RMSD), Radius of gyration (Rg), Solvent accessible surface area (SASA), Root Mean Square Fluctuation (RMSF), as well as hydrogen bond. Listed ligands have precisely satisfied every pharmacokinetics requirement for a qualified drug candidate and they are non-toxic, non-carcinogenic, and have high stability. This natural molecule known as isatin derivative 1 has shown the potential of being a drug for fungal treatment. However, the impact of the chemicals on living cells requires more investigation and research.

Introduction

The pandemic coronavirus disease (Covid-19) has spread over the entire world since 2019 and caused more than 760 million known cases with 6.873 million deaths till now [1]. The humongous vaccination program all over the world has helped to mitigate the effects of this severe disease [2]. In early 2021, there were a lot of reports and documentation regarding the increase of mucormycosis (black fungus) coinfections among Covid-19 patients [3]. Additional difficulties arose for doctors and scientists to manage the COVID-19 pandemic because of the coinfection seen in some individuals [4]. Covid-19 patients were infected by black fungus when they were in the hospital or after discharge [5]. In India, 45,432 confirmed black fungal cases were confirmed, and among them, 4252 patients were demised [6]. Infection with black fungus, also known as mucormycosis, is caused by a fungus from the 'Mucorales' order, which is composed of filamentous aseptate fungi [7]. Approximately, 25–73% of SARS-related deaths were attributed to fungi according to estimates [8, 9]. Patients with Covid-19 who had recently

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Anticonvulsant effect of (±) citronellal possibly through the GABAergic and voltage-gated sodium channel receptor interaction pathways: *In vivo* and *in silico* studies

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ABSTRACT

This study aimed to investigate the anticonvulsant effects of citronellal (CIT) and possible underlying mechanisms through an isoniazid (INH)-induced seizure (convulsion) via *in vivo* and *in silico* studies. For this, convulsions were induced by the oral administration of INH (300 mg/kg) to the mice. The animals were treated orally with different doses of CIT (50, 100, and 200 mg/kg). Vehicle served as a negative control (NC), while diazepam (DZP) (2 mg/kg) and carbamazepine (CAR) (80 mg/kg) were provided (p.o.) as positive controls (PC). A combination therapy of CIT (middle dose) with DZP and CAR was also given to two separate groups of animals to estimate the synergistic or antagonistic effects. Molecular docking and visualization of ligand-receptor interactions are also estimated through different computational tools. The results of the *in vivo* study showed that CIT dose-dependently significantly ($p < 0.05$) exhibited a higher onset of seizures while reducing the frequency and duration of seizures in mice compared to the NC group. Besides these, in combination therapy, CIT significantly antagonized the activity of CAR and DZP, leading to a reduction in the onset of seizures and an increase in their frequency and duration compared to treatment with CAR and DZP alone. Additionally, molecular docking revealed that the CIT exhibited a moderate binding affinity (−5.8 kcal/mol) towards the $GABA_A$ receptor and a relative binding affinity (−5.3 kcal/mol) towards the voltage-gated sodium channel receptor by forming several bonds. In conclusion, CIT showed moderate anticonvulsant activity in INH-induced convulsion animals, possibly by enhancing $GABA_A$ receptor activity and inhibiting the voltage-gated sodium channel receptor.

1. Introduction

Epilepsy is a chronic neurological condition characterized by recurrent or unexpected seizures, which may be categorized into partial and generalized seizures as well as simple and complicated seizures (Sirven, 2015). On a global scale, around 50 million individuals have epileptic seizures, with an additional 5 million receiving an annual diagnosis of epilepsy. These conditions have a significant impact on their quality of life, leading to various psychological issues (Alimoradi et al., 2023; Pontes Silva and Gama Marques, 2023). Approximately 80% of individuals diagnosed with epilepsy reside in nations classified as low- and middle-income (Minwuyelet et al., 2022). Epilepsy may arise from hereditary factors that can be attributed to other brain injuries, such as head trauma, stroke, vascular abnormalities, congenital brain deformities, or central nervous system infections (Stafstrom and Carmant, 2015). Epileptic seizures are often characterized by transient symptoms

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Longevity Spinach (*Gynura procumbens*) Ameliorated Oxidative Stress and Inflammatory Mediators in Cisplatin-Induced Organ Dysfunction in Rats: Comprehensive *in vivo* and *in silico* Studies

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This study focused to assess the efficacy of *Gynura procumbens* (GP) leaf extract against cisplatin (CP)-induced hepatorenal complications in Wister albino rats. Additionally, it aims to detect polyphenolic compounds using high-performance liquid chromatography with diode-array detection (HPLC-DAD). The rats were treated intraperitoneally with CP (7.5 mg/kg) to mediate hepatorenal damage. They were then treated with GP extract (75 and 150 mg/kg, P.O.) for 7 consecutive days. Although GP extract significantly ameliorated CP-mediated hepatorenal biomarkers like alkaline phosphatase (ALP), alanine aminotransferase (ALT), aspartate aminotransferase (AST), creatinine, and blood urea nitrogen (BUN) levels in a dose-dependent manner, GP extract at 150 mg/kg dose normalized hepatorenal biomarkers ALP (45.11 U/L), ALT (34 U/L), AST (29 U/L), creatinine (10.3 mg/dl) and BUN (11.19 mg/dl) while comparing to control and disease group. Similarly, though it significantly reduced CP-induced oxidative stress inducers, including nitric oxide (NO) and advanced oxidative protein products (AOPP), higher dose (150 mg/kg) exhibited better activity in reducing NO (281.54 mmol/gm tissue in liver and 52.73 mmol/gm tissue in the kidney) and AOPP (770.95 mmol/mg protein in liver and 651.90 mmol/mg protein in the kidney). Besides, it showed better enhancement in the antioxidant enzymes superoxide dismutase, and glutathione levels at a higher dose (150 mg/kg). Histopathological studies showed that CP caused collagen accumulation in the liver and kidney tissues. GP extract drained the collagen mass and acted against hepatorenal damage. Ellagic acid, gallic acid, quercetin hydrate, kaempferol, and rutin hydrate were revealed in GP extract. *In-silico* modelling showed good docking scores of the polyphenolic compounds with molecular targets including CYP4502E1, NF-κB, caspase-3, and TNF-α. GP could be an effective therapeutic option for management of anticancer drugs' complications like CP-induced organ damage, although clinical studies are required to establish herbal formulation.

1. Introduction

Cancer is one of the most alarming global public health issues.[1,2] Cisplatin (CP) is an anti-cancer medication based on inorganic platinum.[3] It works well for treating solid tumors such as head and neck, ovarian, malignant pleural mesothelioma, lung, and ovarian malignancies.[4–6] Despite being therapeutically effective, CP has several serious adverse effects, including nephrotoxicity, hepatotoxicity, cardiotoxicity, and neurotoxicity.[7,8] CP increases hydroxyl and other free radicals while destroying cell membranes leading to a rise in lipid peroxidation, inflammation, and hypoxia.[4,9] Acute nephrotoxicity is caused by these injuries, which also decreases glomerular infiltration. The major site for intracellular CP accumulation is the mitochondria.[10] Mitochondrial damage can occur by CP attack, and thus the level of reactive oxygen species (ROS) can

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Efficacy of Rotundic Acid and Its Derivatives as Promising Natural Anticancer Triterpenoids: A Literature-Based Study

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Rotundic acid (RA) is a naturally occurring pentacyclic triterpene with a multitude of pharmacological activities. The primary emphasis of this study is on summarizing the anticancer properties with the underlying mechanisms of RA and its derivatives, as well as the pharmacokinetic features. Data was collected (up to date as of November 10, 2023) from various reliable and authentic literatures by searching in different academic search engines, including PubMed, Springer Link, Scopus, Wiley Online, Web of Science, ScienceDirect, and Google Scholar. The findings imply that RA and its synthetic derivatives possess promising anti-cancer properties against breast, colorectal, liver, and cervical cancers in various preclinical pharmacological test systems. The results also indicate that RA and its derivatives demonstrated anticancer effects via a number of cellular mechanisms, including apoptotic cell death, inhibition of oxidative stress, anti-inflammatory effect, cytotoxicity, cell cycle arrest, anti-proliferative effect, anti-angiogenic effect, and inhibition of cancer cell migration and invasion. It has been proposed that RA and its derived compounds have the capability to serve as a hopeful chemotherapeutic agent, so further extensive clinical research is necessary.

Introduction

Cancer is a disease that can grow in almost all kinds of organs or surrounding tissues. The excessive proliferation of cancerous cells in the body identifies approximately 100 specific illnesses that compensate for the cancer group.[1] According to the World Health Organization (WHO), 10 million deaths, or almost one-sixth of all deaths, occurred in the world in 2020, leading to cancer. In 2020, lung cancer (1.80 million deaths) was the leading cause of cancer-associated death, and each year, about 400 000 young people receive cancer diagnoses (https://www.who.int/health-topics/cancer, accessed on 05 March 2023). When one or more genes mutate, cancerous cells are created. These cells form cancerous clusters and can separate from tumors to spread to multiple body sites. Cancer can sometimes progress silently, or it can produce observable symptoms that worsen rapidly.[2] Cancer cells disseminate the disease through proliferation, metastasis, invasion, treatment resistance, angiogenesis, and the formation of pre-metastasis niches.[3] Despite the complicated nature of cancer development, the precise role of several risk factors varies globally due to inherited genetic factors, improper lifestyles such as poor diets, alcohol drinking and smoking, physical inactivity, and several diseases.[4,5]

With the advancement of medical biology, traditional methods like chemotherapy, surgery, and radiotherapy have been used for decades as cancer treatments.[6–12] Since cancer cells resemble healthy human cells, anticancer medications frequently harm healthy cells as well, and some of their side effects are extremely dangerous. In addition, during cancer treatment, patients may experience bone marrow toxicity, cardiac abnormalities, and hair loss, ulcers in the mouth and other surrounding tissues, and possibly permanent infertility.[13,14] However, some of the technologies that will transform the way cancer is treated include targeted therapeutics, customized vaccines, gene therapy, stem cell transplantation, and microbiome treatments.[15]

In the current period of drug development, natural compounds have provided an unparalleled supply of anticancer medications.[16–19] There are a number of natural substances being used to cure cancer, such as vitamins, minerals, and phytochemicals, which have produced promising outcomes in the therapy of a number of malignant tumors.[20] There are many sources of bioactive substances from herbs that have been proven to have anti-cancer properties, including genistein from soybeans, curcumin from turmeric, polyphenols from green tea, sulforaphane from broccoli, resveratrol from grapes, diallyl sulfide from garlic, rosmarinic acid from rosemary, lycopene from tomatoes, and gingerol from gingers, to name just a few examples.[21–24] In this context, natural substances have been proposed for evaluation of their synergistic efficacy with conventional anticancer medications due to their strong antitumor activity and low toxicity in healthy tissues.[20]

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RESEARCH ARTICLE

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Quercetin increases the antidepressant-like effects of sclareol and antagonizes diazepam in thiopental sodium-induced sleeping mice: A possible GABAergic transmission intervention

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Abstract

Quercetin is the most common polyphenolic flavonoid present in fruits and vegetables demonstrating versatile health-promoting effects. This study aimed to examine the effects of quercetin (QR) and sclareol (SCL) on the thiopental sodium (TS)-induced sleeping and forced swimming test (FST) mouse models. SCL (1, 5, and 10 mg/kg, *p.o.*) or QR (50 mg/kg, p.o.) and/or diazepam (DZP) (3 mg/kg, i.p.) were employed. After 30 min of TS induction, individual or combined effects on the animals were checked. In the FST test, the animals were subjected to forced swimming after 30 min of administration of the test and/or controls for 5 min. In this case, immobility time was measured. In silico studies were conducted to evaluate the involvement of GABA receptors. SCL (5 and 10 mg/kg) significantly increased the latency and decreased sleeping time compared to the control in the TS-induced sleeping time study. DZP (3 mg/kg) showed a sedative-like effect in animals in both sleeping and FST studies. QR (50 mg/kg) exhibited a similar pattern of activity as SCL. However, its effects were more prominent than those of SCL groups. SCL (10 mg/kg) altered the DZP-3-mediated effects. SCL-10 co-treated with QR-50 significantly ($p < 0.05$) increased the latency and decreased sleep time and immobility time, suggesting possible synergistic antidepressant-like effects. In silico studies revealed that SCL and QR demonstrated better binding affinities with GABAA receptor, especially α_2, α_3, and α_5 subunits. Both compounds also exhibited good ADMET and drug-like properties. In animal studies, the both compounds worked synergistically to provide antidepressant-like effects in a slightly different fashion. As a conclusion, the combined administration of SCL and QR may be used in upcoming neurological clinical trials, according to in vivo and in silico findings. However, additional investigation is necessary to verify this behavior and clarify the potential mechanism of action.

KEYWORDS

combined treatment strategy, computer-assisted studies, depression, quercetin, sclareol

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Phytochemical analysis and biological investigation of *Cheilanthes tenuifolia* (Burm.f.) Swartz

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Introduction: *Cheilanthes tenuifolia* is an evergreen ornamental small fern, belonging to the family Pteridaceae, that grows in warm and rocky regions worldwide. Many species of *Cheilanthes* genus are evidently endowed with important phytochemicals and bioactivities. This study aimed to perform a preliminary phytochemical analysis of *Cheilanthes tenuifolia* leaves alongside an evaluation of free radical scavenging, anti-inflammatory, antimicrobial, and clot lysis activities of extract fractions.

Materials and methods: A preliminary phytochemical analysis was done after fractionation of ethanolic extract (ECT) with *n*-hexane (HCT) and chloroform (CCT). Then, 2,2-diphenyl-1-picrylhydrazyl (DPPH) radical scavenging, egg albumin and RBC membrane stabilization tests, disc diffusion, and human blood clot lysis assays were performed.

Results: Phytochemical investigations suggested that the plant is rich in alkaloids, glycosides, tannins, and flavonoids. All obtained fractions exhibited concentration-dependent radical scavenging, inhibition of egg protein denaturation and RBC membrane lysis capacities. Except for antifungal tests, ECT exhibited better DPPH radical scavenging, anti-inflammatory, antibacterial, and clot lysis capacities than HCT and CCT fractions. However, all fractions exhibited a mild anti-inflammatory activity.

Conclusion: *C. tenuifolia* might be a good source of antioxidant, anti-microbial, and anti-atherothrombotic agents. Further studies are required to isolate and characterize the active principles liable for each bioactivity, along with possible molecular interactions.

KEYWORDS

anti-inflammatory, *Cheilanthes tenuifolia*, secondary metabolites, antimicrobial, membrane stabilization, anti-atherothrombotic, radical scavenging

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Phytochemical, Pharmacological, Phyto-cosmeceutical, Toxicity, and *In silico* Toxicological Evaluations of *Vernonia amygdalina* Delile – A Review

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Abstract: *Vernonia amygdalina* Delile, which is in the Asteraceae family, is used as food and medicine all over the world, especially in Africa and Asia. This review reports the phytochemical, ethnopharmacological, phyto-cosmeceutical, and toxicological potentials of the plant. Recent scientific exploration of the plant has mainly focused on both its nutritional potential and ethnopharmacological properties. The antioxidant, anti-inflammatory, antidiabetic, hepatoprotective, hematological, anti-plasmodial, antimicrobial, anticancer, neurological, cosmeceutical, and other pharmacological values of *V. amygdalina* continue to be extensively explored. Many empirical studies of the therapeutic potential of the plant have attributed the ethnomedicinal properties of the plant to its phytochemical constituents, which include glycosides, saponins, tannins, terpenoids, etc. Compounds obtained from the leaves, root, stem, and flowers, which include vemoniosides, vernoamyosides, vernoniamyosides, vernoniosides, vernolide, vernodalol, vernodalin, vernomenin, vernomygdin, vernodalinol, epivernodalol, vernolepin, coumarins, luteolin, edotides, etc. have been identified as bioactive constituents responsible for numerous pharmacological activities of the plant. In addition, the toxicological evaluation of the plant revealed that it is safe for consumption at relatively high concentrations.

Keywords: Medicinal plant; nutraceuticals; antidiabetic; antioxidant; vemoniosides; bioactives

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1. INTRODUCTION

Medicinal plants form the fulcrum of folk medicine due to their numerous economic, pharmacological, nutritional, and tremendous health benefits to humans. The utilization and relevance of medicinal plants, particularly in the drug development and food industries, cannot be overemphasized. Their medicinal and pharmacological properties have been attributed to the presence of phytoconstituents, which are typically bioactive compounds capable of producing definite physiological action in humans (1). Since ancient practice, medicinal plants have been adopted ethnobotanically for medicine, food,

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Pharmacological Activities of Plant-Derived Fraxin with Molecular Mechanisms: A Comprehensive Review

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Fruits and vegetables serve not only as sources of nutrition but also as medicinal agents for the treatment of diverse diseases and maladies. These dietary components are significant resources of phytochemicals that demonstrate therapeutic properties against many illnesses. Fraxin is a naturally occurring coumarin glycoside mainly present in various species of *Fraxinus* genera, having a multitude of therapeutic uses against various diseases and disorders. This study focuses to investigate the pharmacological activities, botanical sources, and biopharmaceutical profile of the phytochemical fraxin based on different preclinical and non-clinical studies to show the scientific evidence and to evaluate the underlying molecular mechanisms of the therapeutic effects against various ailments. For this, data was searched and collected (as of February 15, 2024) in a variety of credible electronic databases, including PubMed/Medline, Scopus, Springer Link, ScienceDirect, Wiley Online, Web of Science, and Google Scholar. The findings demonstrated favorable outcomes in relation to a range of diseases or medical conditions, including inflammation, neurodegenerative disorders such as cerebral ischemia-reperfusion (I/R) and depression, viral infection, as well as diabetic nephropathy. The phytochemical also showed protective effects such as osteoprotective, renoprotective, pulmoprotective, hepatoprotective, and gastroprotective effects due to its antioxidant capacity. Fraxin has a great capability to diminish oxidative stress-related damage in different organs by stimulating the antioxidant enzymes, downregulating nuclear factor kappa B and NLRP3, and triggering the Nrf2/ARE signaling pathways. Fraxin exhibited poor oral bioavailability because of reduced absorption and a wide distribution into tissues of different organs. However, extensive research is required to decipher the biopharmaceutical profiles, and clinical studies are necessary to establish the efficacy of the natural compound as a reliable therapeutic agent.

Introduction

For millennia, natural resources have been mined for the ingredients needed to produce medicines.[1] The phenomenon "natural products" (NPs) describes chemicals with significant biological characteristics that come from species found in nature, including plants, animals, and microbes.[2,3] In recent decades, plant medicines have been increasingly used for health promotion and sickness treatment in many countries, especially wealthy ones.[4,5] The results of some studies demonstrated that NPs have different types of therapeutic applications, including anticancer, antimicrobial, anti-hyperuricemia, anti-inflammatory, antiviral, antioxidant, analgesic, antibacterial, and immunological modulation, along with diuresis activities.[6] There are benefits and drawbacks to using NPs within the drug development process because of their unique characteristics when compared to those of traditional synthetic compounds.[7] Medicines produced from plants have proven successful in treating a wide range of pathological disorders.[4] As a result of the pharmaceutical industry's shift away from natural substances and towards high-throughput evaluation of manufactured chemical databases in the 1990s, discovery rates plummeted. However, natural materials still serve as critical building blocks in the pharmaceutical industry.[8]

The phenolic chemicals known as coumarins (2*H*-1-benzopyran-2-one), which are composed of fused benzene and α-pyrone rings, make up a significant family of compounds found in plants.[9] Coumarin glycosides are composed of a coumarin molecule imposed on a sugar molecule (glycoside). These natural bioactive phytoconstituents are known for their antioxidant and neuroprotective actions, as well as their anti-inflammatory, anticoagulant, antimicrobial, antihypertensive,

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Anti-inflammatory activity of d-pinitol possibly through inhibiting COX-2 enzyme: *in vivo* and *in silico* studies

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Introduction: D-pinitol, a naturally occurring inositol, has diverse biological activities like antioxidant, antimicrobial and anticancer activities. This study aimed to evaluate anti-inflammatory effect of d-pinitol in a chick model. Additionally, *in silico* studies were performed to evaluate the molecular interactions with cyclooxygenase-2 (COX-2).

Methods: The tested groups received d-pinitol (12.5, 25, and 50 mg/kg) and the standard drugs celecoxib and ketoprofen (42 mg/kg) via oral gavage prior to formalin injection. Then, the number of licks was counted for the first 10 min, and the paw edema diameter was measured at 60, 90, and 120 min.

Results and Discussion: The d-pinitol groups significantly ($p < 0.05$) reduced the number of paw licks and paw edema diameters, compared to negative control. When d-pinitol was combined with celecoxib, it reduced inflammatory parameters more effectively than the individual groups. The *in silico* study showed a promising binding capacity of d-pinitol with COX-2. Taken together, d-pinitol exerted anti-inflammatory effects in a dose-dependent manner, possibly through COX-2 interaction pathway.

KEYWORDS

d-pinitol, paw edema, anti-inflammatory effect, cyclooxygenase-2, molecular docking study

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Gigantol, a promising natural drug for inflammation: a literature review and computational based study

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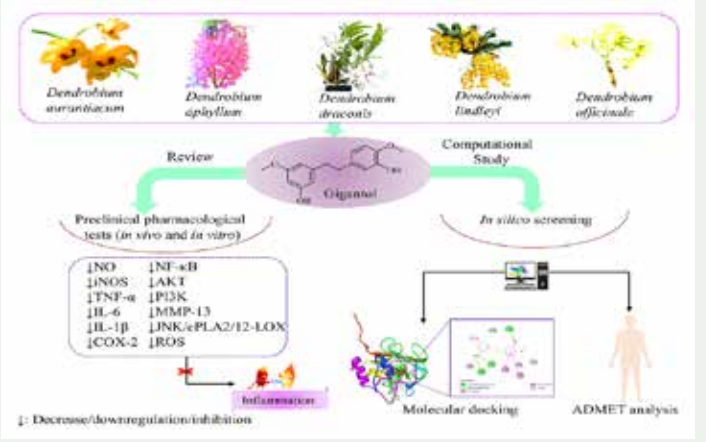
ABSTRACT

Gigantol, a bibenzyl compound extracted from various medicinal plants, has shown a number of biological activities, making it an attractive candidate for potential medical applications. This systematic review aims to shed light on gigantol's promising role in inflammation treatment and its underlying mechanisms. Gigantol exhibits potential anti-inflammatory properties in pre-clinical pharmacological test systems. It effectively reduced the levels of pro-inflammatory markers and arachidonic acid metabolites through various pathways, such as NF-κB, AKT, PI3K, and JNK/cPLA2/12-LOX. The in-silico investigations demonstrated that the MMP-13 enzyme served as the most promising target for gigantol with highest binding affinity (docking score = −8.8 kcal/mol). Encouragingly, the absorption, distribution, metabolism, excretion, and toxicity (ADMET) analysis of gigantol confirmed its compatibility with the necessary physiochemical, pharmacokinetic, and toxicity properties, bolstering its potential as a drug candidate. Gigantol, with its well-documented anti-inflammatory properties, could be a promising agent for treating inflammation in the near future.



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Bromelain as a natural anti-inflammatory drug: a systematic review

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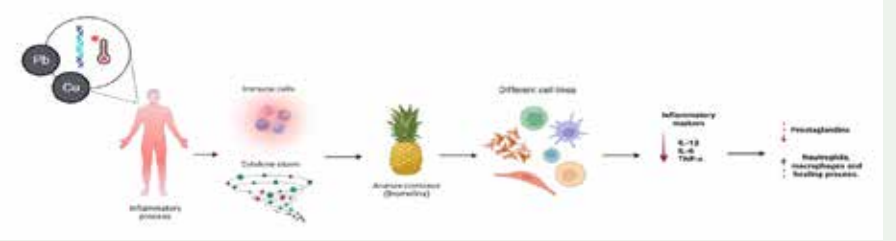
ABSTRACT

Inflammation is a complex and necessary mechanism of an organ's response to biological, chemical and/or physical stimuli. In recent years, investigations on natural compounds with therapeutic actions for the treatment of different diseases have increased. Among these compounds, bromelain is highlighted, as a cysteine protease isolated from the *Ananas comosus* (pineapple) stem. This review aimed to evaluate the anti-inflammatory activity of bromelain, as well as its pathways on inflammatory mediators, through a systematic review with *in vitro* studies on different cell lines. The search was performed in PubMed, Science Direct, Scopus, Cochrane Library and Web of Science databases. Bromelain reduced IL-1β, IL-6 and TNF-α secretion when immune cells were already stimulated in an overproduction condition by proinflammatory cytokines, generating a modulation in the inflammatory response through prostaglandins reduction and activation of a cascade reactions that trigger neutrophils and macrophages, in addition to accelerating the healing process.



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Therapeutic Promises of Bioactive Rosavin: A Comprehensive Review with Mechanistic Insight

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Rosavin is an alkylbenzene diglycoside primarily found in **Rhodiola rosea** (L.), demonstrating various pharmacological properties in a number of preclinical test systems. This study focuses on evaluating the pharmacological effects of rosavin and the underlying molecular mechanisms based on different preclinical and non-clinical investigations. The findings revealed that rosavin has anti-microbial, antioxidant, and different protective effects, including neuroprotective effects against various neurodegenerative ailments such as mild cognitive disorders, neuropathic pain, depression, and stress, as well as gastroprotective, osteoprotective, pulmoprotective, and hepatoprotective activities. This protective effect of rosavin is due to its capability to diminish inflammation and oxidative stress. The compound also manifested anticancer properties against various cancer via exerting cytotoxicity, apoptotic cell death, arresting the different phases (G_0/G_1) of the cancerous cell cycle, inhibiting migration, and invading other organs. Rosavin also regulated MAPK/ERK signaling pathways to exert suppressing effect of cancer cell. However, because of its high-water solubility, which lowers its permeability, the phytochemical has low oral bioavailability. The compound's relevant drug likeness was evaluated by the *in silico* ADME, revealing appropriate drug likeness. We suggest more extensive investigation and clinical studies to determine safety, efficacy, and human dose to establish the compound as a reliable therapeutic agent.

1. Introduction

The remarkable diversity of natural products produced by nature is truly fascinating.[1] Substances derived from plants, animals, and microorganisms, known as natural products, possess crucial biological properties and have been used for centuries to treat various human illnesses as traditional medicines.[2,3] These can be used for medical purposes since they comprise various chemically distinctive components.[4] It is a proven statement that more than 60% of synthetic medications are obtained from organic compounds, and naturally active substances derived from plants comprise 75% of anticancer medicines. Without any doubt, natural products offer potential therapeutic abilities that are paramount to consider.[5] Inarguably, the inclusion of natural substances in drug research is of utmost importance and has resulted in the identification of numerous medications that have successfully tackled some of the most critical health issues of our era.[6] For instance, by using natural products, we were able to quickly discover potential therapeutic options for treating coronavirus infections with polyphenolic compounds.[7] Despite their therapeutic advantages, synthetic medications have the potential to produce toxicity and adverse consequences, whereas natural products are typically thought to be less toxic or have fewer adverse reactions.[8,9] Overall, natural products are a promising area of research that holds tremendous potential for the future of medicine.[10] Scientists are becoming more intrigued by the exploration of natural products, as they offer a vast range of benefits to the medicinal field.[11] Even though certain natural compounds can have negative effects, the potential of natural products is undeniable and holds great promise for the future.[12]

The *Rhodiola* species are commonly referred to as stonecrops, and they are the only *Crassulaceae* species with unisexual blooms.[13] Alaska, Scandinavia, eastern Siberia, and northern Europe are all places where it naturally grows. A number of biological impacts of *Rhodiola* species have been studied *in vitro* and *in vivo*, including in bacteria, mice, rats, and humans. In Asia and Europe, *Rhodiola* species have long been utilized as functional foods, adaptogens, tonics, and antidepressants. According to the toxicological data from animal studies, it has been generally proven that *Rhodiola* plants, such as *R. rosea*, *R. heterodonta*, *R. imbricate*, *R. fastigiata*, *R. sacra*, and *R. kirilowii*, are safe for use.[13,14]

Rhodiola rosea L.'s primary active constituent is an alkylbenzene diglycoside molecule known as rosavin ($C_{20}H_{28}O_{10}$) (Figure 1).[14] This ingredient is primarily found in the plant's rhizomes and holds a number of important benefits, including anti-inflammatory, anti-oxidative, nootropic, anti-cancer, and anti-depressant properties. Furthermore, it has been shown to have an immunomodulatory effect, provide radiation protec-

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Therapeutic Promises of Ferulic Acid and its Derivatives on Hepatic damage Related with Oxidative Stress and Inflammation: A Review with Mechanisms

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Ferulic acid (FA) is a naturally occurring phenolic compound commonly found in the plant *Ferula communis*. This study aims to investigate the hepatoprotective effect of FA and its derivatives (methyl ferulic acid and *trans*-ferulic acid) against oxidative stress and inflammation-related hepatotoxicity due to toxicants based on the results of different non-clinical and preclinical tests. For this, data was collected from different reliable electronic databases such as PubMed, Google Scholar, and ScienceDirect, etc. The results of this investigation demonstrated that FA and its derivatives have potent hepatoprotective effects against oxidative stress and inflammation-related damage. The findings also revealed that these protective effects are due to the antioxidant and anti-inflammatory effects of the chemical compound. FA and its analogues significantly inhibit free radical generation and hinder the effects of proinflammatory markers and inflammatory enzymes, resulting in diminished cytotoxic and apoptotic hepatocyte death. The compounds also prevent intracellular lipid accumulation and provide protective effects.

1. Introduction

The liver plays a vital role in ensuring the survival of an organism. The liver is particularly prone to damage from the many chemicals we come into contact with because of where it's located, its important function in circulating blood, and its key role in breaking down foreign substances. This susceptibility ultimately contributes to the development of a multitude of liver diseases.[1] Liver disease is a widely frequent condition that ranks among the foremost causes of mortality on a worldwide basis. The global prevalence of chronic liver disease (CLDs), encompassing all stages of disease severity, is estimated to reach 1.5 billion cases.[2,3] The primary factors contributing to the high prevalence of disease include nonalcoholic fatty liver disease (59%), alcoholic liver disease (2%), hepatitis B virus (29%), and hepatitis C virus (9%). Primary biliary cholangitis, primary sclerosing cholangitis, Wilson's disease, alpha-1-antitrypsin deficiency, and autoimmune hepatitis are among the other liver illnesses that make up 1% of cases.[2] Liver disease is also a significant cause of mortality, resulting in roughly two million fatalities each year and contributing to 4% of the total world's death rate, equivalent to one out of every 25 deaths. Notably, the majority of liver-related deaths, approximately two-thirds, are observed in the male population.[4] Among the 2 million, 1 million were caused by cirrhosis complications and 1 million by viral hepatitis and hepatocellular carcinoma. Cirrhosis is the eleventh leading cause of mortality worldwide, and liver cancer is the sixteenth; together, they account for 3.5% of all deaths worldwide.[5] Continuous exposure of the liver to certain factors, such as viruses, alcohol, lipids, and biotransformed metabolites, can result in hepatic damage, which can cause inflammation and liver degeneration.[4,6] However, CLDs encompassing a range of pathological conditions that span from simple steatosis and steatohepatitis (characterized by inflammation, hepatocyte injury, and cell death) to fibrosis, cirrhosis, and hepatocellular carcinoma (HCC).[2,7,8]

In light of the crucial function of oxidative stress in liver disease, antioxidants are viewed as an effective therapeutic strategy for treating liver diseases. To date, study results remain equivocal and contentious; however, the therapeutic efficacy of

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Membrane-stabilizing and clot lysis activities of (±) citronellal: In-vitro studies

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ABSTRACT

Numerous plants and their phytochemicals have been identified as having potential medicinal values and are used to treat different ailments worldwide. (±) Citronellal (CTL) is a monoterpene phytochemical with potential therapeutic benefits including anti-inflammatory, antioxidant, antifungal, and antibacterial actions.
Aim: The present study aimed to evaluate the membrane-stabilizing and clot-lysis activities of CTL through *in vitro* studies. For this, we performed hypotonic solution-induced erythrocyte lysing and human blood clot lysis methods to check the membrane-stabilizing and clot lysis capacities of CTL using acetylsalicylic acid (ASA) and streptokinase (STK) as standards, respectively. CTL exhibited concentration-dependent membrane-stabilizing activity with an IC_{50} = 28.83 ± 1.19 µg/mL. In the clot lysis test, CTL also showed a concentration-dependent clot lysing capacity, where it exhibited 50.46 ± 3.81 % clot lysis at a concentration of 160 µg/mL. In the latter case, the IC_{50} value was I158.22 ± 2.21 µg/mL. CTL exhibit potent membrane-stabilizing and moderate clot-lysis activity. We suppose that CTL may exert these effects, possibly through its capacity to inhibit inflammatory mediators. Further *in vivo* and *in silico* studies are required to elucidate CTL's exact molecular mechanisms behind these biological effects.

1. Introduction

Numerous cultures all over the world use plant phytochemicals because of their therapeutic properties to treat a wide range of diseases [1]. The majority of pharmaceutical medicines use phytochemicals from healing plants as one of their main sources of raw ingredients [2]. When subjected to producing lyses, a number of herbal medicines include particular principles that may maintain biological membranes [3]. Approximately 80 % of the world's population, according to a World Health Organization (WHO) assessment, uses herbal plants to cure and manage serious illnesses [4]. Since ancient times, natural products have played a significant role in traditional medicine due to their numerous potential health benefits [5]. Like natural plant derivatives vitamin E long-chain, metabolites modulate anti- and pro-inflammatory lipid mediators [6]. Natural plant *Astragalus membranaceus* (Fisch), exhibited immune-inflammatory response in vitro and in vivo studies [7]. Alkaloids, flavonoids, terpenoids, steroids, tannins, saponins, phenols, and glycosides are all phytochemicals that can be found in plants [8,9]. These chemicals have been used for a long time because of their antioxidant, antifungal, antimicrobial, antidiabetic, wound-healing, anticarcinogenic, antimutagenic, anticytotoxic, anti-inflammatory, and blood-clotting properties [10,11].

Inflammation is a complex biological immune function of vascular tissues to respond to harmful stimuli, remove the injurious stimuli, and

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Recent Insights into the Antimicrobial Properties of *Phyllanthus emblica* L.: A Comprehensive Review of Wonder Berry

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Phyllanthus emblica L., or Amla, is known for its therapeutic properties and has been used as a medicinal plant. It is rich in vitamin C and other bioactive phytochemicals like polyphenols, gallic acid, chebulagic acid, leutolin, quercetin, etc. Different parts of this plant are used to treat various viral, bacterial, and fungal diseases. This review article summarizes the recent literature relevant to the antiviral, antibacterial, and antifungal effects of *P. emblica*. A variety of bacteria (*Staphylococcus aureus, Bacillus subtillus*, *Enterococcus faecalis, Salmonella typhi, and Escherichia*, etc.), fungi (*Alternaria alternate Botroyodiplodia theobromae, Colletotrichum corcori, Curvularia lunata, Fusarium exquisite, Fusarium solanii, Aspergillus niger, Candida albicans*, *Colletotrichum gleosparoitis*, and *Macrophomina phaseolina*) and viruses, like Influenza A virus strain H3N2, hepatitis B, Human Immunodeficiency virus type-1 (HIV-1), Simplex virus type 1 (HSV-1) and type 2 (HSV-2) have experimented. Different techniques were used based on the way of identification. 'For example, disc diffusion, dilution methods, sound diffusion, Immuno-peroxidase monolayer assay, serum HBV and HBsAg assay, enzyme immunoassay, etc. The present review analyzed and summarized the antimicrobial activities of *P. emblica* and possible mechanisms of action to provide future directions in translating these findings clinically.

1. Introduction

P. emblica is a South Asian traditional medicinal plant commonly known under regional names of Amalaki, Amla, Amlaki, Amala, and Usirikaya in different regions, such as India, Sri Lanka, and Indonesia.[1] In regards to its botanic characteristics, it is noted that it can reach 8–18 m in height, presenting spreading branches and a crooked trunk.[1] Also, it is well known that this plant makes a significant economic contribution in the countries where it is present, contributing to the income of farming families and forming part of the budget generated from vegetable farming.[2] Being a traditional medicinal plant, some holistic interventions such as *Ayurveda* provide treatments based on leaves, roots, and extracts of *P. emblica*, commonly being used in situations involving immunity, hair care, reducing stress, eye diseases, respiratory health, anemia, digestion, and many other contexts.[3]

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Possible hemoglobin enhancing effect of phytol in methotrexate-induced folate deficient *Swiss* albino mice: *In vivo* and in silico studies

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ABSTRACT

The diterpenoid phytol is evidently acting against anemia in experimental animals. However, the molecular mechanisms behind this issue are yet to be discovered. This study aimed to evaluate phytol's effect on methotrexate-induced folate-deficient animals through in vivo and in silico studies. For this, a total of thirty adult male Swiss albino mice were randomly divided into six different groups, namely the normal control (vehicle), the negative control (folate deficiency inducer, methotrexate 3 mg/kg), the standard (folic acid 1.5 mg/kg), two test groups comprising phytol 25 and 50 mg/kg, and a combined group composed of the standard and highest test doses of phytol. Except for the vehicle, all groups were treated with methotrexate for the first 3 days (once/day) to induce folate deficiency. Then followed by the respective treatment once a day for 3 days. Hemoglobin (Hb) level was measured from the peripheral blood (by tail cutting) on days 1st (before treatment), 4th (after methotrexate treatment), and 7th (after treatment). On the other hand, the computational studies were performed by PyMol, PyRex, Discovery Studio, and other complementary tools. Findings suggest that phytol significantly ($p < 0.05$) augmented Hb levels that are altered by methotrexate-induced reduction of Hb levels in animals dose-dependently. The combination also augmented Hb levels in animals; however, its effect was slightly lower than the individual groups (standard and test). In the in silico study, phytol showed good binding capacity (binding energy: −7.0 kcal/mol) with dihydrofolate reductase (DHFR). In conclusion, phytol may act against folate deficiency by altering methotrexate's impacts in animals, possibly through interacting with DHFR. Further validated research is necessary to develop phytol as an anti-anemia drug in the near future.

1. Introduction

Vitamin B_9, also known as folate or folacin, is an important water-soluble vitamin naturally present in foods such as fruits, green leafy vegetables, and liver. It synthesizes folic acid, which prevents congenital disabilities, especially neural tube defects (NTDs) in babies. 50% of babies are born with NTDs due to folate deficiency [1]. Folate is necessary for the formation of several coenzymes, which are essential for DNA and RNA to synthesize and metabolize amino acids necessary for cell division. However, the human body cannot make folate; it is supplied by diets naturally [2]. The recommended adult daily intake of folate in the U.S. is 400 μg. Anemia is a condition that decreases the blood's ability to

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Review article

An insight into the anticancer potentials of lignan arctiin: A comprehensive review of molecular mechanisms

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ABSTRACT

Natural products are being developed as possible treatment options due to the rising prevalence of cancer and the harmful side effects of synthetic medications. Arctiin is a naturally occurring lignan found in numerous plants and exhibits different pharmacological activities, along with cancer. To elucidate the anticancer properties and underlying mechanisms of action, a comprehensive search of various electronic databases was conducted using appropriate keywords to identify relevant publications. The findings suggest that arctiin exhibits anticancer properties against tumor formation and various cancers such as cervical, myeloma, prostate, endothelial, gastric, and colon cancers in several preclinical pharmacological investigations. This naturally occurring compound exerts its anticancer effect through different cellular mechanisms, including mitochondrial dysfunction, cell cycle at different phases (G2/M), inhibition of cell proliferation, apoptotic cell death, and cytotoxic effects, as well as inhibition of migration and invasion of various malignant cells. Moreover, the study also revealed that, among the various cellular pathways, arctiin was shown to be more potent in terms of the PI3K/AKT and JAK/STAT signaling pathways. However, pharmacokinetic investigation indicated the compound's poor oral bioavailability. Because of these findings, arctiin might be considered a promising chemotherapeutic drug candidate.

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REVIEW

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Anticancer potential of phytochemicals derived from mangrove plants: Comprehensive mechanistic insights

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Abstract

Cancer is a collection of illnesses characterized by aberrant cellular proliferation that can infiltrate or metastasize to distant anatomical sites, posing a notable threat to human well-being due to its substantial morbidity and death rates worldwide. The potential of plant-derived natural compounds as anticancer medicines has been assessed owing to their favorable attributes of few side effects and significant antitumor activity. Mangrove plants and their derived compounds have been scientifically shown to exhibit many significant beneficial biological activities, such as anti-inflammatory, immunomodulatory, antioxidant, neuroprotective, cardioprotective, and hepatoprotective properties. This study summarized mangrove plants and their derived compounds as potential anticancer agents, with an emphasis on the underlying molecular mechanisms. To explore this, we gathered data on the preclinical (in vivo and in vitro) anticancer effects of mangrove plants and their derived compounds from reputable literature spanning 2000 to 2023. We conducted thorough searches in various academic databases, including PubMed, ScienceDirect, Wiley Online, SpringerLink, Google Scholar, Scopus, and the Web of Science. The results demonstrated that mangrove plants and their derived compounds have promising anticancer properties in preclinical pharmacological test systems through various molecular mechanisms, including induction of oxidative stress and mitochondrial dysfunction, cytotoxicity, genotoxicity, cell cycle arrest, apoptosis, autophagy, antiproliferative, antimetastatic, and other miscellaneous actions. Upon thorough observation of the pertinent information, it is suggested that mangrove plants and their derived chemicals may serve as a potential lead in the development of novel drugs for cancer therapy.

KEYWORDS
anticancer phytochemicals, cancer, mangrove plants, molecular mechanisms

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REVIEW

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A mechanistic insight into the anticancer potentials of resveratrol: Current perspectives

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Abstract

Resveratrol is a widely recognized polyphenolic phytochemical found in various plants and their fruits, such as peanuts, grapes, and berry fruits. It is renowned for its several health advantages. The phytochemical is well known for its anticancer properties, and a substantial amount of clinical evidence has also established its promise as a chemotherapeutic agent. This study focuses on assessing the anticancer properties of resveratrol and gaining insight into the underlying molecular mechanisms. It also evaluates the biopharmaceutical, toxicological characteristics, and clinical utilization of resveratrol to determine its suitability for further development as a reliable anticancer agent. Therefore, the information about preclinical and clinical studies was collected from different electronic databases up-to-date (2018–2023). Findings from this study revealed that resveratrol has potent therapeutic benefits against various cancers involving different molecular mechanisms, such as induction of oxidative stress, cytotoxicity, inhibition of cell migration and invasion, autophagy, arresting of the S phase of the cell cycle, apoptotic, anti-angiogenic, and antiproliferative effects by regulating different molecular pathways including PI3K/AKT, p38/MAPK/ERK, NGFR-AMPK-mTOR, and so on. However, the compound has poor oral bioavailability due to reduced absorption; this limitation is overcome by applying nanotechnology (nanoformulation of resveratrol). Clinical application also showed therapeutic benefits in several types of cancer with no serious adverse effects. We suggest additional extensive studies to further check the efficacy, safety, and long-term hazards. This could involve a larger number of clinical samples to establish the compound as a reliable drug in the treatment of cancer.

KEYWORDS
apoptosis, cancer, cytotoxicity, pharmacokinetics, resveratrol

1 | INTRODUCTION

Cancer is only properly referred to as a malignant tumor when it spreads to the tissues around it and eventually moves through the bloodstream or lymphatic system to distant organs by excessive cell growth and proliferation (Bhuia, Chowdhury, Sonia, et al., 2023). Cancer is the second leading cause of mortality worldwide; more than 8 million individuals die from it yearly (Bisht et al., 2023). Cell proliferation, resisting growth inhibitors, triggering invasion and metastasis, enabling replicative immortality, resisting cell death, changing energy

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Anti-inflammatory activity of d-pinitol possibly through inhibiting COX-2 enzyme: *in vivo* and *in silico* studies

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Introduction: D-pinitol, a naturally occurring inositol, has diverse biological activities like antioxidant, antimicrobial and anticancer activities. This study aimed to evaluate anti-inflammatory effect of d-pinitol in a chick model. Additionally, *in silico* studies were performed to evaluate the molecular interactions with cyclooxygenase-2 (COX-2).

Methods: The tested groups received d-pinitol (12.5, 25, and 50 mg/kg) and the standard drugs celecoxib and ketoprofen (42 mg/kg) via oral gavage prior to formalin injection. Then, the number of licks was counted for the first 10 min, and the paw edema diameter was measured at 60, 90, and 120 min.

Results and Discussion: The d-pinitol groups significantly ($p < 0.05$) reduced the number of paw licks and paw edema diameters, compared to negative control. When d-pinitol was combined with celecoxib, it reduced inflammatory parameters more effectively than the individual groups. The *in silico* study showed a promising binding capacity of d-pinitol with COX-2. Taken together, d-pinitol exerted anti-inflammatory effects in a dose-dependent manner, possibly through COX-2 interaction pathway.

KEYWORDS

d-pinitol, paw edema, anti-inflammatory effect, cyclooxygenase-2, molecular docking study

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Potential utilization of ferulic acid and its derivatives in the management of metabolic diseases and disorders: An insight into mechanisms

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ABSTRACT

Metabolic diseases are abnormal conditions that impair the normal metabolic process, which involves converting food into energy at a cellular level, and cause difficulties like obesity and diabetes. The study aimed to investigate how ferulic acid (FA) and its derivatives could prevent different metabolic diseases and disorders and to understand the specific molecular mechanisms responsible for their therapeutic effects. Information regarding FA associations with metabolic diseases and disorders was compiled from different scientific search engines, including Science Direct, Wiley Online, PubMed, Scopus, Web of Science, Springer Link, and Google Scholar. This review revealed that FA exerts protective effects against metabolic diseases such as diabetes, diabetic retinopathy, neuropathy, nephropathy, cardiomyopathy, obesity, and diabetic hypertension, with beneficial effects on pancreatic cancer. Findings also indicated that FA improves insulin secretion by increasing Ca^{2+} influx through the L-type Ca^{2+} channel, thus aiding in diabetes management. Furthermore, FA regulates the activity of inflammatory cytokines (TNF-α, IL-18, and IL-1β) and antioxidant enzymes (CAT, SOD, and GSH-Px) and reduces oxidative stress and inflammation, which are common features of metabolic diseases. FA also affects various signaling pathways, including the MAPK/NF-κB pathways, which play an important role in the progression of diabetic neuropathy and other metabolic disorders. Additionally, FA regulates apoptosis markers (Bcl-2, Bax, and caspase-3) and exerts its protective effects on cellular destruction. In conclusion, FA and its derivatives may act as potential medications for the management of metabolic diseases.

1. Introduction

Metabolic diseases refer to a group of pathophysiological abnormalities in the body that occur when there is a disruption in normal metabolic processes, leading to an imbalance in energy and redox [1]. Metabolic disorders, such as obesity, insulin resistance, hyperlipidemia, and hypertension, are a number of disorders that are associated with metabolic dysfunction and disrupted energy balance [2]. There are some other related metabolic disorders, including metabolic dysfunction associated fatty liver disease, type 2 diabetes (T2D), and cardiovascular diseases (CVDs) [3]. Metabolic diseases also may cause harmful impacts on humans, such as high cardiac output, hypercoagulability, elevated inflammatory activity [4], impairment of the blood-brain barrier [5,6], defects of the insulin receptor substrate (IRS) [7], male infertility [8], *etc.* These metabolic complications also induce polycystic ovarian syndrome (PCOS) [9], influence the intrauterine period and the long-term implications of fetal programming [10–12]. According to the World Health Organization's (WHO) global report on diabetes, the prevalence of diabetes surged from 108 million in 1980 to 422 million in 2014. From 2000 to 2019, mortality rates due to diabetes rose by 3% across different age groups (https://www.who.int/news-room/fact-sheets/detail/diabetes, accessed on January 3, 2024).

There are several factors involved with metabolic diseases such as dyslipidemia, leptin resistance, impaired insulin secretion, and glucose

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Sclareol antagonizes the sedative effect of diazepam in thiopental sodium-induced sleeping animals: *In vivo and in silico* studies

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Keywords:
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ABSTRACT

Background: Sclareol (SCL), a labdane diterpene compound found in *Salvia sclarea* L., exhibited therapeutic effects. This study investigated the potential interaction between SCL and diazepam (DZP) in modulating sedation in the thiopental sodium-induced sleeping animal model, supported by *in-silico* molecular docking analysis.
Methods: The control, sclareol (5, 10 and 20 mg/kg), and the reference drugs [diazepam: 3 mg/kg and Caffeine (CAF): 10 mg/kg] were used in male albino mice. Then, sodium thiopental (40 mg/kg, *i.p.*) was administrated to induce sleep. The latent period, percentage of sleep incidence and modulation of latency were measured. Further, homology modeling of human γ-aminobutyric acid (GABA) was conducted examine the binding mode of GABA interaction with SCL, DZP, and CAF compounds
Results: SCL (low dose) slightly increased the sleep latency, while the higher dose significantly prolonged sleep latency. DZP, a $GABA_A$ receptor agonist, exhibited strong sleep-inducing properties, reducing sleep latency, and increasing sleeping time. Caffeine (CAF) administration prolonged sleep latency and reduced sleeping time, consistent with its stimulant effects. The combination treatments involving SCL, DZP, and CAF showed mixed effects on sleep parameters. The molecular docking revealed good binding affinities of SCL, DZP, and CAF for $GABA_A$ receptor subunits A2 and A5.
Conclusions: Our findings highlighted the complex interplay between SCL, DZP, and CAF in regulating sleep behaviors and provided insights into potential combination therapies for sleep disorders.

1. Introduction

Depression is a prevalent mental health condition that affects people of all ages and has become a global issue [1,2]. It is characterized by symptoms such as loss of interest, anxiety, sleep disturbances, decreased appetite, low energy levels, and an increased risk of suicidal thoughts [3]. The fast-paced and demanding nature of the modern world has contributed to the rising prevalence of depression [4]. This mental health disorder has a significant impact on individuals' overall well-being, affecting their mental, physical, and emotional health and reducing their quality of life [5]. According to the World Health Organization (WHO), depression is the leading cause of disability worldwide, with more than 30 million people affected globally [6,7]. The transition into adulthood is often accompanied by hormonal changes, which can contribute to the development of depression and emotional instability [8].

Pharmacological treatment plays a significant role in the primary management of depression, with different classes of antidepressants

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Discover Applied Sciences

Review

Pharmacological and phytochemical review of *Acmella oleracea*: a comprehensive analysis of its therapeutic potential

Mst. Asma Aktar[1] · Md. Shimul Bhuia[1,2] · Shamim Molla[1] · Raihan Chowdhury[1,2] · Chandan Sarkar[1] · Md. Al Shahariar[3] · Pias Roy[4] · Željko Reiner[5] · Javad Sharifi-Rad[6,9] · Daniela Calina[7] · Md. Abdul Kader Shakil[8] · Muhammad Torequl Islam[1,2]

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Abstract
Acmella oleracea L. (Asteraceae), commonly known as the toothache plant, is a tropical herb with significant therapeutic potential. Traditionally, it has been used for its analgesic and sialagogue properties, and it is known for its distinctive yellow flower crest. This review addresses current gaps in the understanding of its pharmacological properties and aims to provide a comprehensive analysis of its therapeutic potential. A thorough literature review was conducted using databases such as Google Scholar, ScienceDirect, and PubMed/MedLine. The findings indicate that A. *oleracea* contains a variety of phytochemicals, including spilanthol, which exhibit diverse pharmacological activities such as antioxidant, anti-inflammatory, immunomodulatory, antinociceptive, pronociceptive, antibacterial, antifungal, antidiabetic, diuretic, and vasorelaxant effects. The results highlight the significant medicinal potential of *A. oleracea* while also identifying areas for further research, particularly regarding its toxicological impacts on humans and animals. This review aims to guide future studies on the health benefits and safety of this plant.

Article Highlights

- *Acmella oleracea* exhibits significant pain-relieving properties, interacting with pain receptors effectively.
- The plant's extracts show strong antimicrobial effects, useful against various bacterial infections.
- *Acmella oleracea* demonstrates potent antioxidant and antifungal activities, promoting health and disease prevention.

Keywords *Acmella oleracea* L. · Asteraceae · Phytochemicals · Pharmacological activities · Toxicology

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Allium cepa as a Toxicogenetic Investigational Tool for Plant Extracts: A Systematic Review

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Toxicological studies are important to investigate the genotoxic effects of various substances. *Allium cepa* can be used as test model for this purpose. This review summarizes the scope and applications for this *A. cepa* test model. For this, an up-to-date (April 2023) literature search was made in the Science Direct, PubMed, and Web of Science databases to find published evidence on studies performed using *A. cepa* as a test model. Out of 3,748 studies, 74 fit the inclusion criteria. The results showed that the use of the test model *A. cepa* contributed considerably to measuring the toxicological potential of plant extracts, proving the efficacy of the test as a potent bioindicator of toxic effects. In addition, 27 studies used more than one test system to verify the toxicological potential of extracts and fractions. Studies have shown that the *A. cepa* model has the potential to replace other test systems that make use of animals and cell cultures, besides having other advantages such as low cost, ease of execution, and good conditions for the observation of chromosomes. In conclusion, the *A. cepa* test can be considered one of the potential biomonitoring systems in toxicological studies of crude extracts.

1. Introduction

Medicinal plants and their derived natural products have been used to alleviate illnesses since the dawn of human history.[17,18] The discovery and development of novel medications based on natural products are still the focus of several research efforts.[96] Eren and Özata[25] and Batiha et al.[11] reported an increase in the acceptance and interest of the public in the use of plants as complementary and traditional medicine. Despite their many therapeutic advantages, some of the components of medicinal plants are described as potentially toxic, mutagenic, carcinogenic, and teratogenic.[74] Thus, the use of toxicogenetic models to assess these effects is fundamental to the safe use of plants for therapeutic purposes.

Genetic toxicology tests are assays projected to detect direct or indirect genetic damage induced by chemical compounds.[85] The *Allium cepa* (*A. cepa*) test model was introduced by Levan[46] while he investigated the effects of colchicine on mitosis in its root meristem. For this, he immersed onion root tips in solutions with different concentrations of colchicine for different exposure times to verify root growth.[30] Ever since its development, the *A. cepa* test has been applied in

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RESEARCH ARTICLE

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Prevalence of plant pathogenic nematodes in banana fields of Sylhet district, Bangladesh

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ABSTRACT

Plant pathogenic nematodes pose a significant threat to banana production, causing symptoms such as root lesions, stunted growth, and reduced yield. A comprehensive study in Bangladesh's Sylhet district aimed to assess nematode infestations in banana fields, involving interviews with farmers, soil sample collection, and microscopic examination. Results revealed the presence of multiple nematode species, with *Helicotylenchus spp.* being the most abundant. PCR analysis confirmed *R. similis* infestation in 35% of fields, highlighting its prevalence. Monoculture practices were observed among farmers, exacerbating nematode infestation risks. Limited communication between farmers and agricultural offices contributes to unawareness of nematode infestations. Country-wide studies and improved communication are crucial for implementing effective nematode mitigation strategies and safeguarding banana yield.

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KEYWORDS
Plant-parasitic nematode; *Radopholus similis*; burrowing nematode; banana; Bangladesh

Introduction

Banana (*Musa* spp.) is one of the most popular and economically important tropical fruits in the world, including Bangladesh (Roy et al. 2017). Bangladesh ranks 14th among the top 20 banana-producing countries and produces 1.00 million tons of bananas per year (Hossain 2014; Rubel

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An Insight of Plant Source, Toxicological Profile, and Pharmacological Activities of Iridoid Loganic Acid: A ComprehensiveReview

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This study evaluates the pharmacological effects of iridoid glucoside loganic acid, a plant constituent with diverse properties, based on literature, and explores the underlying cellular mechanisms for treating several ailments. Data were collected from reliable electronic databases, including PubMed, Scopus, Web of Science, and Google Scholar, etc. The results demonstrated the anti-inflammatory, anti-oxidant, and other protective effects of loganic acid on metabolic diseases and disorders such as atherosclerosis, diabetes, and obesity, in addition to its osteoprotective and anticancer properties. The antioxidant activity of loganic acid demonstrates its capacity to protect cells from oxidative damage and mitigates inflammation by reducing the activity of inflammatory cytokines involving TNF-α and IL-6, substantially upregulating the expression of PPAR-γ/α, and decreasing the clinical signs of inflammation-related conditions related to hypertriglyceridemia and atherosclerosis. Meanwhile, loganic acid inhibits bone loss, exhibits osteoprotective properties by increasing mRNA expression levels of bone synthesizing genes such as Alpl, Bglap, and Sp7, and significantly increases osteoblastic proliferation in preosteoblast cells. Loganic acid is an anti-metastatic drug that reduces MnSOD expression, inhibits EMT and metastasis, and prevents cellular migration, proliferation, and invasion in hepatocellular carcinoma cells. However, additional clinical trials are required to assess its safety, efficacy, and human dose.

1. Introduction

For thousands of years, people have turned to plants as a remedy for a wide range of medical conditions.[1] Natural sources, including plants, animals, especially microbes, have been the genesis of several advantageous natural products (NPs).[2,3] The use of NPs and structural analogs in pharmacotherapy has been revolutionary, particularly in the treatment of cancer along with infectious illnesses,[4,5] further used as age-old cures, elixirs, and oils; but, the exact bioactive components contained inside were unknown, and the only evidence for their utility came from human experimentation spanning hundreds of years.[6,7] Infectious illnesses are another important area in which NPs have contributed a significant role; between the 1940s and 2014, around 175 small molecules were authorized for use in cancer treatment alone. From 1981 to 2014, 174 cancer medications were licensed, 38 of which were NP derivatives, 1 of which was a botanical drug (specified combination), and 17 of which were NPs.[1] Several pharmaceuticals, such as doxorubicin, artemisinin, and tetracycline, were found in naturally occurring substances. The medicinal properties of the plants were derived from their extracts and mixtures.[8,9]

Among the several classes of chemicals known as monoterpenoids, iridoid glycosides stand out for their structural similarity to iridodial. These compounds feature cyclopentane rings bonded to six-membered rings, and they also contain oxygen in their atoms. There are two plant forms from which these compounds may be extracted: loganin as well as cyclopentane pyran monoterpenoid glucoside.[10,11] Iridoids are considered defense chemicals versus herbivores and infections since iridoid glycosides often taste bitter and may hinder the development of insects and other insects that feed on them.[12,13] Among the many biological functions of iridoid glycosides are antifungal and antibacterial[14] and antimicrobial.[15,16] However, the tinctoroid is a potential choice because of the iridoid glycoside that was identified from *Morinda tinctoria* (Roxb.) roots. The compound's efficiency in the thiobarbituric (TBA) assay further demonstrates its biological activity and, consequently, its significance as a potent medication.[17] The iridoid glycoside (loganic acid) extracted from the roots of *Gentiana lutea* L. (GL) has been shown to have antiadipogenic properties and could potentially be effective in the treatment of obesity, especially in menopausal women.[18] Therefore, Strong antioxidant properties and the prospect of

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In vivo and *in silico* studies of membrane-stabilizing and clot lysis activities of *Trachyspermum ammi*

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ABSTRACT

Trachyspermum ammi contains many important phytochemicals, including thymol, which is used to treat many diseases. This study aimed to check the membrane-stabilizing and clot-lysis capacity of the ethanol extract of T. ammi (ETA) and its main chemical component, thymol (THY). For this, we used hypotonic solution-induced erythrocyte lysing and egg-albumin protein denaturation for membrane-stabilizing capacity and human blood clot lysis for anti-atherombosis capacity. Further, we observed *in silico study* of THY and ntric oxide synthase (NOSs) isoform. The stabilizing effects of ETA and THY on the membrane changed depending on the concentration. At the highest concentration (160 µg/mL), they stopped the most bleeding, while the standard drug, acetylsalicylic acid, stopped less bleeding at the same concentration. In the erythrocyte lysing test, ETA showed 102.60 ± 0.01 and 75.83 ± 1.44% membrane protection. In the egg-albumin denaturation test, they showed 27.62 ± 0.02% and 56.71 ± 0.02% membrane protection, respectively. In our clot lysis experiment, ETA and THY also showed significant and concentration-dependent clot lysis capacity. The IC_{50} and EC_{50} values of THY were lower than ETA when it came to keeping the membrane stable and breaking up clots, respectively. In our *in silico* investigation, THY and NOSs showed significant binding interaction. Taken together, ETA and its major component, THY, exhibited potent membrane stabilizing activity and clot lysis activity in in vitro studies. Further studies are required to elucidate its other active principles and their biological effects, along with possible mechanisms.

1. Introduction

Membrane stabilization leads to the prevention of leakage of serum proteins and fluids into the tissues during a period of increased permeability caused by inflammatory mediators. Membrane stabilizers are used in both acute and chronic inflammation management (Viswanath et al., 2019). In inflammation, there is lysis of the lysosomal membrane, which exposes component enzymes that can lead to a variety of disorders. Inflammation is an immune reaction of the tissue to damaging factors and a defensive attempt by the organism to get rid of the harmful stimuli and start the healing process (Dholi et al., 2019). Acute inflammation is the body's initial reaction to harmful stimuli, and it is

Abbreviations: OH, hydroxyl radical; ASA, acetyl salicylic acid; EC_{50}, half-minimum effective concentration; ETA, ethanolic extract of *Trachyspermum ammi*; HRBC, human red blood cell; IC_{50}, half-minimal inhibitory concentration; LOO-, lipid peroxyl anion; NO, nitric oxide; NO_2•, nitrogen dioxide radical; NSAIDS, non-steroidal anti-inflammatory; O_2-, superoxide anion; OH-, hydroxyl ion; PAI-1, plasminogen activator inhibitor-1; ROO-, peroxyl anion; SK, streptokinase; THY, thymol.

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Evaluation of toxic effects of rabeprazole sodium on the plant-based eukaryotic test models

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ABSTRACT

Background: Rabeprazole (RPZ), a widely used proton pump inhibitor, is known to have toxic effects on human beings. **Objective**: To evaluate the toxic effects of RPZ sodium (RPZ-Na) using plant-based eukaryotic test systems. **Methods**: The toxic effect of RPZ-Na (0.025-0.4 mM) was evaluated on *Allium cepa*, *Allium sativum*, and *Cicer arietinum* at different exposure times using $CuSO_4$ as a reference standard. **Results**: RPZ-Na concentration-dependently reduced the root length of *A. cepa* and *A. sativum*, as well as the shoot and root lengths of *C. arietinum*. RPZ-Na at 0.1 to 0.4 µg/mL and at 48 h exposure time exerted toxic effects on the tested systems. **Conclusions**: RPZ-Na exerted a concentration- and time-dependent toxic effect on *A. cepa*, *A. sativum*, and *C. arietinum*. Therefore, it is important to take adequate precautions during its long-term use.

Keywords: Rabeprazole sodium; *Allium cepa; Allium sativum; Cicer arietinum;* Toxicity monitoring tools

RESUMEN

Antecedentes: El rabeprazol (RPZ), un inhibidor, de la bomba de protones del estómago, ampliamente utilizado; sin embzrgo, tiene efectos tóxicos en los seres humanos. **Objetivo**: Evaluar los efectos tóxicos del RPZ sódico (RPZ-Na) Utilizando plantas como modelos eucariotas para evaluación de toxicidad. **Métodos**: El efecto tóxico de RPZ-Na (0,025-0,4 mM) en *Allium cepa, Allium sativum* y *Cicer arietinum* en diferentes tiempos de exposición utilizando $CuSO_4$ como estándar de referencia. **Resultados**: RPZ-Na, de forma dependiente de su concentración, redujo la longitud de raíces de *A. cepa* y *A. sativum*, así como el tamaño de los brotes y la raíz de *C. arietinum*. RPZ-Na a 0,1 a 0,4 µg/mL y a 48 h de tiempo de exposición ejerció efectos tóxicos en los sistemas de prueba. **Conclusiones**: RPZ-Na ejerció un efecto tóxico dependiente de la concentración y el tiempo de exposición en *A. cepa, A. sativum* y *C. arietinum*. Por lo tanto, es importante tomar precauciones adecuadas durante su uso a largo plazo.

Palabras clave: Rabeprazol sódico; *Allium cepa; Allium sativum*; *Cicer arietinum;* Herramientas de monitoreo de toxicidad

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RESEARCH ARTICLE

DRUG DEVELOPMENT RESEARCH WILEY

Assessment of sedative activity of fraxin: In vivo approach along with receptor binding affinity and molecular interaction with GABAergic system

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Abstract

Insomnia is a sleep disorder in which you have trouble falling and/or staying asleep. This research aims to evaluate the sedative effects of fraxin (FX) on sleeping mice induced by thiopental sodium (TS). In addition, a molecular docking study was conducted to investigate the molecular processes underlying these effects. The study used adult male Swiss albino mice and administered FX (10 and 20 mg/kg, i.p.) and diazepam (DZP) (2 mg/kg) either separately or in combination within the different groups to examine their modulatory effects. After a period of 30 min, the mice that had been treated were administered (TS: 20 mg/kg, i.p.) to induce sleep. The onset of sleep for the mice and the length of their sleep were manually recorded. Additionally, a computational analysis was conducted to predict the role of gamma-aminobutyric acid (GABA) receptors in the sleep process and evaluate their pharmacokinetics and toxicity. The outcomes indicated that FX extended the length of sleep and reduced the time it took to fall asleep. When the combined treatment of FX and DZP showed synergistic sedative action. Also, FX had a binding affinity of −7.2 kcal/mol, while DZP showed −8.4 kcal/mol. The pharmacokinetic investigation of FX demonstrated favorable drug-likeness and strong pharmacokinetic characteristics. Ultimately, FX demonstrated a strong sedative impact in the mouse model, likely via interacting with the $GABA_A$ receptor pathways.

KEYWORDS
fraxin, insomnia, molecular docking, sedation

1 | INTRODUCTION

Insomnia is a sleep disorder characterized by difficulty staying asleep, falling asleep, or both at least three times per week for a month or more (Roth, 2007). Approximately 10% of the usual population meets the criteria for insomnia disorder. Still, university students must suffer from problems with sleep regularity, quality, and quantity, resulting in daily pain and functional impairment. People have been facing various insomniac problems in recent years due to the blow of COVID-19 statewide (AlRasheed et al., 2022; Jaafari et al., 2022; Kraus & Rabin, 2012). In the general population, insomnia can lead to depression in about 60%–80% of depressed patients, and other diseases can involve insomnia, including

Sonaly Akter Mukty and Rubel Hasan equally contributed.

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Anxiolytic-*like* effect of daidzin possibly through $GABA_A$ receptor α2 and α3 subunits interaction pathway: *In vivo* and *in silico* studies

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ABSTRACT

The soy plant-derived isoflavone daidzin (DZN) has diverse biological activities, including neuroprotective (e.g., memory-enhancing and antiepileptic) effects. This study emphasizes evaluating the anxiolytic effect of DZN on mice. Additionally, *in silico* investigations were also carried out to check the potential molecular mechanisms for the anxiolytic effect of DZN. For this, adult male *Swiss* albino mice were intraperitoneally (i.p.) treated with DZN (5, 10, and 20 mg/kg) with or without the standard GABAergic agonist drug diazepam (DZP: 2 mg/kg) and/or antagonist drug flumazenil (FLU: 0.1 mg/kg) and checked for different locomotor behaviors using various mouse models. The molecular docking study of DZN was conducted against $GABA_A$ receptor subunits. Findings suggest that DZN dose-dependently and significantly ($p < 0.05$) increased locomotor activities such as the number of field crosses, hole crosses, swings, grooming, and light residence time while decreasing the rearing of the animals. With DZP, it significantly ($p < 0.05$) reduced the test parameters, while altering these parameters with FLU. Our molecular docking studies demonstrate that DZN has a strong binding affinity of −7.4 and −6.9 kcal/mol for α2 and α3 subunits of the $GABA_A$ receptor, respectively, whereas the standard drugs DZP and FLU showed binding affinities between −6.0 and −6.7 kcal/mol for these subunits. Taken together, DZN augmented the anxiolytic effect of DZP while reducing the effect of FLU in mice. We suppose that DZN may show anxiolytic-*like* effects on *Swiss* mice, possibly through α2 and α3 subunits of the $GABA_A$ receptor interaction pathway.

1. Introduction

Current records demonstrate that approximately 25 % of the global population suffers from anxiety disorders, which impart significant socio-economic burdens [1]. Anxiety is defined as a mental condition that negatively impacts a person's activities, including thoughts, feelings, and behavior [2]. In general, anxiety is an adaptive mechanism that is necessary for the organism's survival. However, excessive anxiety is harmful. It is due to extreme anxiety that individuals develop discrete disorders that are commonly comorbid with other psychological disturbances [3].

Benzodiazepines (BZDs) (e.g., diazepam, lorazepam, midazolam, and alprazolam) are commonly used to treat anxiety [4]. However, these medications are also used to treat other medical conditions such as sedation, hypnosis, muscle congestion, and convulsion. Each biological effect follows a distinct pathway [5]. Therefore, long-term use of this class of medication may decrease its efficacy for these kinds of medical conditions. These drugs have mild to serious side effects and are highly

Abbreviations: ADMET, Absorption, distribution, metabolism, excretion, and toxicity; AMES, *Salmonella typhimurium* reverse mutation assay; ANOVA, Analysis of variance; BBB, Blood-brain barrier; BZDs, Benzodiazepines; CNS, Central nervous system; CYP, Cytochrome P450; DZN, Daidzin; DZP, Diazepam; FLU, Flumazenil; GABA, Gamma-aminobutyric acid; HIA, Human intestinal absorption; HPLC, High-performance liquid chromatography; LD_{50}, Median lethal dose; LRT, Light-residence time; NG, Number of grooming; NHC, Number of hole-cross; NR, Number of rearing; NS, Number of swing; NSC, Number of square crosses; PDB, Protein data bank; SD, Standard deviation; VDss, Volume of distribution at steady state.

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Anxiolytic Efficacy of Indirubin: *In Vivo* Approach Along with Receptor Binding Profiling and Molecular Interaction with GABAergic Pathways

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Anxiety is a natural response to stress, characterized by feelings of worry, fear, or unease. The current research was conducted to investigate the anxiolytic effect of indirubin (IND) in different behavioral paradigms in *Swiss* albino mice. To observe the animal's behavioural response to assess anxiolytic activity, different tests were performed, such as the open-field (square cross, grooming, and rearing), swing, dark-light, and hole cross tests. The experimental mice were administered IND (5 and 10 mg/kg, p.o.), where diazepam (DZP) and vehicle were used as positive and negative controls, respectively. In addition, a combination treatment (DZP + IND-10) was provided to the animals to determine the modulatory effect of IND on DZP. Molecular docking approach was also conducted to determine the binding energy of IND with the $GABA_A$ receptor (α2 and α3 subunits) and pharmacokinetics were also estimated. The findings revealed that IND dose-dependently significantly ($p < 0.05$) reduced the animal's movement exerting calming behavior like DZP. IND also demonstrated the highest docking score (−7.7 kcal/mol) against the α3 subunit, while DZP showed a lower docking value (−6.4 kcal/mol) than IND. The ADMET analysis revealed that IND has proper drug-likeness and pharmacokinetic characteristics. In conclusion, IND exerted anxiolytic effects through GABAergic Pathways.

1. Introduction

Neurodegenerative disorders are defined by the gradual deterioration of the structure and function of the nervous system, specifically the neurones of the brain.[87] These disorders often include the progressive degeneration of neurones and their interconnections, resulting in a deterioration of cognitive abilities, motor control, or both[3]. In addition, anxiety disorders include a range of psychological issues that are often associated with symptoms of depression.[54,82] Though their emotional characteristics are similar, anxiety and depression vary in a number of ways. Approximately 4% of the world's population is now suffering from an anxiety condition. In 2019, anxiety disorders accounted for 301 million cases globally, making them the most prevalent kind of mental illness (https://www.who.int/news-room/fact-sheets/detail/anxiety-disorders, accessed on 15 April, 2024).

However, anxiety has a substantial risk factor for multiple diseases and disorders, such as neuropsychiatric, cardiovascular, and metabolic problems.[25] It can arise from numerous factors, including mental conditions, stressful lifestyles, physical status, alcohol abuse, genetics, and the harmful impact of drugs. (Bhuia et al., 2023).[24]

Several neurotransmitters may be involved in the pathophysiological mechanisms of anxiety disorders, such as dysregulation or abnormalities of norepinephrine (NE), serotonin (5HT), histaminergic, acetylcholine, glutamate, dopamine, and gamma-aminobutyric acid (GABA), which are major factors.[7,36,47] GABA is the primary neurotransmitter responsible for inhibiting neural activity in the brain and is recognized for its role in regulating and balancing the transmission of excitatory signals in different neuronal systems.[56] The regulation of anxiety-related responses is significantly influenced by GABAergic neurotransmission in the amygdala.[61] However, the anticonvulsant, amnesia, and sedative actions of benzodiazepines (BZDs) are caused by the activation of GABA type A ($GABA_A$) receptors that include the α1-subunit. On the other hand, the anxiolytic effects of BZD are linked to certain types of $GABA_A$ receptors, including those that have the α2- and α3-subunits,[7,49,73,74] According to a study, anxiety behaviours may be regulated by

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Understanding Liver Function and Its Potential Complications

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Abstract

Protein synthesis, detoxification, and metabolism are just a few of the critical tasks carried out by the liver, an indispensable organ. It creates bile for digestion and processes medications, nutrients, and poisons. Many illnesses, including cirrhosis, fatty liver disease, and hepatitis, can impair liver function and have consequences such portal hypertension, jaundice, and liver failure. Prompt identification and intervention are essential to avert grave consequences. Treatments aim to address the underlying cause and maintain liver function, while diagnostic techniques including imaging, blood tests, and biopsies aid in assessing liver health. For preventative and intervention measures to be effective, it is essential to comprehend these elements.

Keywords: Liver function; Detoxification; Nutrient processing; Cirrhosis; Intervention strategies.

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Modulatory Sedative Activity of Abrine on Diazepam in Thiopental Sodium Mediated Sleeping Mice: An In Vivo Approach with Receptor Binding Affinity of GABAergic Transmission

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The current study aims to assess the effects of abrine (ABR) in thiopental sodium (TS)-induced sleeping mice and to explore the sedative impacts of the compound by using in vivo and in silico investigations. ABR (5 and 10 mg k^{-1}g, i.p.) and diazepam (DZP) (2 mg k^{-1}g, i.p.) were administered to the experimental animals either single or combined. TS (20 mg k^{-1}g, i.p.) was administered to induce sleep, and latency with sleeping duration was observed for 3 h. The in silico investigation was conducted to predict the role of ABR in the gamma-aminobutyric acid A ($GABA_A$) receptor in the sleeping process and to evaluate pharmacokinetics and toxicity. Results showed that ABR (10 mg k^{-1}g) significantly ($p < 0.05$) decreased the latency period (8.20 ± 1.85 min) and enhanced sleep duration (187.8 ± 8.87 min) in comparison with the control group. Additionally, the co-treatments of ABR and DZP remarkably reduced the latency period (4.40 ± 0.24 min) and increased the sleeping duration (201.40 ± 5.89 min) compared to the single therapy. The molecular docking indicated that ABR has a binding affinity of −7.4 kcal/mol for the $GABA_A$ receptor. In conclusion, ABR provides strong sedative and synergistic efficacy on TS-induced sleeping mice via the GABAergic system.

1. Introduction

Insomnia is a complex condition consisting of difficulties getting asleep, keeping asleep, or nonrefreshing sleep, which leads to impairment during the day.[1] Nowadays, almost 15% of people complain of extreme sleepiness, and over 40% complain of an inability to sleep.[2] Various demographic risk factors have been associated with insomnia, such as physical ailments, mental problems, and poor sleeping habits.[3] Students who have a family history of psychological conditions like sadness or anxiety are more likely to have sleeplessness.[4] Sleeping problems are associated with several diseases, such as pain syndromes, hypertension, higher cortical function, metabolic, weight gain, obesity, susceptibility to colds, significant depression, neurodegenerative disorders, and overall mortality.[3b,5]

Many neurotransmitters, such as gamma-aminobutyric acid (GABA), norepinephrine, dopamine, glutamate, histamine, epinephrine, serotonin (5-hydroxytryptamine), and hypocretin, have a considerable impact on sleep length and hence may be a potential remedy for insomnia concern.[6] Among various neurotransmitters, GABA plays an important function in sedation and is the most predominant inhibitory neurotransmitter in the central nervous system (CNS).[7] There are two subtypes of GABA receptors: $GABA_A$ and $GABA_B$.[8] $GABA_A$ receptors form ligand-gated pentameric architectural ion channels that appear to be medication for various anxiolytic, and hypnotic disorders. In contrast, $GABA_B$ receptors are a kind of G-protein-coupled heterodimer receptor that is responsible for muscle relaxation.[9] The fully evolved form of the GABA receptor consists of $\alpha 1$, $\beta 2$, and $\gamma 2$ subunits, with most sedative-hypnotics attached to the $\alpha 1$ and $\beta 2$ subunits.[10] When GABA is generated in the synaptic cleft, this leads to the opening of the chloride channel, increasing the influx of chloride ions into the cell. Consequently, the cell membrane becomes more negatively charged due to the increased input of chloride ions, causing a reduction in the excitability of neurons.[10b] Three separate signaling pathways are used by $GABA_B$ receptors: (I) voltage-gated Ca^{2+} channels, (II) G protein-activated inwardly-rectifying K^+ channels (GIRK),

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Assessment of antiemetic activity of dihydrocoumarin: *In vivo* and *in silico* approaches on receptor binding affinity and modulatory effects

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ABSTRACT

Dihydrocoumarin (DCN) is a natural compound widely used in the flavor industry and has antioxidant and anti-inflammatory properties. However, its potential antiemetic effects on gastrointestinal disturbances remain untested. This study emphasizes assessing the antiemetic properties of the natural aromatic compound DCN using copper sulfate ($CuSO_4.5H_2O$)-induced emetic model on chicks, and an *in silico* approach was also adopted to estimate the possible underlying mechanisms. Two doses (25 and 50 mg/kg b.w.) of DCN and several referral drugs considered positive controls (PCs), including domperidone (6 mg/kg), hyoscine (21 mg/kg), aprepitant (16 mg/kg), diphenhydramine (10 mg/kg), and ondansetron (5 mg/kg), were orally administered to chicks. The vehicle was provided as the control group. Co-treatments of DCN with referral drugs were also provided to chicks to evaluate the modulatory action of the test compound. According to the results, DCN delayed the emetic onset and decreased the frequency of retches in a dose-dependent manner compared to the vehicle group. DCN (50 mg/kg) represented a notable delayed latency period (61.17 ± 4.12 s) and a diminished number of retchings (17.67 ± 1.82 times) compared to the control group. Further, in the co-treatments, DCN increased the latency period and reduced the number of retches, except for domperidone. In the *in silico* investigation, DCN showed notable binding affinity toward the D_2 (−7 kcal/mol), H_1 (−7.5 kcal/mol), and M_5 (−7 kcal/mol) receptors in the same binding site as the referral ligand. Our research indicates that DCN has mild antiemetic properties by interacting with the D_2, H_1, and M_5 receptors. Therefore, several pre-clinical and clinical studies are necessary to assess the effectiveness and safety profile of this food ingredient.

1. Introduction

Vomiting, also known as emesis, is an uncomfortable condition in which the stomach fluids are violently evacuated *via* the mouth. It has a close relationship to the gastrointestinal system's motion (Hasler, 2013). Vomiting is triggered by stomach irritants in the gut lumen *via* the gastrointestinal tract's (GIT) thin mucosal chemoreceptors or toxins in the gut lumen (Furness, Rivera, Cho, Bravo, & Callaghan, 2013; Xie et al., 2022). In addition to absorbing poisons or irritants, various illnesses, including poisoning from food, gastroenteritis (diarrhea),

Abbreviations: DCN, dihydrocoumarin; PC, positive control; GIT, gastrointestinal tract; VC, vomiting center; CTZ, chemoreceptor trigger zone; NTS, nucleus tractus solitaries; CSF, cerebrospinal fluid; NK1, neurokinin type 1; 5HT, serotonin; DOM, domperidone; HYO, hyoscine butyl bromide; APR, aprepitant; DHM, diphenhydramine; OND, ondansetron; DW, distilled water; SEM, standard error of the mean; PDB, protein data bank; HB, hydrogen bond; MW, molecular weight; HBD, hydrogen bond donors; MR, molar refractivity; HBA, hydrogen bond acceptor; BBB, blood brain barrier.

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Review Article

Botanical Sources, Pharmacokinetics, and Therapeutic Efficacy of Palmatine and Its Derivatives in the Management of Cancer: A Comprehensive Mechanistic Analysis

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Natural compounds and their derivatives have been identified as valuable sources of therapeutic ingredients for cancer treatment. The naturally occurring phytochemical palmatine (isoquinoline alkaloid) is extracted from plant parts (rhizomes, roots, stems, stem barks, and others) and has protective effects including antioxidant, anti-inflammatory, and anticancer. This study aims to summarize the anticancer potential of palmatine and its derivatives in the treatment of numerous types of cancer with molecular mechanisms. We also include the pharmacokinetic features, botanical origin, and toxicological characteristics of palmatine and its derivatives. For this, data have been collected from plausible different electronic databases, including PubMed, Google Scholar, PubChem, Science Direct, Web of Science, Scopus, Springer Link, and Wiley Online. The findings demonstrate that palmatine and its derivatives have a protective anticancer effect against a variety of cancers, including breast, colorectal, gastric, ovarian, prostate, pancreatic, skin, hepatocellular cancer, and mammary gland tumors. They provoke their anticancer properties against various cancer cell lines via modifying molecular mechanisms like induction of oxidative stress, cytotoxicity, apoptosis, inhibition of cell invasion and migration, arresting the cell cycle at the S phase, antiproliferative, and antiangiogenic effects. It is suggested that palmatine and its derivatives may be a good option in the development of novel drugs for cancer therapy in the future.

Keywords: apoptosis; cancer; natural products; palmatine; pharmacokinetics; toxicology

1. Introduction

Cancer, a deadly disease, is one of the prominent contributors to mortality worldwide [1]. Human cells are known as destruction agents of cancers that are exerted by the building blocks of tumors and transformed into pathological organisms [2]. In Global Cancer Statistics, 2024, the American Cancer Society (ACS) reported 9.7 million individuals worldwide lost their lives to cancer in 2022, with an expected 20 million new cases receiving a diagnosis (https://pressroom.cancer.org/GlobalCancerStatistics2024, accessed on August 3, 2024). According to data from the International Agency for Research on Cancer (IARC), the cancer division of the World Health Organization (WHO), in 2020, lung cancer will be the most frequent cancer globally, accounting for 2.5 million new cases, or 12.4% of all

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Phytochemical screening and evaluation of antibacterial, antipyretic, hypoglycemic, and anxiolytic effects of *Adiantum philippense* leaf extracts

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ABSTRACT

Adiantum philippense (AP) is a source of various important phytochemicals and has been traditionally used to cure many diseases, including dysentery, ulcers, fevers, cooling, and elephantiasis. This study aimed to evaluate the anti-bacterial, anti-pyretic, analgesic, and anxiolytic effects of AP using a number of *in vitro* and *in vivo* test protocols. For this, dried leaves were extracted by the Soxhlet extractor using ethanol. The crude ethanol extract was then fractionated by treating with chloroform and n-hexane. A preliminary phytochemical screening was done for its crude extracts. The antibacterial activity of ethanol, chloroform, and n-hexane extracts of AP was tested against 10 pathogenic bacteria at concentrations of 500 μg/disc. The ethanol extract showed significant activity against Gram (+ve) and Gram (-ve) bacteria. In mice, the chloroform extracts showed significant ($p < 0.05$) antipyretic and hypoglycemic effects, while the ethanol extract exerted significant anxiolytic effects on mice. The results obtained from this study indicate that AP leaf extracts contain important phytochemical groups and exert antibacterial, antipyretic, hypoglycemic, and anxiolytic effects. Further studies are required to isolate the bioactive compounds responsible for these claimed biological activities.

1. Introduction

Phytochemicals as secondary plant metabolites represent non-nutrient chemical compounds of plants, which are the major medicinal source due to their diverse pharmacological activity [1]. Research conducted by the World Health Organization (WHO) found that about 80 % of people worldwide use herbal plants to cure and manage serious diseases [2]. One of the main sources of raw materials for the majority of pharmaceutical medications is phytochemicals derived from medicinal plants [3]. Numerous plant phytochemicals have been demonstrated to have medicinal properties, and they are used by various cultures to treat a variety of diseases [4]. Since ancient times, a variety of phytochemicals, such as alkaloids, flavonoids, terpenoids, steroids, tannins, saponins, phenols, and glycosides, have been used for their anti-inflammatory, anti-mutagenic, antioxidant, antifungal, antimicrobial, anti-diabetic, and anxiolytic properties. These phytochemicals can be used alone or in combination with a whole plant diet [5,6]. Natural medicines are considered to be safe, effective, and have fewer side effects compared to conventional medicine [7].

Traditionally, *Adiantum philippense* (L.) (AP) (Family: Adiantaceae), often referred to as "Goyalelata," has been used to treat a variety of illnesses, such as diarrhea, ulcers, fevers, chills, and elephantiasis [8]. It is a species of maidenhair fern that is extensively dispersed throughout the southern hemisphere, including Asia, Africa, and Madagascar. It is often referred to as walking maidenhair fern or black maidenhair [8,9]. Southeast Asian countries such as Bangladesh, India, Nepal, Thailand,

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UPLC-ESI/MS^n metabolic profiling of *Cedrela odorata* L. and *Toona ciliata* M. Roem and *in vitro* investigation of their anti-diabetic activity supported with molecular docking studies

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Introduction: The genus *Cedrela* is one of the phytochemically rich genera of the family Meliaceae. In this study, two *Cedrela* species, namely, *Cedrela odorata* and *Toona ciliata* M. Roem (formerly *Cedrela toona*), were selected for in-depth phytochemical profiling with the aid of UPLC-ESI/MS^n analysis followed by evaluation of their anti-diabetic potential through assessment of *in vitro* α-amylase and α-glucosidase inhibitory effects, alongside the molecular docking studies on these target enzymes.

Materials and methods: UPLC-ESI/MS^n technique was applied to tentatively identify the extracts. The anti-diabetic properties were assessed using BioVision α-amylase and α-glucosidase inhibitor screening kits. Further, the molecular docking studies utilized PyRx® and Discovery Studio software.

Results and discussion: The UPLC-ESI/MS^n analysis led to the identification and quantification of 55 metabolites with their fragmentation patterns for the first time for these two species. Flavonoids represented the main identified class, followed by phenylpropanoids, terpenes, tannins, and others. The two species showed potent enzyme inhibition, where *C. odorata* and *C. toona* significantly inhibited α-amylase (IC_{50} = 4.83 ± 0.01 and 3.50 ± 0.03 µg/mL) compared to pioglitazone (IC_{50} = 2.17 ± 0.23 µg/mL), while their α-glycosidase inhibitory properties were also potent with (IC_{50} = 7.17 ± 0.01 and 6.50 ± 0.69 µg/mL), respectively, compared to acarbose (IC_{50} = 4.83 ± 1.02 µg/mL). The enzyme

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Synergistic Antiemetic Effects of Nerolidol on Domperidone, Hyoscine, and Ondansetron: *In Vivo* and *in Silico* Investigations on Receptor Binding Affinity

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The present study was designed to measure the potential antiemetic properties of nerolidol (NDL) via *in vivo* and *in silico* studies. To induce emesis copper sulfate pentahydrate ($CuSO_4.5H_2O$) was administered at a dose of 50 mg/kg (orally) to 2-day-old chicks. The test sample (NDL) was given at two doses of 50 and 100 mg/kg. b.w. orally. Additionally, aprepitant (16 mg/kg), domperidone (6 mg/kg), hyoscine (21 mg/kg), ondansetron (5 mg/kg), and diphenhydramine (10 mg/kg) were given also orally as positive controls. To observe the modulatory effects of the test sample, combination therapies with reference drugs were also administered to three different groups of animals. Molecular docking and visualization of ligand-receptor interaction were performed against several emesis-inducing receptors ($5HT_3$, D_2, D_3, H_1, and M_1-M_5) using diverse computational tools. Pharmacokinetics and drug-likeness of the selected ligands were also calculated. Findings demonstrated that NDL significantly ($p < 0.05$) dose-dependently lessens the mean number of retches and delays the emetic onset in the chicks. The combined drug therapy with ondansetron exposed better antiemetic activity. In addition, *in silico* analysis, NDL has greater binding affinity (−7.3 kcal/mol) against M_2 and M_3 receptors. In conclusion, NDL exerted mild antiemetic activity with synergistic properties through muscarinic receptors.

1. Introduction

Emesis (also known as vomiting) refers to the forceful ejection of gastric contents, a prominent physiological reflex that can be stimulated by various central and peripheral stimuli.[1,2] It characterizes a variety of disorders defined by many weeks of symptoms.[1] It is considered a defense mechanism while aggressive toxins, drugs, or microorganisms come into the body either by the parenteral routes (such as skin, body, inhalation, etc.) or enteral pathways (such as the gastrointestinal tract (GIT)).[2] Separating from this fact, several traumatic events and negative responses to drugs, motion sickness, and other therapeutic situations can also lead to emesis and nausea in the living and natural worlds.[3] Additionally, there are some causes of vomiting, such as gastrointestinal (GI) infections, gastroparesis, migraine, cyclic vomiting syndrome, disturbance of the vestibular, food poisoning, early pregnancy, non-gastrointestinal effects, etc..[1,4,5] However, vomiting is also a familiar side effect of radiation therapy, inhalation, anesthetics, chemotherapy, and opioid analgesics.[6,7]

The area postrema (AP), which is also known as the chemoreceptor trigger zone (CTZ), carries receptors that identify emetic agents and transfer that information to the vomiting center (VC). It is responsible for inducing the vomiting response.[8] The brainstem AP lacks the blood brain barrier (BBB), and for disseminating emetic stimuli in the cerebrospinal fluid and blood, it presents as direct central receptor sites.[9] However, orderly administered drugs, which develop sensory signals to the nucleus of the solitary tract, can trigger related receptors present on vegal afferents.[9,10] Additionally, peripheral stimuli (for example, microbes, and poisonous drugs) come into the lumen of the GIT and cause the release of confined emetic neurotransmitters (dopamine, serotonin, etc.), which act on connected receptors on vegal afferents, and circulating blood stimulates the CTZ.[10,11] Besides CTZ and sensory vegal afferents from the splanchnic nerves (sensation carriers), direct neural inputs are caused by visceral organ disease. Brainstem vestibular nuclei are also responsible for inducing emesis, causing motion sickness.[12] To the dorsal motor nucleus of the vegus, the solitary tract's nucleus has output routes. It promotes the project to the upper GIT to give the vomiting response [9].

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Review article:

A PARADIGM SHIFT IN THE DETECTION OF BLOODBORNE PATHOGENS: CONVENTIONAL APPROACHES TO RECENT DETECTION TECHNIQUES

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Qualitative Phytochemical Analysis and Assessments of Analgesic and Antidiarrheal Activity of the Methanolic Leaf Extract of *Cheilanthes tenuifolia*: In Vivo Study

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ABSTRACT

Background: *Cheilanthes tenuifolia* (Burm.f.), commonly known as the Sword Fern or Narrow-leaved Cloak Fern, is a little evergreen fern that belongs to the *Pteridaceae* family and is abundant in various bioactive compounds exerting promising medicinal properties. The current study is designed to evaluate in vivo analgesic and antidiarrheal activity of the methanol leaf extract of *C. tenuifolia* (MCT).

Methods: For this purpose, *Swiss* albino mice were used to investigate the analgesic and antidiarrheal properties using acetic acid-induced writhing and castor oil-induced diarrhea methods, respectively. The mice were administered orally with different doses of MCT (125, 250, and 500 mg/kg). The vehicle performed as a negative control (NC), while diclofenac sodium (DCN) (25 mg/kg), loperamide (LOP) (3 mg/kg), bismuth subsalicylate (BSS) (10 mg/kg), and nifedipine (NDP) (2.5 mg/kg) were supplied as positive controls (PC) (p.o.). In both models, combination treatment of MCT (higher dose) and PC was also administered to different groups of animals for assessing potential antagonistic or synergistic activity.

Results: Findings of the in vivo study demonstrated that MCT dose-dependently significantly ($p < 0.05$) exhibited analgesic and antidiarrheal properties by reduction in the number of writhing and reductions in the total fecal output in contrast to the NC group. Moreover, in combination treatment, MCT significantly ($p < 0.05$) synergized the activity of PC in both models, exerting potential analgesic and antidiarrheal activity.

Conclusion: In conclusion, MCT has analgesic and antidiarrheal activity; it might be beneficial for the management of pain and diarrhea.

1 | Introduction

Since ancient times, plants for therapeutic purposes have been utilized to treat medical conditions [1]. For medicinal purposes, whole plants or their derivatives—as well as natural resources—are employed. Nearly 80% of the global populace receives basic healthcare services from the traditional medicine (TM) system, which uses plants as bulk components [2]. From the almost two-century-old discovery of morphine, plants have played a significant role in medicine, and novel plant-based

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Research Article

Journal of Clinical & Experimental Immunology

Pakistani Medicinal Plants Used to Treat Asthma

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Review Article

Response of Stakeholders on Pandemic: A review

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Abstract

A pandemic encompasses both health and economic concerns. Pandemics are not a novel phenomenon in human society. Their nature, severity, and response, however, vary over time. Pandemics amplify ambiguity, make comprehension more complex, and necessitate the acquisition of new information. Integrating the finest available knowledge and frequently reconciling diametrically conflicting thoughts and attitudes is vital to draw a refinedopinion. The coronavirus pandemic of 2019 (COVID-19) is causing chaos in the community with severe and protracted impacts on individuals and the community. The study proposes a conceptual model for multi-stakeholder governance in pandemic response.Thismodelis based on multi-sector participation in health policy decision-making, action on global development issues, allocating responsibilities and obligations among stakeholders, collective action solutions for the common good, the establishment of specific responsibilities, and proactive health protection for the community governance.

Keywords: Communitygovernance; Covid-19; Public Health Policy; Health Risk; Stakeholders

Introduction

The WHO pandemic phases

These systems are environmentally friendly and provide strategiesto aid countries involved in disease and self-regulation. The six-point plan encourages a mix of new ideas for existing national projects. However,the spread of the disease has improved. To support national and international planning points 1-3 and 5-6 have been aggregated to include the program's objectives. Likewise, the time after the onset of epilepsy is defined as the peak time after the onset of the disease. In the process of development and globalization, the world Health Organisation (WHO) will carefully consider all available data for analysis when implementing alternative approaches.

The ebola problem

The Ebola virus was introduced in West Africa (2013-2016) in Guinea in December 2013 before spreading to neighbouring Sierra Leone and Liberia, as well as small parts of Nigeria, Mali and Senegal, as well as cases from foreign countries registered with the United States of America, Spain, Great Britain and Norway. Numerous entertainment producers, both legal and non-regulatory, have discussed the threat to mobility on the planet as well as the clear plans of its actors. They have different interests in this group. Attempts are made to hear different voices at both the textual and the speech levels. The news directly covered the communication process, and controversy arose in the middle of this maze. Since then, partnerships have been identified as one of the key issues during the Ebola crisis. Data incidents are a gathering of partners, especially those caused by accidents, or contemplate reliable data sources, in the midst of a sea of fraudulent or fraudulent assets. The clear, contradictory and contradictory messages from many experts (such as the government, traditional pioneers, and energetic pioneers) are as follows: Some asked, the situation is getting worse. In this case, some networks took the first information about Ebola.

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Tangeretin exerts and modulates the anxiolytic effects of the GABAkine drugs diazepam and flumazenil in mice: Molecular interventions through animal behavior and molecular dynamic simulations

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ABSTRACT

The citrus peel flavonoid tangeretin (TAN) has diverse biological activities, including antioxidant, anti-inflammatory, anti-tumor, hepatoprotective, and neuroprotective effects. This study emphasizes evaluating the anxiolytic effect of TAN on mice. Additionally, we conducted *in silico* investigations to examine the potential molecular mechanisms behind the anxiolytic effect of TAN. For this, adult male *Swiss* albino mice were treated with TAN (10 and 20 mg/kg, p.o.) with or without the standard GABAergic agonist drug diazepam (DZP: 2 mg/kg, p.o.) and/or antagonist drug flumazenil (FLU: 0.1 mg/kg, i.p.) and checked for different locomotor behaviors using various mouse models. The molecular docking study of TAN was conducted against $GABA_A$ receptor subunits. Findings suggest that TAN dose-dependently and significantly ($p < 0.05$) increased locomotor activities such as the number of field crosses, hole crosses, swings, and light residence time while decreasing the grooming and rearing parameters of the animals. With DZP, it significantly ($p < 0.05$) reduced the test parameters while altering these parameters with FLU. In molecular docking, TAN has a strong binding affinity of −6.6 and −7.0 kcal/mol for the α2 and α3 subunits of the $GABA_A$ receptor, respectively, whereas the standard drugs DZP and FLU showed binding affinities between −6.0 and −6.7 kcal/mol for these subunits. MD simulations showed that TAN interacts with α3 subunits in a way similar to DZP, with similar RMSD and RMSF values and ligand properties. TAN also demonstrated acceptable drug-likeness and pharmacokinetics. Taken together, TAN augmented the anxiolytic effect of DZP while reducing the effect of FLU in mice.

1. Introduction

Mental health issues are one of the primary causes of worldwide disease-related burden (Tiller, 2013). Anxiety is defined as a diffuse, uncomfortable, hazy, scared, or worried mood that involves neurological signs such as headache, perspiration, palpitations, tachycardia, and gastrointestinal distress (M. S. Islam et al., 2022). Anxiety and stress have an adverse effect on one's physical and mental health, leading to conditions including diabetes, cardiovascular disease, and hypertension also associated with some somatic disorders (Khan & Khan, 2020; Pahl, Barrett, & Gullo, 2012). Anxiety can be caused by many kinds of factors, including gender and age, mental health, urbanization, physical status, conflict, the negative effects of pharmaceuticals, trauma, heredity, and

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(±) Citronellal Exerts Antidepressant and Modulatory Effects on Duloxetine Possibly Through Serotonin and Norepinephrine Reuptake Interaction Pathway: In Vivo Approach with Molecular Docking

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This study aims to assess the antidepressant and modulatory activities of citronellal (CIT) on duloxetine (DUX) and its possible underlying mechanisms through in vivo and in silico studies. Hence, the forced swimming test (FST), tail suspension test (TST), and open field test (OFT) were carried out. Mice were treated with different doses of CIT (50, 100, and 200 mg/kg, p.o.), while DUX (15 mg/kg, p.o.) was used as a positive control and a vehicle served as a negative control. Additionally, molecular docking was conducted to evaluate binding interactions. Results demonstrated that CIT dose-dependently and significantly ($p < 0.05$) alleviated immobility time in both the FST and TST. At a dose of 200 mg/kg, CIT showed notable effects with immobility times of 42.17 ± 3.70 and 70.17 ± 2.56 s in the FST and TST, respectively. In combination therapy, CIT (100 mg/kg) modulated the activity of DUX. However, antidepressant activity is confirmed by the OFT test, which reduced the locomotion activity. Further, CIT exhibited a moderate binding affinity (−6.1 kcal/mol) toward both the serotonin and norepinephrine reuptake transporters (SRT and NRT) by forming several bonds. In conclusion, CIT demonstrated moderate antidepressant activity, possibly by interacting with SRT and NRT.

1. Introduction

Depression is a prevalent, typically persistent, and debilitating psychiatric disorder. It causes significant symptoms that influence someone's emotions, cognition, and ability to carry out everyday activities, including sleeping, eating, or working.[1] The psychopathological condition is typified by a constellation of symptoms, including a persistent depressed mood, anhedonia, and reduced energy or fatigue. Additional manifestations encompass disturbances in sleep and psychomotor activity, feelings of guilt, diminished self-esteem, suicidal ideation, and alterations in the autonomic nervous system and gastrointestinal functions.[2] The World Health Organization (WHO) reports that there are 264 million people worldwide suffering from serious depression. Approximately 800,000 suicides occur every year, making it the second most prevalent reason for death among young people.[3] Adolescents aged 12–17 have the highest prevalence of severe depression cases, with a rate of 11.3%. They are observed by young adults aged 12–20 years, who have a rate of 9.6%. Research has shown that the incidence of depression in women is nearly double that of men.[4] Several factors are connected with depression, including social disadvantages, economics, and unsupportive relationships. Major depression appears to be influenced by a variety of mechanisms, including neurological, immune-mediated, hormonal, and neuroendocrinological factors.[5] Depression can lead to the development of several medical conditions, such as Alzheimer's disease, heart disease, strokes, diabetes, epilepsy, and malignancy. Cushing's syndrome and hypothyroidism are often associated with a significant incidence of mental health conditions.[6] Therefore, depression posed a substantial global burden of disorder.

Several neurotrophic and growth factors, such as vascular endothelial growth factor (VEGF), brain-derived neurotrophic factor (BDNF), insulin-like growth factor 1 (IGF1), and fibroblast growth factor 2, have been associated with depression.[7] Additionally, the monoamine-deficiency theory posits that depression is caused by a reduction in the levels of neurotransmitters

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Protective effects of sclareol against paracetamol-induced liver damage in rats, possibly through an oxidative stress-reducing pathway

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ABSTRACT

This study evaluates the liver-protective properties of sclareol (SCL), a diterpene derived from plant clary sage. Because of its antioxidant properties, sterol is often used in food and cosmetics. In addition, SCL has neuropharmacological, immune-modulating, anti-inflammatory, anti-hypertensive, and anti-cancer properties. The investigation sought to determine the efficacy of SCL in reducing paracetamol (PCM)-induced liver toxicity in rats. The animals were allocated into five separate groups and given the following care: the vehicle group received normal saline; the PCM dosage for the negative control (NC) group was 640 mg/kg; in addition to 640 mg/kg PCM, the treatment groups received SCL at dosages of 5 or 10 mg/kg, while the positive control (PC) group was given 50 mg/kg of silymarin. Blood and tissue samples were obtained from rats treated with an oral dose of paracetamol at 640 mg/kg for 14 consecutive days. Serum and hepatic tissue samples were subjected to histological and biochemical assessment. The data showed that PCM therapy resulted in considerable necrosis and inflammatory cell infiltration, while the liver structure remained intact in SCL and PC groups. SCL significantly reduced hepatotoxic indicators and corrected PCM-tempted alterations in hepatic enzymes, plasma proteins, serum bilirubin, antioxidant enzymes, lipid peroxidation, and cholesterol levels, particularly at 10 mg/kg dosage. In summary, SCL demonstrated substantial hepatoprotective benefits against paracetamol-induced hepatic toxicity in laboratory animals.

1. Introduction

Our hepatic system is responsible for numerous biological functions, including the metabolism and processing of various substances like medications, carbohydrates, proteins, and fats. Liver illnesses pose a substantial worldwide issue because of their potential to affect public health significantly [1,2]. The efficacy and safety of any therapeutic medication might also be impacted by the individual's hepatic function. An increasing number of people are interested in treating both sudden and long-lasting liver problems with complementary and alternative therapies [3]. Researchers are now investigating natural compounds and their derivatives as prospective therapies for several liver illnesses. Silymarin is one such compound renowned for its liver-protective properties that is extracted from plant milk thistle [4]. Moreover, it is essential to comprehend the impact of a drug candidate on the hepatic system, particularly for drugs taken orally.

Sclareol (SCL) is an aromatic compound initially extracted from *Salvia sclarea* L. (clary sage). It is classified as a bioactive labdane-type diterpene and is often used in the fields of food, cosmetics, and traditional medicine. SCL has been the subject of scientific research, which has identified several biological activities associated with it. These activities include antioxidant properties [5], anti-inflammatory effects, immune-modulating effects [6,7], antimicrobial effects [8], antihypertensive effects [9], anticancer effects [10–12], chemo-enhancing effects

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Chemical Characterization, Cytotoxicity, Anti-inflammatory, Antioxidant, Antimicrobial and Anti-toxoplasmosis of *Chrysophyllum albidum* Seed Oil

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Abstract: *Chrysophyllum albidum*, an important tropical fruit with seeds, was investigated for its chemical composition, cytotoxic free radical scavenging, anti-inflammatory, antimicrobial (on clinical isolates) and antiparasitic properties for prospective application in the cosmeceuticals and food sectors. The physicochemical results of the *C. albidum* oil were 179.52±2.80 mg KOH/g saponification value, 3.93±0.56 mg KOH/g acid value, 1.58±0.11% free fatty acid and 39.34±2.54 g I_2/100 g iodine value, suggesting the suitability of the oil for industrial purposes, such as in skin care production. *C. albidum* seeds contained linoleic acid (33.12%), oleic acid (31.81%), palmitic acid (17.68%) and stearic acid (5.30%) as the major fatty acids. The IC_{50} value estimated for the anti-lipooxygenase potential of the oil (0.56±0.09 µg/mL) was close to that obtained for the standard indomethacin (0.53± 0.07 µg/mL). The IC_{50} obtained for the DPPH (4.74±0.83 µg/mL) and ABTS (0.03±0.11 µg/mL) of the oil was significant but relatively low compared to that of ascorbic acid (0.34±0.04 and 0.54±0.04 µg/mL) used as standards for the DPPH and ABTS free radical scavenging activities, respectively. The oil had significant activities against all the clinical isolates, with *A. niger* showing a significant MIC of 12.5 mg/mL. The seed oil of *C. albidum* possesses numerous biological activities that can be harnessed. The presence of essential fatty acids is

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RESEARCH ARTICLE

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Antibody-Conjugated Magnetic Nanoparticle Therapy for Inhibiting T-Cell Mediated Inflammation

*Mahbub Hasan, Jong-Gu Choi, Hafeza Akter, Hasung Kang, Meejung Ahn, and Sang-Suk Lee**

Tolerance induction is critical for mitigating T cell-mediated inflammation. Treatments based on anti-CD3 monoclonal antibody (mAb) play a pivotal role in inducing such tolerance. Anti-CD3 mAb conjugated with dextran-coated magnetic nanoparticles (MNPs) may induce inflammatory tolerance is posited. MNPs conjugated with anti-CD3 mAb (Ab-MNPs) are characterized using transmission and scanning electron microscopy, and their distribution is assessed using a nanoparticle tracking analyzer. Compared to MNPs, 90% of Ab-MNPs increased in size from 54.7 ± 0.5 to 71.7 ± 2.7 nm. The in vitro and in vivo studies confirmed the therapeutic material as nontoxic and biocompatible. Mice are administered various dosages of Ab-MNPs before receiving concanavalin-A (ConA), an inflammation inducer. Preadministration of Ab-MNPs, as opposed to MNPs or anti-CD3 mAb alone, significantly reduced the serum levels of interferon-γ and interleukin-6 in ConA-treated mice. Additionally, the transdermal stamp patch as an effective delivery system for Ab-MNPs is validated. This study demonstrates the utility of the Ab-MNP complex in pathologies associated with T cell-mediated hyperinflammation, such as organ transplantation and COVID-19.

1. Introduction

T-cell function relies on the activation of the multi-subunit apparatus cluster of differentiation 3 (CD3) complex. This complex and $\alpha\beta$ T-cell receptor (TCR) form the TCR–CD3 complex, which triggers the activation of T cells. Key components of the CD3 complex include single units of $\alpha\beta$TCR, CD3$\epsilon\gamma$, CD3$\epsilon\delta$, and CD3$\zeta\zeta$ dimers.[1] The murine anti-CD3 monoclonal antibody (mAb), OKT3, was the first mAb-based immunosuppressant drug used to reduce organ rejection in patients receiving kidney, liver, or heart transplants. However, the clinical development of OKT3 was halted owing to its adverse effects. In contrast, the mouse-specific mAb clone 145-2C11 did not induce such toxicity in a murine model.[2]

The fundamental mechanism of anti-CD3 mAb treatment involves inducing tolerance through the shedding or internalization of the TCR-CD3 complex, rendering T cells unresponsive to proinflammatory antigens. Moreover, signaling induced by anti-CD3 mAb through the TCR-CD3 complex can trigger T cell apoptosis. The resulting apoptotic T cells, along with the macrophages detecting them, release transforming growth factor-β (TGF-β), further promoting tolerance.[3] Anti-CD3 mAb can bind to the Fc receptors of antigen-presenting cells (APCs) and the TCR-CD3 complex.[3] Therefore, preventing Fc-mediated interactions with APCs is necessary to stop the activation of T cells and the subsequent increase in inflammatory cytokine levels. Humanized anti-CD3 mAb (HuM291) was designed to bind specifically to the CD3ϵ chain of the TCR, avoiding Fc-mediated binding and complement fixation. Based on preclinical and clinical research data, HuM291 effectively depletes circulatory T cells.[4] However, after phase II/III clinical trials, further development of HuM291 was discontinued owing to concerns regarding its efficacy and safety profiles.

Magnetic nanoparticles (MNPs) have been extensively used in imaging, drug delivery, and therapeutics. The surface modification and dosage of MNPs determine their in vivo biodistribution patterns and toxicities. Size is a crucial factor for nanoparticle bioavailability. MNPs larger than 200 nm accumulate in the spleen, while those smaller than 10 nm are easily eliminated through renal clearance. Therefore, based on the size criterion,[5] MNPs ranging between 10 and 100 nm are optimum for

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Research article

Molecular dynamics simulation of wild and mutant proteasome subunit beta type 8 (PSMB8) protein: Implications for restoration of inflammation in experimental autoimmune encephalomyelitis pathogenesis

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ABSTRACT

Multiple Sclerosis (MS) is an autoimmune and chronic disease in the brain and spinal cord. MS has inflammatory progression characterized by its hallmark inflammatory plaques. The histological and clinical characteristics of MS are shared by Experimental Autoimmune Encephalomyelitis (EAE). Genetic and environmental factors contribute to the development of MS. In EAE-MS disease, the level of proteasome subunit beta type-8 (PSMB8), encoded by the PSMB8 gene, is increased and regulates the inflammatory response in this disease. In humans, the Nakajo-Nishimura Syndrome is caused by a mutation in the gene PSMB8, a part of the immunoproteasome subunit. Therefore, special attention to wild and mutant (G210V) PSMB8 protein is imperative. In this study, we performed a 100 ns molecular dynamics (MD) simulation for wild-type PSMB8 and the mutant G210V. Then, we analyzed the fundamental and essential simulation results using another Google Colab system. The energy analysis ensures the structural deviation due to point mutation. The trajectory of the fundamental simulation (RMSD, RMSF, and Rg) describes that the G210V mutated protein is more flexible and less stable than the wild type. We observed the conformational changes due to mutation by analyzing the RMSD average linkage hierarchical clustering, total SASA, and SASA autocorrelation. The differences in the protein's overall motion and the atoms' precise location are identified by the principal component analysis, showing that the overall motion and location of the atoms are different. Our study provides valuable insights into the dynamics and structure of this protein, which can aid in further understanding its biological functions and potential implications for disease.

1. Introduction

Multiple sclerosis (MS) is one of the most prevalent neurological disorders, which is an inflammatory autoimmune disease leading to macrophage and lymphocyte invasion in the central nervous system (CNS) [1–4]. Damages in the myelin sheath, the insulator

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ORIGINAL ARTICLE OPEN ACCESS

L-quebrachitol Modulates the Anti-convulsant Effects of Carbamazepine Possibly Through Voltage-gated Sodium Channel Blocking Mechanism in Chicks: In Vivo and In Silico Studies

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Keywords: convulsion | L-Quebrachitol | molecular docking study | sodium channel

ABSTRACT

Introduction: L-Quebrachitol (LQB), a naturally occurring bioactive compound, exhibits anti-inflammatory, anti-oxidant, anti-cancer, and anti-diabetic properties. However, its therapeutic potential in convulsant management remains largely unexplored. The objective of this study was to investigate the anticonvulsant effects of LQB in an In Vivo model and to examine its molecular interactions via In Silico docking simulations.

Methods: In the In Vivo study, pentylenetetrazol (PTZ) was administered intraperitoneally (i.p.) at 80 mg/kg to induce convulsions, and the test animals were treated orally with three doses of LQB (1, 5, and 10 mg/kg), with carbamazepine (CBZ) at 80 mg/kg as a standard drug.

Results: The results indicated that LQB at all tested doses significantly ($p < 0.05$) prolonged seizure latency and decreased convulsion frequency, with the 10 mg/kg dose showing the most significant effects. Furthermore, the combination of LQB (10 mg/kg) and CBZ (80 mg/kg) resulted in a synergistic increase in anticonvulsant activity. In the In Silico study, molecular docking analysis revealed that both LQB and CBZ interacted with the voltage-gated sodium channel (VGSC), a key receptor involved in convulsions, with LQB demonstrating a binding affinity (BA) of −5.4 kcal/mol, which was moderate compared to CBZ's BA.

Conclusion: LQB showed potential anti-convulsant activity in PTZ-induced convulsion animals, possibly through blocking sodium channel receptors. Further studies are needed to clarify its mechanisms and clinical potential in convulsion treatment.

Abbreviations: %P, Percentage protection.; BA, binding affinity; CBZ, carbamazepine; DC, Duration of convulsion; HB, hydrogen bond; i.p., intraperitoneally; LC, Latency of convulsion; LQB, L-Quebrachitol; ND, Number of deaths; NF, Number of frequency; PTZ, pentylenetetrazol; VGSC, voltage-gated sodium channel.

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High-throughput screening of natural antiviral drug candidates against white spot syndrome virus targeting VP28 in *Penaeus monodon*: Computational drug design approaches

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MM-PBSA

ABSTRACT

The white spot syndrome virus (WSSV), considered the deadliest pathogen impacting Penaeid shrimp (*Penaeus monodon*), remains worrisome for the global shrimp industry due to its extreme virulence and mortality rate of up to 100%. To date, there has been no breakthrough in effective antivirals or vaccines that can mitigate the financial damage caused by the pathogen. The distinctive structure of VP28 facilitates its role as a trimer, serving as the primary envelope protein of WSSV. It anchors to the viral envelope, directly interacts with PmRab7, a membrane protein in *P. monodon*, and aids in entry into the host. This research aims to discover antiviral drug candidates targeting VP28 trimer by screening a virtual library of 187 bioactive compounds derived from the medicinal herbs *Azadirachta indica* and *Bacopa monnieri*. To evaluate the drug ability of compounds in restricting VP28 trimer interaction within the endocytic pathway, a computational strategy was employed, including virtual screening, pharmacokinetics and toxicity analysis, and molecular dynamics (MD) simulation. The four strongest compounds, epicatechin, luteolin, kaempferol, and apigenin, exhibited binding affinities of −8.8, −8.8, −8.7, and −8.5 Kcal/mol, respectively, and demonstrated excellent pharmacokinetic properties. Furthermore, we employed 100 nanoseconds MD simulations and MM-PBSA binding free energy calculations to examine intermolecular interactions and confirmed the structural stability of the compounds at the VP28 binding site. The findings of this research suggest that these compounds hold promise in combating WSSV infection, reducing economic losses, and contributing to the sustainability of the shrimp industry.

1. Introduction

The black tiger shrimp (*Penaeus monodon*) presents a highly nutritious choice for human consumption, renowned for its substantial protein content and abundant supply of vitamins, minerals, unsaturated fatty acids, vital amino acids, and antioxidants.[1] Consequently, the shrimp industry has expanded uninterruptedly, firmly establishing its economic importance in the Blue Revolution.[2] The global commercial production of black tiger shrimp amounted to 4200 million metric tons (mt) in the most recent fiscal year, with an estimated worth of USD 4.8 billion. The high demand in local and international markets has led to the prominence of black tiger prawn farming across the coastal regions of Asia, Australia, and numerous Pacific Island countries.[3] Bangladesh, contributing 2.5% to global shrimp production, generated around USD 300 million as the second largest source of export earnings in the previous economic year by exporting 29,000 mt of black tiger shrimp.[4] In addition, around 1.2 million individuals depend on the *P. monodon* sector for their source of income in Bangladesh.[3–5] However, the catastrophic effects of various viral diseases have negatively impacted the shrimp industry. The extremely pathogenic White Spot Syndrome Virus (WSSV), which causes White Spot Disease (WSD), has been a major concern for over thirty years.[6] It infects *P. monodon* at various stages of development, and causes severe disease outbreaks, leading to a mortality rate of up to 100% within 3–10 days.[7] WSD manifests through a range of clinical symptoms, including lethargy, decreased food intake,

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Research Article

Alfin-like (AL) transcription factor family in *Oryza sativa* L.: Genome-wide analysis and expression profiling under different stresses

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ABSTRACT

Oryza sativa L. is the world's most essential and economically important food crop. Climate change and ecological imbalances make rice plants vulnerable to abiotic and biotic stresses, threatening global food security. The Alfin-like (AL) transcription factor family plays a crucial role in plant development and stress responses. This study comprehensively analyzed this gene family and their expression profiles in rice, revealing nine AL genes, classifying them into three distinct groups based on phylogenetic analysis and identifying four segmental duplication events. RNA-seq data analysis revealed high expression levels of OsALs in different tissues, growth stages, and their responsiveness to stresses. RT-qPCR data showed significant expression of OsALs in different abiotic stresses. Identification of potential *cis*-regulatory elements in promoter regions has also unveiled their involvement. Tertiary structures of the proteins were predicted. These findings would lay the groundwork for future research to reveal their molecular mechanism in stress tolerance and plant development.

1. Introduction

During their lifespan, plants encounter a range of challenging and ever-changing environmental circumstances, including drought, low temperatures, high salinity, and heat, along with being susceptible to various pathogens due to their sessile nature. The existence of various abiotic and biotic stresses represents an obstacle to the growth, maturation, and overall yield of plants [1]. To endure and enhance their tolerance to various stresses, plants have evolved intricate adaptation strategies at molecular, cellular, physiological, and biochemical levels [2–4]. One notable aspect of the plant stress response is the activation of a complex interwoven network of events involving interactions between genes, signaling molecules, and cross-talk within multiple molecular pathways [3,5–8]. Specific stresses trigger the expression of various stress-responsive genes [9], and stress-signaling pathways play a crucial role in helping plants adapt to environmental challenges by connecting the sensing mechanism with the genetic response [10–15]. Furthermore, the regulation of plant defense mechanisms is significantly influenced by different gene families that function as transcription factors (TFs). These transcription factors are responsible for functionally regulating plants in terms of metabolism and physiology, enabling them to respond effectively to abiotic stresses and defend against invading pathogens [16–18]. Acting as molecular switches that control gene expression, they can govern critical downstream responses by regulating the expression of target genes that respond to stress [19,20]. Alongside other developmental and genetic responses [21,22], the function of these TFs stands out as a prominent and dynamic mechanism that aids higher terrestrial plants in adjusting to their surroundings [23]. To date, researchers have identified a variety of transcription factors in plants and categorized them into different families according to the conserved domains they possess [24]. Amongst them, the Alfin-like TF family holds significant importance in the realm of plants as it participates in a range of important biological processes such as root development and elongation, formation of meristem, and response to salt stress [25,26]. As a 7S storage protein, the *Alfin-like* gene was first identified in *Medicago sativa* (alfalfa) plant [27,28]. The AL TF family members share the distinctive feature of having two highly conserved regions: the DUF3594/Alfin domain at the N termini and the PHD-finger motif at the C termini. With

Abbreviations: AL, Alfin-like; TF, transcription factor; CREs, *cis*-regulatory elements; miRNA, microRNA; RNA-Seq data, RNA (cDNA) sequencing data; PEG, polyethylene glycol; RT-qPCR, reverse transcription quantitative polymerase chain reaction; h, hour; d, day.

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cells

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Review

Exploring Importance and Regulation of Autophagy in Cancer Stem Cells and Stem Cell-Based Therapies

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Abstract: Autophagy is a globally conserved cellular activity that plays a critical role in maintaining cellular homeostasis through the breakdown and recycling of cellular constituents. In recent years, there has been much emphasis given to its complex role in cancer stem cells (CSCs) and stem cell treatment. This study examines the molecular processes that support autophagy and how it is regulated in the context of CSCs and stem cell treatment. Although autophagy plays a dual role in the management of CSCs, affecting their removal as well as their maintenance, the intricate interaction between the several signaling channels that control cellular survival and death as part of the molecular mechanism of autophagy has not been well elucidated. Given that CSCs have a role in the development, progression, and resistance to treatment of tumors, it is imperative to comprehend their biological activities. CSCs are important for cancer biology because they also show a tissue regeneration model that helps with organoid regeneration. In other words, the manipulation of autophagy is a viable therapeutic approach in the treatment of cancer and stem cell therapy. Both synthetic and natural substances that target autophagy pathways have demonstrated promise in improving stem cell-based therapies and eliminating CSCs. Nevertheless, there are difficulties associated with the limitations of autophagy in CSC regulation, including resistance mechanisms and off-target effects. Thus, the regulation of autophagy offers a versatile strategy for focusing on CSCs and enhancing the results of stem cell therapy. Therefore, understanding the complex interactions between autophagy and CSC biology would be essential for creating therapeutic treatments that work in both regenerative medicine and cancer treatment.

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cells

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Review

Advancements in Utilizing Natural Compounds for Modulating Autophagy in Liver Cancer: Molecular Mechanisms and Therapeutic Targets

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Abstract: Autophagy, an intrinsic catabolic mechanism that eliminates misfolded proteins, dysfunctional organelles, and lipid droplets, plays a vital function in energy balance and cytoplasmic quality control, in addition to maintaining cellular homeostasis. Liver cancer such as hepatocellular carcinoma (HCC) is one of the most common causes of cancer deaths globally and shows resistance to several anticancer drugs. Despite the rising incidence and poor prognosis of malignant HCC, the underlying molecular mechanisms driving this aggressive cancer remain unclear. Several natural compounds, such as phytochemicals of dietary and non-dietary origin, affect hepatocarcinogenesis signaling pathways in vitro and in vivo, which may help prevent and treat HCC cells. Current HCC cells treatments include chemotherapy, radiation, and surgery. However, these standard therapies have substantial side effects, and combination therapy enhances side effects for an acceptable therapeutic benefit. Therefore, there is a need to develop treatment strategies for HCC cells that are more efficacious and have fewer adverse effects. Multiple genetic and epigenetic factors are responsible for the HCC cells to become resistant to standard treatment. Autophagy contributes to maintain cellular homeostasis, which activates autophagy for biosynthesis and mitochondrial regulation and recycling. Therefore, modifying autophagic signaling would present a promising opportunity to identify novel therapies to treat HCC cells resistant to current standard treatments. This comprehensive review

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REVIEW OPEN ACCESS

A Review: CRISPR Cas System and the Mechanism With an Inhibition of Binding of CRISPR Cas-9

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ABSTRACT

CRISPR Cas system is a revolutionary and precise genome editing system that induces bacterial and archaeal adaptive immunity and already has shown several promising applications in the treatment of genetic diseases and detection of nucleic acid targets. It is a complex tool, comprising diverse effector proteins and guide RNA that can be applied to dissociate and modify genes in living organisms along with the in vitro process. The review concentrates on the advances accomplished from some recent years to 2023 for the emergence of predicting actions of Cas protein with the guide RNA (gRNA), playing a key role in genome editing. This review emphasizes the effect of DNA structure and chromosomal protein on Cas 9 binding with a distinct classification of Cas types. The relevance of this review is highlighted by the significance of the rapid development of wide study methods and their potential impacts on the efficiency of the CRISPR Cas system. We have analyzed recent kinds of literature in this work to integrate a deep learning way that contributes over the next time with some important discussion about viral resistance in eukaryotes along with some cancer treatment strategies, and crop improvement by the CRISPR Cas system.

1 | Background

The existence of prokaryotes is threatened by several viruses present in the surroundings. Clustered regularly interspaced short palindromic repeats (CRISPR), an adaptive immune system, were engineered by prokaryotes as defensive tackles [1]. The utilization of the CRISPR/Cas system has exhibited its prowess as a formidable, uncomplicated, highly effective, and direct methodology for manipulating viral genomes, showcasing its vast capacity for scientific investigation [2]. The CRISPR/Cas system is hypothesized to confer antiviral defense in prokaryotes by selectively identifying and associating with phage DNA via CRISPR RNA (crRNA) [3, 4]. This interaction subsequently directs Cas proteins to identify and cleave foreign DNA by means of transactivating crRNA (tracrRNA) [2]. The CRISPR defense mechanism serves as a protective mechanism for bacteria against recurrent viral assaults, encompassing three cardinal stages: adaptation (spacer acquisition), crRNA synthesis (expression), and prey interference [5]. The CRISPR/Cas-9 tools for modifying the genome exhibit a diverse range of programs across various domains, encompassing medicine, agriculture, and biotechnology [5–7]. This framework comprises a collection

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Review

A Comprehensive Review of Nanoparticle-Based Drug Delivery for Modulating PI3K/AKT/mTOR-Mediated Autophagy in Cancer

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Abstract: The phosphoinositide 3-kinase (PI3K)/AKT/mammalian target of the rapamycin (mTOR) pathway plays a crucial role in the regulation of autophagy, a cellular mechanism vital for homeostasis through the degradation of damaged organelles and proteins. The dysregulation of this pathway is significantly associated with cancer progression, metastasis, and resistance to therapy. Targeting the PI3K/AKT/mTOR signaling pathway presents a promising strategy for cancer treatment; however, traditional therapeutics frequently encounter issues related to nonspecific distribution and systemic toxicity. Nanoparticle-based drug delivery systems represent a significant advancement in addressing these limitations. Nanoparticles enhance the bioavailability, stability, and targeted delivery of therapeutic agents, facilitating the precise modulation of autophagy in cancer cells. Functionalized nanoparticles, such as liposomes, polymeric nanoparticles, and metal-based nanocarriers, facilitate targeted drug delivery to tumor tissues, minimizing off-target effects and improving therapeutic efficacy. These systems can deliver multiple agents concurrently, enhancing the modulation of PI3K/AKT/mTOR-mediated autophagy and related oncogenic pathways. This review examines advancements in nanoparticle-mediated drug delivery that target the PI3K/AKT/mTOR pathway, emphasizing their contribution to improving precision and minimizing side effects in cancer therapy. The integration of nanotechnology with molecularly targeted therapies presents substantial potential for addressing drug resistance. Future initiatives must prioritize the optimization of these systems to enhance clinical translation and patient outcomes.

Keywords: nanoparticles; drug delivery; PI3K/AKT/mTOR; autophagy; cancer therapy; targeted therapy

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1. Introduction

Autophagy is a crucial mechanism that conserves cellular integrity by degrading and recycling damaged organelles and proteins, thereby maintaining cellular homeostasis [1,2]. Autophagy functions in a dual capacity in cancer, serving as a tumor suppressor in early stages and as a tumor promoter in advanced stages, where it supplies cancer cells with essential metabolic resources for survival under stress [3]. The phosphoinositide 3-kinase

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Review article

Current understanding of heat shock protein-mediated responses to heat stress in rice

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ABSTRACT

Global warming significantly impacts crop production and poses a major threat to food security. Indeed, as one of the world's most important food crops, the yield and quality of rice (*Oryza sativa* L.) are frequently affected by heat stress (HS). Therefore, clarifying the molecular mechanism of HS and cultivating heat-tolerant rice varieties is of critical importance. To gain insight into the heat shock proteins (HSPs) regulated functions, molecular mechanisms have been explored in rice response to HS. This study synthesizes current research on HSPs and their roles in improving rice tolerance to HS. It also explores the cross-talk between HSPs and phytohormones through cis-acting elements. Additionally, a total of 20 HSPs were identified in the rice genome as playing key roles in the development of heat-tolerant rice varieties. Protein-protein interactions (PPIs) network analysis proposed 15 key HSPs as a model for adaptation strategies. Gene ontology (GO) enrichment analysis revealed that these key HSPs played important roles in rice response to HS. Together, these strategies have the potential to increase rice's resistance to HS, offering fresh concepts and perspectives for further study.

1. Introduction

Heat stress (HS) triggers the expression of heat shock proteins (HSPs) in plants, which are crucial for protecting cells from thermal damage. HSPs are essential for HS tolerance in rice plants by protecting protein structure and conformation. HS triggers a cascade of cellular signaling pathways that coordinate to maintain cellular homeostasis and enhance the survival of rice plants under high-temperature conditions. HSPs act as molecular chaperones, essential for protein transport, proper folding, and assembly, and preventing the aggregation of unfolded proteins during HS (Baruah et al., 2024; Mao et al., 2025; Xu et al., 2024). Heat shock proteins (HSPs) are classified into six major families, such as HSP20 (small HSPs), HSP40, HSP60, HSP70, HSP90, and HSP100, based on their molecular weight, amino acid sequence, cellular localization, and functional roles (Huang et al., 2008; Wang et al., 2024a). These HSPs have different conserved domains and functions. HSP20 typically range in molecular weight from 12 to 42 kDa and play an essential role in cellular protection under HS. These proteins feature an α-crystallin domain (~80–100 amino acids), which is highly conserved and essential for the chaperone activity of HSP20. It helps maintain protein homeostasis by binding to unfolded or partially unfolded proteins, thereby preventing their aggregation and facilitating their proper folding or

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ORIGINAL PAPER

Development and Validation of the Classroom Mindful Attention Regulation Scale (CMARS) for Emerging Adults

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Abstract

Objectives A scale measuring students' attention regulation in classroom contexts has not yet been developed. This research developed and validated the classroom mindful attention regulation scale (CMARS) using modern psychometric approaches for Bangladeshi emerging adults.

Method A convenience sample of 600 university students aged 18–25 years was recruited. Measures completed by the participants include CMARS, Mindful Attention Awareness Scale, Philadelphia Mindfulness Scale, and Depression Anxiety Stress Scale-21. To examine the factor structure and ensure factor retention, an exploratory factor analysis (EFA) and parallel analysis (PA) were run, respectively. To validate the factor structure, confirmatory factor analysis (CFA) was performed. Cronbach's alpha, McDonald's omega, and Ferguson's delta were used to determine the internal consistency reliabilities. Multi-group confirmatory factor analysis (MGCFA) was conducted to test the invariance across gender.

Results Content validation resulted in the retention of 10 items. The two-factor structure emerged from the EFA, and this solution was retained through PA. While validating the factor structure, CFA model fit indices showed an adequate fit to the data. Mean inter-item correlations, corrected item-total correlations, and internal consistency reliabilities fall within the acceptable ranges. MGCFA revealed that the CMARS can invariably measure the mindful attention regulation across gender. The relationship of CMARS with depression, stress, and mindfulness components indicated the convergent validity of the measure.

Conclusions Altogether, the CMARS has been found to be a valid instrument for assessing students' classroom attention regulation skills and identifying areas for improvement.

Preregistration This study is not preregistered.

Keywords CMARS · Mindfulness · Self-regulation · Attention · Emotion

A mindful classroom enhances the sensory awareness in which students empathically acknowledge and intentionally pay attention to the classroom experiences, stimulating their creativity, passion, and resilience towards adjusting to change (Napoli & Bonifas, 2011). Filtering relevant information while ignoring distractions in a classroom context requires attentional control that opens the door of active and engaged learning (Posner & Rothbart, 2007). Students who fail to engage mindfully face difficulties to attend to the instructions of teachers, lose interest in lessons quickly, discontinue their learning tasks, encounter difficulties adhering to classroom rules, and exhibit disruptive behaviors, undermining the learning effectiveness (Granziera et al., 2022; Napoli et al., 2005; Xu et al., 2016).

Therefore, it is critically important for both students and teachers to practice present-moment nonjudgmental

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Original Manuscript

Bangla Version of the Transitional Impact Scale: Assessing Psychometric Properties Among Bangladeshi University Students

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Sage

Mahady Hasan Asif[1], Masuma Parvin[2], and Chayon Kumar Das[3,4]

Abstract

The Transitional Impact Scale (TIS-12) is a self-reported psychological assessment tool that measures the impact of life transitions by assessing material and psychological changes in a person after a transitional event. This study aimed to translate and validate the TIS-12 in Bangla among Bangladeshi university students. A total of 374 students from four universities completed a survey comprising demographic items, the Bangla TIS-12 (TIS-B), the Bangla Depression Anxiety Stress Scale (DASS-21), and the Bangla WHO-5 Well-Being Index. McDonald's ω and Intra-class Correlation Coefficient (ICC) suggested good reliability of the TIS-B. Exploratory factor analysis revealed two factors (materialistic and psychological) replicating the factorial structure of the original scale. Confirmatory factor analysis supported a correlated two-factor model with good fit indices for the TIS-B. Measurement invariance testing using multi-group CFA demonstrated configural, metric, and scalar invariance across gender, and configural invariance across university type. Weak correlations with both the DASS-21 and WHO-5 indicated construct validity of TIS-B. In conclusion, the Bangla version of TIS-12 is a valid and reliable measure to assess the quality and quantity of changes brought about by transitional events within the Bangladeshi context.

Keywords: transitional impact scale, psychometrics, life change events, psychological impact, materialistic impact

Introduction

Transitions are an inevitable part of human life, as people experience various life-changing events throughout life. According to transition theory, an occurrence or sequence of events that fundamentally alters "the fabric of daily life"—what people do, where they do it, and with whom—is referred to as a transition (Brown, 2016). Transitions are currently being studied from a multidisciplinary perspective due to their overlap with geographical events such as, natural disaster (Heanoy et al., 2023), life-span developmental events such as marriage (Shi & Brown, 2021) and starting university or college (Smith et al., 2022), health issues such as terminal illness (Uzer, 2020), crisis situations such as pandemics (Heanoy et al., 2021). As transitions can have detrimental physiological, psychological and social impact, researchers of psychology and related fields also examine life transitions and transitional events that demonstrate the importance of understanding transitions as a manifestation of stress (Hammen, 2005; Svob et al., 2014), depression, anxiety (Hassanzadeh et al., 2017; Johnson & Thompson, 2008; Tennant, 2002; Terziev, 2018) and post-traumatic stress disorder (Stanke et al., 2012).

As per Frege et al. (2023), Bangladesh is the ninth most disaster-prone country where river erosion, floods, cyclones are very common. People need to adjust to a series of changes following a disaster such as migrating to new place after losing one's home, joblessness, financial difficulties etc. Moreover, people of Bangladesh, like any other countries, face challenges in both early life (puberty, admission to college or university, early marriage, and parenthood) and late life (job retirement, terminal illness etc.). Additionally, there are some culture-specific transitional events, such as transitioning to a single family from a joint family because of urbanization, long job-seeking time because of unemployment, and insecurity in old age in the absence of government-based insurance.

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Beyond transformational: how servant leadership fosters knowledge sharing through psychological safety and trust

Ishita Roy and Rawshan Islam

Abstract

Purpose – *The purpose of this study is to analyze the identical effect of transformational leadership (TL) and servant leadership (SL) and to uncover additional variations that SL may represent in employee knowledge-sharing behavior (KSB) above and beyond TL. This research also analyzes the conflicting mechanisms by which TL and SL affect KSB.*

Design/methodology/approach – *Data were obtained through a quantitative survey design of 527 employees from diverse IT businesses in Bangladesh. Structural equation modeling was largely used to test hypotheses and compare models.*

Findings – *The results imply that SL not only has a greater influence on KSB but also represents an additive variation in KSB above and beyond TL. The findings further show that the impact of SL on KSB is better communicated by psychological safety (PS). Alternatively, the power of TL is best transferred via trust in leader.*

Practical implications – *This study unwinds the roles of transformational and SL in allowing knowledge-sharing in knowledge-intensive organizations. It means that by adopting a two-pronged leadership style, managers could promote the sharing of knowledge by generating PS and trust.*

Originality/value – *This study gives early empirical evidence of SL's additional effect on employee KSB, exceeding TL. It also contributes to leadership literature by exploring the diverse implications of sharing knowledge using theory-driven methodologies.*

Keywords *Transformational leadership, Servant leadership, Knowledge-sharing behavior, Psychological safety, Trust in leader*

Paper type *Research paper*

Ishita Roy and Rawshan Islam are both based at the Department of Management Studies, Gopalganj Science and Technology University, Gopalganj, Bangladesh.

Introduction

Leadership has always been a cornerstone of human progress – from shaping the dynamics of work relationships to fostering a healthy work environment (Kyambade *et al.*, 2024). Although academic inquiry into leadership formally began in the 20th century, its influence is evident across all sectors and regions (Liden *et al.*, 2025). Broadly defined, leadership is a social influence process in which leaders inspire and enable followers to work toward shared objectives (Bass, 1990). Yet, it is evident that there is no "one-size-fits-all" leadership approach. Instead, leadership styles depend on various situational and contextual factors, including organizational culture, environment, peer dynamics and strategic goals (Moodley, 2019). This has led to the emergence of multiple leadership styles.

According to a systematic literature review by (Liden *et al.*, 2025), the focus of leadership research has significantly expanded since 2000, with growing attention to transformational, transactional, servant, ethical, authentic, humble and even destructive leadership styles (Carton, 2022). These styles have been widely studied across sectors such as education,

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Impact of authentic leadership on nurses' well-being in Bangladeshi public hospitals

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Abstract

Purpose – This study aims to test the nurses' authentic leadership's direct and indirect impact on job satisfaction and intent to stay through work-to-family conflict (WFC) in health-care organizations.

Design/methodology/approach – Data were gathered at three different time points from 262 nurses employed in public hospitals across Bangladesh. Hierarchical regression analysis using structural equation modeling and PROCESS Macro were used to test the hypotheses.

Findings – Findings disclosed that nurses' authentic leadership impacts job satisfaction, intention to stay and WFC. Moreover, WFC is identified as a mediator in the relationship between nurses' authentic leadership and job satisfaction and intent to stay.

Research limitations/implications – Due to the cross-sectional nature of the study, it does not establish a causal relationship among the study variables.

Practical implications – This research helps health-care managers understand the necessity of developing nurses' authentic leadership. By implementing training, development and mentoring programs, organizations can cultivate authentic leadership among the nurses' supervisors, which ensures higher job satisfaction and intention to stay.

Originality/value – Although many studies exist on the influence of authentic leadership on nurses' work-related outcomes, still no study explored the relationship between authentic leadership and WFC. Moreover, the study explores the indirect effect of authentic leadership on job satisfaction and intent to stay through WFC, which was ignored in earlier studies.

Keywords Authentic leadership, Job satisfaction, Intent to stay, Work-to-family conflict, Nurses

Paper type Research paper

Introduction

Authentic leadership, recognized as a positive leadership style, has garnered significant attention in both academic and practitioner communities over the past decade (Avolio *et al.*, 2004; Mitchie and Gooty, 2005). It is defined as "a pattern of transparent and ethical leader behavior that encourages openness in sharing information needed to make decisions while accepting input from those who follow" (Avolio *et al.*, 2009, p. 424). Authentic leadership is particularly crucial for nurses, who often work long hours, face continuous pressure, cope with limited resources, adhere to service protocols and manage irregular family interactions (Catton, 2020). Nurses frequently prioritize their professional responsibilities over family matters, often sacrificing family well-being (Helou *et al.*, 2022), leading to work-to-family

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Authentic leadership, work–family enrichment and family role performance of the nurses in public hospitals: moderating role of power distance

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Abstract

Purpose – Grounded in the work-home resources model, this study examines the relationship between authentic leadership and family role performance through work–family enrichment (WFE). Additionally, it explores the moderating role of power distance in influencing the relationship between authentic leadership and WFE, thereby affecting family role performance.

Design/methodology/approach – In this two-wave survey research design, the sample comprised 224 nurses in various roles at public hospitals in Bangladesh. Hierarchical regression analysis was conducted using the PROCESS macro and AMOS 23.

Findings – Nurses' authentic leadership is positively associated with family role performance. Additionally, WFE mediates the relationship between authentic leadership and family role performance. Moreover, power distance moderates the association between authentic leadership and WFE. The results also highlight the conditional boundary effect of power distance on the relationship between authentic leadership and family role performance through WFE.

Practical implications – The results of this study help healthcare managers understand the importance of enhancing family role performance. They also emphasize the need for nursing managers to implement appropriate training, development and mentoring programs that foster authentic leadership among nurses, enabling them to enrich their resources effectively and improve work–family dynamics.

Originality/value – While existing literature has explored the connection between nurses' authentic leadership and work–family outcomes, no study has specifically examined its impact on family role performance. This underscores the importance of understanding when and how authentic leadership influences nurses' work–nonwork outcomes, positioning this study as a significant contribution to the existing research.

Keywords Authentic leadership, Family role performance, Work–family enrichment, Power distance, Nurses

Paper type Research paper

Introduction

Over the past decades, academics and practitioners have rigorously focused on authentic leadership in applied research (Avolio *et al.*, 2004). Authentic leadership is defined as "a pattern of transparent and ethical leader behavior that encourages openness in sharing information needed to make decisions while accepting input from those who follow" (Avolio *et al.*, 2009, p. 424). Prior studies have revealed that nurses' authentic leadership positively influences various aspects of work performance, such as contextual performance (Malik, 2018) and job performance (Kyambade *et al.*, 2024; Abbas *et al.*, 2023; Zeb *et al.*, 2020). Recent leadership research has also demonstrated a link between authentic leadership and followers' work-family outcomes, including work-family balance (Lyu *et al.*, 2019) and work-family enrichment (WFE) (Braun and Nieberle, 2017). However, only Chevalier *et al.* (2021) have examined the effect of authentic leadership on nurses' work-family balance, finding a correlation between authentic leadership and nurses' flourishing and satisfaction with work-

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RESEARCH ARTICLE

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Nurturing Bonds: The Essence of Moral Reasoning in Linking Relationship Marketing Orientation to Customer Value Co-Creation Behavior Through Customer Engagement

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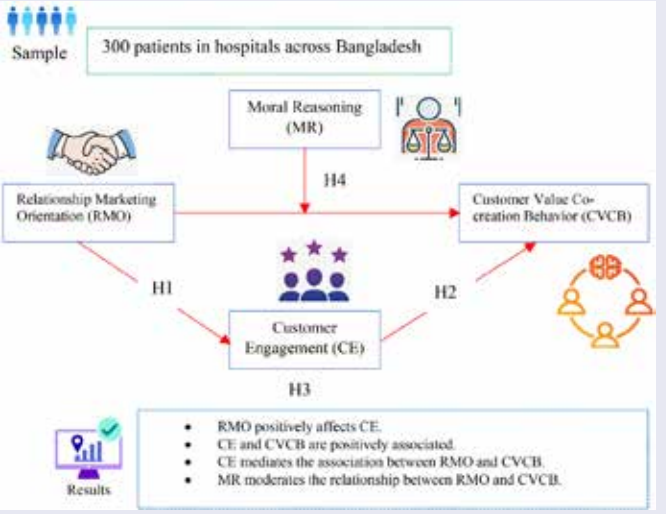
ABSTRACT

Based on the social exchange theory and moral foundation theory, this study explores the relationship between relationship marketing orientation (RMO) and customer value co-creation behavior (CVCB), with a focus on the mediating role of customer engagement (CE) and the moderating role of customers' moral reasoning in the hospital context. Data were collected through a survey of 300 patients in Bangladesh's healthcare sector and analyzed using SmartPLS 4. The study's findings indicate direct relationships between RMO and CE, and CE and CVCB. This study found that CE mediates the relationship between RMO and CVCB. Moreover, the study also confirms that customers' moral reasoning moderates the effect of RMO on CVCB, strengthening the relationship when moral reasoning is high. These findings offer practical insights for hospital administrators and healthcare marketers, suggesting that aligning relationship marketing efforts with patients' values and moral reasoning can enhance engagement and foster value co-creation in healthcare services.

GRAPHICAL ABSTRACT



KEYWORDS

Relationship marketing orientation; Customer engagement; Customer value co-creation behavior; Healthcare industry; Moral Reasoning

Introduction

With the rise of digital transformation and disruptive technologies, the global business landscape is evolving faster than ever, shifting from a product-centric to a customer-centric paradigm (Ladeiras & Machado, 2024; Marjanovic & Murthy, 2016). Co-creation empowers organizations to better understand customer needs and deliver tailored solutions, making it a strategic

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RESEARCH ARTICLE

The role of emotional intelligence on social entrepreneurial intention of university students: evidence from a lower-middle income country

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ABSTRACT

Objective: The application of the Theory of Planned Behavior (TPB) is employed to scrutinize how emotional intelligence relates to the intention for social entrepreneurship within the context of Bangladesh. Specifically, this study investigates whether relationship management, social awareness, self-awareness, and self-management components constituting emotional intelligence- affect the decision-making process towards embracing social entrepreneurship.

Research Design & Methods: In accordance with a quantitative methodology, a cohort of 400 freshmen from Bangladeshi universities, aged between 21 and 26, participated in responding to a structured questionnaire comprising 46 items. Data collection employed a systematic random sampling technique. Subsequently, for hypothesis assessment, the SmartPLS version 4 software facilitated consistent PLS-SEM algorithm and bootstrapping analyses.

Findings: According to survey findings, there is a strong positive association between the relevant variables. The results demonstrate that intentions of students to become social entrepreneurs were highly influenced by their levels of relationship management, social awareness, and self-management. However, it is observed that self-awareness did not significantly contribute to the inclination towards social entrepreneurship.

Implications & Recommendations: The findings of this study hold potential utility for academia and policymakers aiming to foster social entrepreneurship among university students. Succeeding research endeavors could enhance the understanding of social entrepreneurial intention by integrating contextual variables, thus providing a comprehensive perspective on the phenomenon.

Contribution & Value Added: This study examines entrepreneurial intention within a distinct entrepreneurial context, integrating the four dimensions of emotional intelligence into the realm of social entrepreneurship research.

Keywords: Relationship management; social awareness; self-awareness; self-management; social entrepreneurial intention; sustainable growth

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Updates in the evolution of AI-driven digital marketing practices: a literature review with bibliometric analysis

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Abstract: This study aims to present an update on the evolution of AI-driven digital marketing practices by determining the thematic development and identifying research clusters that have been developed over time. Adopting an objectivist research philosophy, this study employs the bibliometric analysis method on 206 identified research papers from the Scopus database based on the PRISMA framework from 2000 to 2024. The findings identify that the most contributing author is Dwivedi, while the *Journal of Business Research* is the most contributing journal and the USA is the most contributing country in the research related to AI-driven digital marketing practices. Furthermore, the findings reveal that the research in AI-driven digital marketing practices is grouped into four clusters. In addition, the evolutionary trends are moving

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The Effect of E-Service Quality and Perceived Risk on Customer Loyalty among Bangladeshi Online Banking Consumers

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Abstract

Purpose: This quantitative study aims to determine the impact of two variables-online banking service and its perceived threat—on consumer pleasure and purchaser loyalty in Bangladesh.

Methodology: Of late, a survey was conducted to gather primary data, and a total of 329 respondents were selected using a convenient specimen approach from a specific group of public and authority-owned banks. Although the right devices have been chosen for each construct by experimental review, the relationship between some of the constructs has been carefully assessed through the use of structural modeling. Factor analysis systems have been employed to perceive the underlying structures and a few of the explored online banking service attributes.

Findings: The results of an exploratory issue evaluation revealed twelve composite dimensions of first-class electronic service and perceived threat, which included the availability of convenient electronic banking operations. The structural modeling method was used to assess the relationships between some of the constructs, and exploratory analysis was carefully employed to determine the right items for each construct. It appears from their examination that there are clear connections between buyer satisfaction, client loyalty, and perceived hazards.

Research Limitations: Generally, relating to only employer awareness, exploratory thing analysis is employed, and an alternative generalized view of digital banking is adopted. Future research needs the intention to improve on these by replicating the examination in multi-industry settings, assessing the stability of the revealed issue shape, and examining whether specific e-providers great and perceived threat factors range in significance across one of the generations or not.

Originality/Value: This study used a sample of 329 online banking customers in Bangladesh to investigate the key elements of the relatively new electronic service satisfaction assembly and assess the survey participants' perceptions of the risk associated with online banks'

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Driving Social Entrepreneurship Among Students: Investigating Through PLS-SEM and fsQCA Approaches in Emerging Economies

Rubaiyat Sabbir [1], Bashir Uddin [1], Subrata Kumar [2*], Md. Rashed [3], Yeanur Rahman [4], Sourav Paul Chowdhury [5], Munmun Rahaman [2], Mohammad Fakhrul Islam [6*]

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Abstract

This study aims to identify the relationship between social self-efficacy, social innovation, resilience, and proactive personality concerning university students' behavioral intention to engage in social entrepreneurship, particularly in emerging economies, like Bangladesh. A structured questionnaire was utilized to collect quantitative data from 540 students in various disciplines of study as part of the study's quantitative research methodology using partial least squares-Structural Equation Modelling (PLS-SEM) and fuzzy-set Qualitative Comparative Analysis (fsQCA). The analysis reveals that proactive personality traits are associated with the social entrepreneurship intention (SEI) and that leadership orientation is also significant to SEI. The study also demonstrates that social entrepreneurial activities tend toward higher social self-efficacy and resilience, making it crucial to focus on such characteristics while facing social risk and bearing innovations. This study's novelty lies in its focus on the unique combination of psychological traits—social self-efficacy, social innovation, resilience, and proactive personality—and their impact on university students' intention to engage in social entrepreneurship in emerging economies. Additionally, the research emphasizes the importance of integrating leadership skills and social innovation into academic curricula and policy development to foster social entrepreneurship. Practical implications indicate that leadership skills and social innovation should be included in the curricula of educational institutions, and supportive policies should be developed to create available resources for prospective social entrepreneurs.

Keywords:

Social Entrepreneurship Intention;
Self-efficacy;
Social Innovation;
Resilience;
Proactive Personality;
PLS-SEM;
fsQCA.

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1- Introduction

Social entrepreneurship is now considered a powerful tool for systematic social change as well as sustainable social innovation as a response to the multifaceted world's problems [1]. This promising sector of study needs people to have social responsiveness, vision, and spirit of entrepreneurship to come up with unique ideas that address vociferous social problems [2]. However, as social entrepreneurship gains attention more often, its driving force, combining the social

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International Journal of Organizational Analysis

Authentic leadership, work-family enrichment and nurses' life satisfaction

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Abstract

Purpose – This study aims to test the relationship between authentic leadership and the life satisfaction of nurses and shows the mediating effect of work–family enrichment (WFE) on this relationship.

Design/methodology/approach – Data were collected by simple random sampling from the different health care in Bangladesh. The sample contained 563 nurses in various positions. Hierarchical Linear Regression, PROCESS Macro and Sobel test were used together to test the direct and indirect impact of authentic leadership on nurses' life satisfaction.

Findings – Findings disclosed that authentic leadership was positively related to the nurses' life satisfaction and WFE. Moreover, WFE was identified as a partial mediator that mediated the connection between authentic leadership and life satisfaction.

Research limitations/implications – Despite of having various contributions to this study, it possesses limitations that provide areas for future research. This study only considered WFE as a primary mediator. Other alternative mechanisms, for instance, job resources and psychological capital were avoided which could also explain the authentic leadership–life satisfaction relationship.

Practical implications – Results of this study would assist health-care managers in recognizing the requirements of developing the life satisfaction of the nurses. Furthermore, this paper emphasizes the significance of authentic leadership as a proper and powerful leadership style, in affecting life satisfaction in health-care organizations.

Social implications – This study indicates that WFE mediates the positive correlation between authentic leadership and nurses' life satisfaction via the Work-Home Resources (W-HR). Therefore, this study reinforces and substantiates the significant impact of the W-HR model on the entire life domain.

Originality/value – Although plenty of literature offers on authentic leadership and its influence on the followers' work-related outcomes, studies connecting authentic leadership with their life domain are rare. No prior research explored the relationship between authentic leadership and nurses' life satisfaction. So, the research is treated as unique and original and of extensive value emphasizing the association among the work and nonwork propositions.

Keywords Authentic leadership, Life satisfaction, WFE, Nurse, Life domain

Paper type Research paper

1. Introduction

Authentic leadership, as a positive leadership style, has garnered more attention among academic scholars and practitioners in recent decades (Gardner *et al.*, 2021). Authentic leadership is characterized as:

> A pattern of leader behaviours that utilizes and encourages both positive psychological attributes and a constructive ethical environment, to enhance self-awareness, an internalized moral viewpoint, balanced information processing, and relational transparency among leaders collaborating with followers, thereby promoting positive self-development (Walumbwa *et al.*, 2008, p. 94).

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RESEARCH

Impact of university education support on green entrepreneurship intentions among university students in Bangladesh: a mediating and moderating analysis

Fatima Khuku Mony[1] · Tuhin Ahmed[1] · Md. Nazmus Sakib[1] · Muhammad Torequl Islam[1,2]

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Abstract

The environmental and social benefits of green practices have attracted a lot of attention from organizations and educational institutions, but researchers have rarely examined the moderating effect of perceived happiness on green entrepreneurial intention (GEI). Based on the combination of social cognitive theory and theory of planned behavior, we hypothesized that university education support (UES) has a significant impact on GEI among some Bangladeshi university students. Additionally, the relationship between UES and GEI mediated and moderated by perceived behavioral control (PBC) and perceived happiness (PH) was also determined. We collected data from 350 students from a variety of public and private universities in Bangladesh, including the fields of business, arts and humanities, and science backgrounds using adopted questionnaires. The analysis was made by applying structural equation modeling using a bootstrapping sample of 5000 with the help of SMART PLS 4.1. The study results revealed that UES have a significant impact on GEI. Moreover, the mediating effect of PBC is significant between UES and GEI. PH also successfully moderated between UES and GEI. Taken together, UES significantly impacted GEI among the participants. PBC was between UES and GEI, and PH also significantly moderated between UES and GEI. Further studies are highly appreciated to check these factors among the university students in large diversity groups.

Keywords Green entrepreneurship intention · Education support · Behavioral control · Happiness

Extended author information available on the last page of the article

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The impact of ESG performance on investment efficiency in Chinese and US banks: the moderating role of environmental uncertainty

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ABSTRACT

This study investigates the relationship between environmental, social and governance performance (ESGP) and investment efficiency (INVE) in the banking sectors of China and the United States (US), with emphasis on the moderating effects of environmental uncertainty. The research uses panel data from 315 banks in China and the US from 2011 to 2022 and employs the two-stage generalized method of moments (2sGMM) approach to examine the hypotheses empirically. A two-stage least squares (2SLS) model is also used as a robustness check. It was found that environmental, social, and governance (ESG) performance positively affects investment efficiency, with a more potent effect observed in US banks. The results also indicate a 'non-linear' and 'inverted U-shaped' impact of ESG performance on investment efficiency, highlighting that while ESG practices initially enhance efficiency, excessive emphasis on them leads to diminishing returns. The study further highlights that environmental uncertainty significantly moderates the relationship, reducing investment efficiency, especially in the Chinese banking segment. The COVID-19 pandemic also moderated the ESG performance-investment efficiency nexus. The study contributes to the growing body of literature by providing valuable policy insights into the strategic importance of ESGP in enhancing investment efficiency while navigating uncertainties.

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ESG performance; investment efficiency; environmental uncertainty; banking sector; China; US

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1. Introduction

Environmental, social, and governance performance (ESGP) has recently become a recognized initiative for sustainable performance in the financial sector (Brinette, Sonmez, and Tournus 2023), with stakeholders, including investors, regulators, practitioners and academics, prioritizing environmentally (Isaksson and Kiessling 2021) and socially responsible investment for sustainable organizational growth, integrating ESG[1] considerations into decision-making to address societal challenges and mitigate risk (Abdelkader, Gao, and Elamer 2024; Shakil 2021). As financial intermediaries, banks are increasingly expected to integrate ESG factors, stressing social and environmental responsibility in their strategic decision-making for long-term corporate sustainability and wealth maximization. There is a growing focus on sustainable practices in investment decision-making; those companies with lower ESG performance or more competition will incur penalties because of their stakeholders (Abdul Razak, Ibrahim, and Ng 2023; Chen et al. 2024; Shakil et al. 2019). Therefore, governments and regulatory authorities encourage companies to apply initiatives linked to environmental, social and governance performance (ESGP) that relate to social and environmental policies, and to pursue organizational transparency

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ESG Performance and Financial Stability: A Bibliometric and Meta-Analysis

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Abstract

The rising popularity of environmental, social, and governance (ESG) investing is prompting private and public sectors to enhance their ESG performance and achieve financial stability. Urging the importance, past research has revealed how stake-holders gradually rely on firms' ESG disclosures to assess performance and make well-informed financial decisions, yet under-standing the nexus between ESG performance and financial stability remains scattered. Unlike previous reviews, this paper thoroughly investigates the relationship by synthesizing 140 articles published between 2011 and 2023. In doing so, this review maps out the scholarly contributions of almost 200 researchers across 40 countries, with about 40% of the studies featuring cross-country analyses. The review identifies that no past studies rely on a single theory to outline ESG disclosure; instead, they mostly underpin multiple theoretical bases, including agency theory, legitimacy theory, stakeholder theory, sig-naling theory, resource-based view, risk management theory, institutional theory, etc. Also, it points out diverse critical fac-tors influencing ESG performance, such as environmental uncertainty, political and legal environments, ownership structures, board characteristics, and investment efficiency. Contributing to the growing body of ESG literature, this review offers valu-able insights into deepening our understanding of ESG performance and financial stability, facilitating future improvements in ESG reporting frameworks. Moreover, it outlines notable future research directions to enrich this evolving research field.

Keywords

ESG performance, financial stability, bibliometric analysis, systematic literature review, meta-analysis

Introduction

Over the past decade, many financial organizations have consistently emphasized reducing the risk associated with Environmental, Social, and Governance (ESG) practices, prioritizing these practices while making critical business decisions. ESG principles help organizations mitigate potential risks and positively impact their long-term environmental and social well-being (L. Wang & Yang, 2023). Given that, globally, scholars have urged taking rapid action and prioritizing ESG-related considerations in line with ESG principles (Abdul Razak et al., 2023). Businesses can enhance long-term financial stability toward more sustainable practices, prioritizing ESG performance by considering their value-creation activities with the Sustainable Development Goals, and integrating ESG issues under consideration (Alfalih, 2023; Danisman & Tarazi, 2024). Highlighting this importance, firms' higher management is recommended to provide sufficient information about ESG opportunities and risks so that stakeholders can make well-informed investment choices (Landi & Sciarelli, 2019).

In recent times, the world has seen a surge of awareness regarding sustainability and ethical business practices, with substantial attention to ESG performance (Barros et al., 2024). Evidence proves that integrating ESG principles into corporate strategies significantly improves organizational reputation and financial performance (Pérez-Cornejo & de Quevedo-Puente, 2023). For

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Exploring the relationship between ESG performance and firm value in Chinese and US banks: The moderating impact of environmental uncertainty and competitive advantage

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ABSTRACT

This paper explores the relationship between environmental, social, and governance performance (ESGP) and firm value in both emerging and developed economies, with the moderating impact of environmental uncertainty and competitive advantage. Using secondary unbalanced data spanning from 2011 to 2022, we examine both the direct and non-linear effects of ESG performance on firm value, employing advanced econometric estimation techniques such as two-step system GMM (2sGMM) and two-stage least square (2SLS). The analysis finds that: (1) ESG performance positively influences firm value in both Chinese and US banks, and the results remain valid after robustness test; (2) The results also confirm that ESG performance non-linearly influence firm value across the samples, with an inverted U-shape relationship; (3) Additionally, we further investigate the moderating effects of environmental uncertainty and competitive advantage, uncovering that environmental uncertainty dampens the ESGP-firm value relationship, while competitive advantage further amplifies it. This study contributes to the understanding of how ESG performance can act as strategic assets that align managerial and stakeholder interests, and improve firm performance, by underpinning agency, stakeholder, and the resource-based view theory. Practical insights are also provided for policymakers, regulators, and financial institutions regarding the use of ESGP as a competitive tool in uncertain and dynamic market environments.

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Introduction

In recent years, environmental, social, and governance performance (ESGP) has become a major global business issue, as there is growing evidence that strong ESGP can mitigate risk, improving firm performance, especially for banks in their strategic decision-making (Wang et al., 2025). Given the rising expectations from ESG stakeholders including regulators, investors, and consumers, ESG principles are assuming a critical business imperative for developing sustainable strategies to manage growth and stability in the face of mounting environmental issues and heightened corporate governance demands (Naeem et al., 2022; Uz-Zaman & Khan, 2021; Yu & Xiao, 2022). Another evidence that has been established is that firms that report better ESG scores are likely to deliver better economic performance including higher market capitalization and lower risk exposure. However, the impact of ESG practices on firm value could vary across countries because of the institutional setting, diversified cultures, and regulatory environment (Bagh, Fuwei, et al., 2024). Furthermore, there might be a significant interaction between environmental uncertainty, such as economic conditions and regulations, and ESGP on the firm's value, and competitive advantage, which might either amplify or mitigate the impact of ESGP on financial performance. As the pressure on banks in the USA and China to integrate sustainability practices into

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Regular Article

Navigating the training satisfaction effects on organizational performance: examining multiple mediating paths with PLS-SEM and IPMA

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ABSTRACT

Drawing on Victor Vroom's expectancy theory, this study falls under the purview of research that examines the impact of training satisfaction on organizational performance. In contrast, employee work engagement and employee job satisfaction were employed as mediating roles between training satisfaction and organizational performance in the context of the textile and apparel industry. The research design included a quantitative method to evaluate the conceptual framework. Data were collected using random sampling and a structured survey questionnaire from important stakeholders of the textile and apparel industry, yielding 282 answers from industry leaders and followers. We utilized PLS-SEM to analyze the data and assessed the measurement model and structural model for hypothesis testing. Empirical results revealed that training satisfaction is positively related to organizational performance. Furthermore, findings also demonstrated that employee work engagement and job satisfaction are positively related to organizational performance. In addition to that, employee work engagement and job satisfaction positively mediate the relationship between training satisfaction and organizational performance. Training has long been regarded as a significant factor in establishing favorable employee attitudes and behaviors. This research reaffirms these ideas and emphasizes the significance of TS as a crucial factor in enhancing employee work engagement, job satisfaction, and organizational performance. Therefore, the findings of this investigation have many implications for researchers and professionals in human resource development in the textile organization. This research provides a noteworthy theoretical contribution to the existing literature by bridging the knowledge gaps and being the first to establish the importance of training satisfaction and the mediation impacts of employee work engagement and job satisfaction in enhancing organizational performance. Moreover, research offers practical implications as an empirical foundation for human resource executives and practitioners, particularly textile organizations.

1. Introduction

Human resource management (HRM) has evolved tremendously in recent decades. For a sustained competitive advantage and organizational success, employees are no longer costs but strategic assets (Gazi et al., 2025). So, it's crucial to encourage employment engagement, contentment, loyalty, and retention (Tien Thanh and Thu Ha, 2024). In the current dynamic and competitive business landscape, there is a growing recognition of training satisfaction (TS) as a critical effort in propelling organizational performance (OP) (Ahmed et al., 2024). Training satisfaction strategies are essential for providing employees with the skills and knowledge needed to adjust to changing market requirements (McGee & Freds, 2025). This also leads to higher employee productivity, efficiency, and effectiveness, thereby improving organizational performance (Ibrahim & Hussein, 2024; Nabhan & Munajat, 2023). Companies must equip their employees with the skills and knowledge necessary to adapt and thrive as industries evolve and technology advances (Al Zeer et al., 2023). In order to stay competitive,

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Unlocking Customer Delight: Exploring the Dynamics of Fin-Tech Satisfaction in Bangladesh

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Abstract

In today's ever-evolving Fin-Tech landscape, understanding what influences customer satisfaction is essential for growth and success. Bangladesh's diverse socio-economic and technological landscape makes it a great place to explore how Fin-Tech products and services impact customer satisfaction. In light of this, this study attempted to find out what factors are influencing customer satisfaction in the Bangladesh Fintech industry. For conducting this study, data of 200 respondents have been collected from Fin-Tech users through online. The partial least square (SEM) approach was adopted for verifying the relationship and SmartPLS 4" tool as well as Python was used to analyze the data. This study shows a notable impact of assurance and security, convenience, and perceived usefulness on customer satisfaction, both in SmartPLS and Python-based analysis. By figuring out the main drivers of Fin-Tech satisfaction, Fintech service providers can adjust their strategies to meet customer needs and expectations, resulting in sustainable growth and better user experiences.

Keywords: Customer Satisfaction, Digital Payment, Fin-Tech, User Preferences.

Introduction

Fintech, which stands for "financial technology", has enabled customers to gain access to financial services from anywhere. Fin-Tech in Bangladesh officially began with the emergence of Mobile Financial Services (MFS) in 2011. Fintech has had a significant impact on the financial sector in Bangladesh, with the country's Fin-Tech sector having seen a surge in growth in recent years. This is largely due to the widespread use of smartphones and the emergence of the internet, which has enabled individuals to access digital services more easily. Additionally, MFS Providers and Mobile Operators offer a limited number of services through their wallet, although due to regulatory restrictions, these services are only available for airtime top-ups, train tickets, and utility bill payments. The degree of appreciation of customers in the banking sector is increased with the implementation of Fin-Tech solutions, which are electronic banking services (1). In Bangladesh, digital payment solutions have become an integral part of Fin-Tech. Platforms such as bKash, Rocket, and others enable users to carry out transactions, pay invoices, and even complete online purchases with ease. By streamlining traditionally laborious procedures of fund transfer and bill payment, these services enhance customer satisfaction through reduced time and effort. Mobile banking apps make it super easy to keep track of money, balance of accounts, and access all kinds of banking services from the phone. This anytime, anywhere strategy improves client experience and happiness because it allows them to monitor and control their financial transactions without having to go to actual bank branches, as shown by the *Rocket* application from *Nagad* and *Dutch-Bangla Bank*. In Bangladesh, P2P lending is becoming more and more popular. Instead of going through intermediaries, people can use P2P platforms. This means that the person borrowing money can get it at a more favorable interest rate, and the person lending the money can earn a better return on their investment. Furthermore, it contributes to financial inclusion and accelerates people's progress towards their goals.

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Social and environmental accounting disclosure and financial performance: Evidence from a developing country Bangladesh

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Abstract

This study aims to explore how social and environmental accounting (SEA) disclosures affect the financial performance of 30 publicly listed companies in Bangladesh from 2020 to 2024. A composite SEA disclosure index was developed using five disclosure categories: environmental management, energy efficiency, employee welfare, community involvement, and customer responsibility. These were scored based on information from annual and sustainability reports. The study applied pooled ordinary least squares (OLS) regression on 150 firm-year observations, while controlling for firm size, leverage, operational efficiency, capital intensity, and industry-specific factors. The analysis indicates a positive but statistically insignificant relationship between SEA disclosure scores and return on assets (ROA). During the course of the study, SEA reporting significantly increased, particularly in terms of community involvement and employee welfare, whereas disclosures related to energy efficiency remained limited. Companies appear to be engaging in SEA reporting primarily for legitimacy rather than for quick financial gains. This analysis confirms that SEA practices in the Bangladeshi context have yet to make significant progress in terms of short-term profitability. This research recommends that the strategic benefits of SEA disclosure can be increased through regulatory standardization, capacity-building programs, and the development of integrated reporting. Future research should focus on the long-term impact and quality of disclosure. Additionally, cross-country comparative studies are recommended.

Keywords: Bangladesh, Financial performance, Return on assets, Social and environmental accounting disclosure, Sustainability reporting.

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Transparency: The author confirms that the manuscript is an honest, accurate, and transparent account of the study; that no vital features of the study have been omitted; and that any discrepancies from the study as planned have been explained. This study followed all ethical practices during writing.
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ORIGINAL ARTICLE

Does artificial intelligence increase learners' sustainability in higher education: insights from Bangladesh

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Abstract
This study investigates the impact of artificial intelligence (AI) on learners' sustainability in higher education, focusing on the context of Bangladesh. The article aims to provide insights into the specific ways in which AI technologies and approaches can be applied within the Bangladeshi higher education context to promote sustainability. Through a mixed-methods approach, combining quantitative surveys and qualitative interviews, data were collected from a diverse sample of students enrolled in both private and public universities in Bangladesh. This study used a quantitative approach via a survey that consisted of 25 items to collect relevant data. Structured questionnaires are used to obtain data from 350 respondents selected with convenience sampling. The questionnaire used a 5-point Likert scale to measure a degree of agreement or disagreement with each of a series of statements related to learner's sustainability. A pilot study with 40 participants was also undertaken to ensure the validity of the questionnaire. Factor analysis is employed to assess the hypotheses in the study. Additionally, reliability test, correlation and multiple regression method was used to examine the associations between the dependent variable and independent variables. According to the study's findings, quantitative analysis indicates that AI-driven concepts such as adaptive learning, personalized learning, teaching evaluation, and educational equity significantly contribute to enhancing educational sustainability. Moreover, virtual classrooms and administrative tasks have been traced as the main barrier to enhancing educational sustainability. Additionally, qualitative findings shed light on the perceived benefits and challenges associated with integrating AI into higher education for sustainability purposes. This study specifically contributes to the fill the research gap of unravelling the uses of AI technologies in Bangladeshi higher education context. The policy makers should take these findings into consideration while planning the higher education policy; for instance, not focusing on virtual classrooms since it is found as a barrier to higher education sustainability.

Keywords Artificial Intelligence · Sustainability · Higher education · Digital education · Application of AI

1 Introduction

Information and communication technologies (ICT) have considerably aided the development of learning pedagogy over the past few years (Jaiswal and Arun 2021; Iftikhar et al. 2020). Technology significantly impacts people's learning by creating enhanced environments (Chen et al. 2008; Roll and Wylie 2016). The significance of this technology in the field of education is becoming more and more well-known as it develops. Artificial intelligence (AI) is commonly used in education and has proven to have important practical benefits that significantly affect the educational process (Chassignol et al. 2018). AI can continuously enhance the learning environment and encourage students' enthusiasm, initiative, and originality (Colchester et al. 2017; Pillai et al. 2021). It is also critical for students to adapt to a changing professional and personal environment to encourage lifelong learning (Azoulay 2019). AI technology is advancing along with the modern sciences and technologies (Tuomi et al. 2021; Wang et al. 2022). The results of related research have enabled the use of AI in education to be expanded, producing successful application effects that have transformed

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RESEARCH ARTICLE OPEN ACCESS

Global Financial Market Spillovers to the Dhaka Stock Exchange: Strategic Insights From Trade-Friendly Nations

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ABSTRACT

This study explores the strategic implications of global financial market spillovers on the Dhaka Stock Exchange (DSE), with a particular emphasis on the financial markets of Bangladesh's key trade partners. Leveraging daily price data, the analysis focuses on major equity indices from Bangladesh, the USA, China, Japan, Russia, and India, in addition to global green and commodity indices. The study employs advanced methodologies, including value at risk (VaR), conditional value at risk (CVaR), continuous wavelet transforms (CWT), wavelet coherence (WC), and time-varying parameter vector autoregression (TVP-VAR). The findings reveal that while the DSE demonstrates lower downside risk relative to global indices, certain global assets, such as WTICO, exhibit heightened tail risk. The wavelet analyses underscore significant volatility and co-movements among key assets, particularly during periods of global crises, such as the COVID-19 pandemic and the Russia–Ukraine conflict, highlighting the profound interconnectedness between global and regional markets and the DSE. Notably, global green and commodity assets provide potential safe haven benefits for Bangladeshi investors during times of crisis. The TVP-VAR model further highlights the dynamic nature of volatility spillovers, identifying global green indices as key volatility transmitters, while the DSE retains robust internal market dynamics with reciprocal spillovers between DSE30 and DSEB. These insights suggest that Bangladesh should strategically integrate green and commodity assets into its financial markets to bolster market stability and protect investors amidst global uncertainties.

1 | Introduction

The integration of global financial markets has significantly increased the interdependence among stock exchanges worldwide (Bessler and Yang 2003; Siddiqui 2009; Forbes and Warnock 2021; Yang et al. 2022). This phenomenon, known as financial market spillover, has profound implications for emerging economies like Bangladesh. Understanding how external financial shocks impact the Dhaka Stock Exchange (DSE) is essential for policymakers, investors, and market participants. The DSE's inefficiency in weak-form efficiency, as evidenced by its failure to adhere to the random walk model (Islam and Khaled 2005), coupled with challenges such as a small market size, low liquidity, high concentration, and weak regulatory frameworks, hampers its development and reduces its attractiveness to investors (Rasul 2013). These vulnerabilities make it imperative for investors to adopt systematic strategies to navigate the market and optimize their portfolios for sustainable profits

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Sustainable Development

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Sustainable Development

RESEARCH ARTICLE

Macroeconomic Drivers of Sustainable Tourism Development in Bangladesh: An ARDL Bounds Testing Approach

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Keywords: Bangladesh tourism growth | climate impact on tourism | environmental sustainability | macroeconomic analysis | refugee dynamics in tourism | SDG policy implications | sustainable tourism development | tourism and infrastructure

ABSTRACT

Tourism serves as a critical driver of economic development, yet its relationship with macroeconomic and socio-political factors remains underexplored in emerging economies like Bangladesh. This study examines the long-run and short-run impacts of macroeconomic drivers, including CO_2 emissions, GDP growth, inflation, population growth, road safety, refugee population, and tourism services, on inbound tourism in Bangladesh, employing the Autoregressive Distributed Lag (ARDL) bounds testing approach. The findings reveal that while CO_2 emissions have a short–term positive impact associated with industrial growth, they negatively affect tourism in the long run due to environmental degradation. Road safety challenges and socio-political instability, including terrorism and refugee influx, significantly deter tourism. Conversely, improvements in infrastructure positively influence tourism demand over time. By integrating sustainability into tourism strategies, this research highlights the alignment of tourism development with Sustainable Development Goals (SDGs), such as SDG 8 (Decent Work and Economic Growth), SDG 13 (Climate Action), and SDG 9 (Industry, Innovation, and Infrastructure). Practical implications include adopting cleaner energy initiatives, improving road safety, and fostering inclusivity through gender-focused entrepreneurship and refugee integration. This study contributes to the theoretical understanding of sustainable tourism in developing nations and offers actionable insights for policymakers aiming to balance economic growth with environmental and social considerations.

1 | Introduction

Tourism in Bangladesh has experienced significant fluctuations in inbound tourist arrivals between 1990 and 2022, as highlighted by World Bank data. These fluctuations stem from various external shocks, including climate change, political instability, terrorism, road safety issues, and inadequate marketing strategies. Events such as the sharp decline during the military rule (2006–2008), the 2016 terrorist attack at the Holey Artisan Bakery, and the COVID-19 pandemic's significant disruption to global tourism underscore these vulnerabilities. Despite these challenges, systematic investigations into the macroeconomic factors driving these fluctuations—particularly within a sustainable development framework—remain limited.

This study addresses this gap by employing a time-series analysis, specifically the Autoregressive Distributed Lag (ARDL) model, to examine the long-term and short-term impacts of

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Audit Committee Characteristics and Sustainable Firms' Performance: Evidence From the Financial Sector in Bangladesh

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Keywords: audit committee characteristics | emerging economies | financial institutions | generalized method of moments (GMM) | sustainability practices | sustainable firms' performance

ABSTRACT

This study examines how audit committee characteristics influence sustainable firms' performance within Bangladeshi commercial banks. Using data from 26 publicly traded banks over 13 years (2011–2023), this research investigates the impact of audit committee size, independence, and meeting frequency on both financial and market-based performance metrics. Specifically, the findings reveal that larger audit committees (ACs) are associated with higher market valuation, indicating that committee size contributes to strategic oversight and governance effectiveness. Independent audit committee members also enhance both financial (Return on Assets) and market-based (Tobin's Q) performance, underscoring their role in promoting transparency, accountability, and alignment with sustainable goals. However, frequent audit committee meetings correlate with diminished performance, suggesting that overly frequent sessions may lead to inefficiencies rather than improved oversight. These results indicate that structuring ACs with balanced size and independence and avoiding excessive meetings, is essential to support sustainable growth, particularly in emerging economies such as Bangladesh. The study contributes to corporate governance and sustainability literature by providing empirical insights into audit committee practices that align governance structures with long-term corporate strategy and sustainable growth. Practical implications include the potential for regulatory reforms that enhance corporate governance, focusing on committee composition and meeting practices to foster sustainable firm performance in the financial sector.

1 | Introduction

In the complex realm of corporate governance, audit committees (ACs) serve as vital guardians of financial integrity and accountability. The characteristics of ACs, such as the independence and proficiency of their members, as well as the frequency of their meetings, play a critical role in determining a firm's overall performance. In developing countries such as Bangladesh, where the financial sector plays a key role in economic progress but faces significant governance challenges (Alkebsee et al. 2022), it is essential to understand how the characteristics of ACs impact firm performance (Kalita and Tiwari 2023; Singhania and

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Financial Volatility Spillovers and Risk Dynamics in Global Tourism: Evidence From Equity and Bond Markets

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Keywords: financial volatility | global tourism | green bonds | international portfolio strategy | risk management | spillover analysis

ABSTRACT

This study explores the financial volatility and asset interdependence in the global tourism sector by examining spillover dynamics between tourism equities and both green and non-green financial assets from global stock and bond markets. Utilizing a combination of risk-adjusted return metrics, Value at Risk (VaR), Conditional VaR (CVaR), wavelet coherence, and Quantile Vector Autoregression (QVAR), the analysis reveals that while tourism equities offer the highest risk-adjusted returns, they also carry significant downside risk—particularly during periods of financial distress. Wavelet analysis uncovers pronounced short- and medium-run volatility in tourism stocks, and QVAR results demonstrate high spillover intensity, with connectedness surpassing 83% in both bull and bear markets. Notably, conventional and green equities do not consistently serve as effective hedges for tourism investments, although green bonds may offer some diversification benefits during stable periods. These findings may offer indicative evidence for international investors, financial analysts, and policymakers aiming to improve asset allocation, enhance risk awareness, and inform investment planning in tourism-dependent economies. By highlighting patterns of market interconnectedness, the study may inform portfolio strategies under conditions of rising global uncertainty.

JEL Classification: C32, F21, G12, G15

1 | Introduction

The rising complexity of global markets and increasing uncertainty in the investment landscape compel international investors, including emerging entrepreneurs, to seek portfolio strategies that minimize financial risk while maximizing returns. In this context, strategic asset allocation across diverse segments becomes essential—not only for profit optimization but also for risk mitigation in an increasingly interconnected world. Global investment decisions are now influenced by a multitude of cross-border factors such as GDP growth trends, geopolitical tensions, climate change impacts, and socio-political disruptions, all of which shape stock market performance and capital flow dynamics. The availability of timely and credible financial information further empowers investors to forecast market trajectories, enabling better allocation of resources across industries and regions.

The travel and tourism sector, in particular, plays an indispensable role in global economic development, significantly contributing to foreign exchange reserves, employment generation, and national brand equity (Kuri et al. 2024; Kumail et al. 2023; Anwar and Valadkhani 2013; Nunkoo et al. 2020). According to the World Travel and Tourism Council (2024), the sector contributed a record $11.1 trillion to the global economy.[1] However, its vulnerability to external shocks became glaring during the COVID-19 pandemic, when tourism-related exports declined by over $900 billion, leading to a significant contraction in global

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PURCHASING TOURISM SERVICES THROUGH ONLINE TRAVEL AGENCY: DOES ELECTRONIC WORD-OF-MOUTH HAVE INFLUENCE? AN EMPIRICAL STUDY ON BANGLADESHI TOURISTS

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Abstract: Tourists nowadays are more dependent on online reviews to make different travel decisions. Electronic word of mouth has been playing a key role in influencing the purchase intention of tourists who travel through an online travel agency. In this context, the study aims to explore how electronic word-of-mouth determinants influence travellers' intention to purchase tourism services from online travel agencies in Bangladesh. Based on Social Exchange Theory information quantity, information quality, information credibility, and information usefulness of electronic word of mouth are identified as the four factors determining the purchase intentions toward buying services through an online travel agency. A total of 302 people participated and replied to the questionnaire, making up the sample. For the analysis, SPSS version 25 integrated with AMOS version 26 was employed. Structural equation modeling was used to test the hypothesis. The analysis revealed that, except for information quantity, the three other independent variables that determine e-WOM - information quality, information credibility, and information usefulness significantly affect tourists' service purchasing intentions from OTAs. The current research findings provide meaningful, practical implications for online travel service providers, online service agents, and managers of different tourism platforms to develop and implement strategies to manage online reviews across different online platforms to generate better responses from travelers.

Keywords: Online Travel Agency, Social Exchange Theory, Purchase Intention, Electronic Word of Mouth, Online Tourism, Information Quantity, Information Quality, Information Usefulness

* * * * * *

INTRODUCTION

Nowadays, to ensure a smooth transaction online, customers depend more on online reviews (Fachrurazi et al., 2022). Consequently, customers' buying habits are influenced by the reviews of other customers (Kuppelwieser et al., 2021). Users of electronic platforms have grown significantly, and this has given them more freedom to engage with one another, express themselves honestly, and spread the word about their experiences online (Khasawneh et al., 2021). Buyers' inclinations to purchase are strongly affected by electronic word of mouth (e-WOM) in virtual communities (Akbari et al., 2022). Thus, to create better relationships with existing and prospective customers, tourism-related service companies have started interacting on social media platforms (Thaothampitak and Wongsuwatt, 2022). Some contemporary research was conducted on the effect of e-WOM determinants on different behavioral aspects. Moreover, the findings of most of the studies are not consistent. Therefore, this research will add a substantial knowledge resource to the current literature in the fields of e-WOM and OTA. OTA is an intermediary organization that arranges attractive travel packages for tourists through its website or applications (Talwar et al., 2020). There has been a sharp increase in online customer reviews of travel-related services on social sites (Salminen et al., 2020; Hossain et al., 2023). Past studies regarding OTA were concentrated on different issues other than e-WOM. However, there is a lack of studies on the impact of online reviews on OTA. Therefore, this research will add fresh knowledge to the literature from the perspective of OTA. Bangladeshi people are looking to adopt different services online. According to The Business Standard (2021), Bangladesh, with a population

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Security concerns, public perceptions and safety initiatives at tourist destinations in Bangladesh: Effective tourist police interventions for sustainable tourism

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ABSTRACT

Tourism drives global economic growth, cultural exchange and regional development. This study examines the effectiveness of tourism police in enhancing sustainable tourism, focusing on security concerns, public perceptions and security initiatives. It explores how tourism police reduce risks such as crime and terrorism, foster a safe environment and assesses whether their presence instills confidence or anxiety among tourists. Using a mixed-method approach including case studies, surveys and interviews, the research found that 78.6 % of respondents were aware of tourism police, but only 29.7 % reported frequent encounters. Increased patrols, technological advances (CCTV, emergency apps) and partner collaboration significantly increase tourist satisfaction and safety. Effective law enforcement reinforces perceptions of safety, encourages repeat visits and the sustainability of destinations. The study highlights the need for improved training, infrastructure and multi-stakeholder partnerships to ensure a safe, welcoming and sustainable tourism environment, particularly in Bangladesh.

1. Introduction

Tourism is increasingly becoming an important part of the global economy, making important contributions to increasing income, creating jobs, and developing cultural exchanges and international cooperation. It promotes cross-cultural understanding and boosts economic development in countries rich in heritage and natural resources [1]. Bangladesh has a rich natural and cultural heritage with huge tourism potential, including world-famous attractions such as Cox's Bazar (the world's longest continuous beach) and Sundarbans (a UNESCO World Heritage Site for its unique mangrove ecosystem) [2]. These tourist destinations, as well as many others in Bangladesh, not only attract domestic and foreign tourists but also serve as catalysts for regional development, job creation, and socio-cultural revitalization [3,4]. However, tourism development in Bangladesh is hampered by a number of interrelated challenges, of which security is the most important. Despite its growth potential, the country continues to grapple with various threats that directly or indirectly affect the tourism experience. These factors include theft, harassment, extortion, inadequate security infrastructure, and political instability, increasing the sense of insecurity among local and international travelers [5]. This fear is further exacerbated by occasional incidents of violence, political instability, and crime in specific tourist areas, which are often reported by domestic and foreign media, creating negative perceptions and deterring potential tourists from traveling [6].

Research shows that safety is a major determinant of travel decisions. Tourists tend to choose destinations where they perceive a lower risk of harm and trust emergency assistance systems and law enforcement agencies [7,8]. Importantly, the perception of safety is influenced not only by actual crime rates, but also by the visibility, responsiveness, and professionalism of law enforcement agencies, including their interactions with tourists, their level of training, and technical preparedness [9]. Media portrayals of safety issues, local rumors, and personal experiences of previous travelers also have a significant impact on the

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Assessment of farmers' knowledge, attitude, and challenges towards biofertilizer application in the Northern Region of Bangladesh

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ABSTRACT

Biofertilizer, considered sustainable agricultural input, holds the potential to replace chemical fertilizers and improve soil health. Still, its limited adoption prompts the need to explore farmers' awareness of the challenges in Bangladesh. Our study focuses on the knowledge, attitude, and challenges related to biofertilizer usage among a hundred randomly selected farmers in the Chapainawabganj District. We exerted a cross-sectional descriptive research technique and a pre-structured questionnaire for data collection through face-to-face interviews. According to the findings, about 52% of the respondents had shallow knowledge about biofertilizers, although the majority (about 67%) had a moderately favorable attitude, indicating enthusiasm to adopt this technology. Additionally, the majority of the farmers strongly supported the idea that increasing publicity initiatives to promote biofertilizer usage would be helpful. Moreover, most of the socio-demographic characteristics of farmers had a significant and positive relationship with their knowledge, where only education and training facilities were positively correlated to their attitude, pointing out that improving these aspects may promote biofertilizer adoption. The study also found that the critical challenges of biofertilizer usage were personal interest gaps, inadequate publicity, lack of awareness about benefits, disorganized training, and high prices or lack of availability. These findings suggest that policymakers and extension service providers should prioritize targeted training and demonstrations to enhance awareness as well as ensure that biofertilizer supplies are affordable and easily accessible.

Keywords: biofertilizer, knowledge, attitude, challenges, sustainable agriculture

INTRODUCTION

Agriculture, the backbone of many economies, is pivotal in ensuring food security and sustainable development. Bangladesh predominantly operates as an agrarian nation, where the majority of its population relies on diverse agricultural subsectors for their sustenance, either through direct involvement or indirect dependence. Based on a report of the Bangladesh bureau of statistics (BBS), approximately 11.20% of the gross domestic product (GDP) for the fiscal year 2022-23 was derived from agriculture, while the agricultural sector engages 45.33% of the total workforce (BBS, 2023). In 2016, agricultural production contributed 17% to the country's GDP, and the proportion of the labor force involved in agriculture exceeded 45% (BBS, 2016). Additionally, the global report on food crises by the Food and Agriculture Organization listed Bangladesh among the top-50 nations with the highest rates of severe food insecurity (Siddique, 2022). All information reflects the contribution of agriculture to our national income and health, appears to be declining. Many entities, including the government, researchers, stakeholders, and crop growers, are working desperately to withstand the situation. As a part of these initiatives, synthetic agrochemicals have been actively pursued in our country. Farmers are injudiciously incorporating these chemicals into their fields, disregarding the potential long-term undesirable consequences. According to the Ministry of Agriculture, Bangladesh required approximately 5 million tons of fertilizer annually in 2016 (BBS, 2016). In the fiscal year 2021-22, the demand for chemical fertilizers was 5.75 million tons. (BBS, 2023). The annual escalation in the utilization of chemical-based fertilizers persists unabated, consequently leading to the gradual depletion of soil fertility in Bangladesh.

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Analyzing the rhetoric of contemporary BSMRSTU student movements: manifestations and social implications in Gopalganj, Bangladesh

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Background: The rich tapestry of student politics and movements in Bangladesh is marked by a history of significant contributions to the country's sociopolitical landscape. This study was prompted by a keen interest in exploring the dynamics of contemporary student movements at Bangabandhu Sheikh Mujibur Rahman Science and Technology University (BSMRSTU), Gopalganj, and their interplay with the broader sociopolitical climate of Bangladesh. A critical examination of these movements reveals a complex web of motivations, strategies, and outcomes that both mirror and influence national sociopolitical dialogues.

Methods: Employing qualitative research methods, including in-depth interviews (IDI) with 26 individuals directly affected by the culture and mechanics of these movements, this study uncovers the nuanced ways in which student activism at BSMRSTU mobilizes cultural ideologies toward societal change. Purposive and snowball sampling techniques were utilized to select participants, revealing that the rhetoric of movements—framed around justice, rights, equality, and reform—plays a crucial role in recruiting and energizing participants.

Results: However, this investigation also highlights a darker facet of these movements: the destructive consequences of specific actions, such as property damage, which not only impact the immediate community but also fuel further unrest. The prevalence of movements centered on themes of injustice underscores the urgent need for both governmental and academic institutions to engage more constructively with student concerns. Addressing this gap requires a nuanced understanding of the motivations behind student movements and a commitment to implementing policies that nurture a culture of dialogue and reform.

Conclusion: This study, therefore, problematizes the contemporary student movements at BSMRSTU by questioning the balance between activism and the potential for unintended consequences, urging a reevaluation of how such movements are perceived and managed in the context of Bangladesh's evolving sociopolitical milieu. For harmful movement culture in academia to be prevented, government and university authorities must take student movements seriously and implement policies and strong norms.

KEYWORDS

BSMRSTU, Gopalganj, manifestation, student movements, social normality

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Exploring socio-cultural stigmas and resilience among tiger widows in coastal Sundarbans communities of Bangladesh: a qualitative study

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The Sundarbans, home to the largest mangrove forest, is also a site of human-wildlife conflict, where tiger attacks claim the lives of many forest-goers engaged in livelihood activities. The sudden and tragic loss of husbands leaves their widows in extreme poverty and social marginalization. While previous studies have explored aspects of tiger widows' lived experiences, gaps remain in understanding the socio-cultural stigmas that shape their exclusion and resilience strategies. This study examines the intricate network of prejudice, social isolation, and psychological distress these widows endure, along with their coping mechanisms. Using in-depth, face-to-face interviews, data were collected from 27 purposively selected tiger widows from the Burigoalini and Gabura regions near the Sundarbans. Colaizzi's descriptive phenomenological approach was employed for data analysis, ensuring a rigorous exploration of their experiences. Findings reveal that social stigma, stereotyping, religious superstitions, negative media portrayals, and limited familial and community support significantly diminish their social status. Social isolation restricts their mobility and participation in communal and religious events, exacerbating psychological distress. Many widows experience financial insecurity due to a lack of alternative income sources, restricted land rights, and limited access to government assistance programs. Furthermore, widows often face exclusion from decision-making processes within their households and communities, reinforcing their marginalization. To foster resilience among tiger widows, targeted interventions such as public awareness campaigns, specialized mental health services, and community-driven social support initiatives are essential. Additionally, sustainable livelihood opportunities through co-management—such as eco-tourism, aquaculture, and handicrafts—can enhance their economic security and social inclusion.

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Menstrual hygiene management in flood-affected Bangladesh: addressing socio-cultural barriers, infrastructure gaps, and policy responses

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Women and adolescent girls in flood-prone regions of Bangladesh face significant challenges in managing menstrual hygiene, which severely impacts their health, dignity, and well-being. This study investigates the socio-cultural, infrastructural, and policy barriers to menstrual hygiene management (MHM) during floods in the districts of Noakhali, Feni, Barisal, Khulna, and Satkhira. Conducted from June to October 2024, the research employed a purposive sampling approach, with 30 in-depth interviews (IDIs) conducted with women and adolescent girls directly affected by the floods. Additionally, 12 key informant interviews (KIIs) were carried out with healthcare workers, NGO representatives, and policymakers, alongside field observations in temporary shelters and relief centers. The findings highlight critical barriers, including the lack of accessible and private sanitation facilities in shelters, compounded by inadequate supplies of menstrual hygiene products. In temporary shelters, the absence of specialized toilets and waste disposal systems for menstruation forces women to resort to unhygienic alternatives such as cloth, leaves, or newspapers, leading to increased health risks. Socio-cultural taboos surrounding menstruation further restrict access to proper hygiene materials and support, intensifying the challenges. Moreover, disaster management systems fail to incorporate menstrual hygiene needs, leaving women and girls particularly vulnerable during floods. The study recommends integrating gender-responsive disaster management policies and comprehensive menstrual health education into disaster relief efforts. The Minimum Initial Service Package (MISP) should be utilized to provide urgent reproductive health services. These findings are crucial for policymakers, healthcare professionals, and researchers, and underscore the importance of reducing stigma and promoting dignity for women and girls. By addressing these gaps, Bangladesh can enhance the resilience and health of women and adolescent girls in the aftermath of floods.

KEYWORDS

menstrual hygiene management (MHM), floods and menstrual health, women and girls, menstrual hygiene in emergencies, Bangladesh

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Understanding mental health challenges and associated risk factors of post-natural disasters in Bangladesh: a systematic review

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Background and objectives: Natural disasters are harmful occurrences caused by the Earth's geological and meteorological processes. Bangladesh is recognized as one of the country's most vulnerable to natural disasters. Therefore, the people of Bangladesh remain at high risk of natural disasters. However, no study has been conducted in Bangladesh to provide an overall perspective on mental health issues that arise after natural disasters. Thus, this systematic review aims to identify all mental health issues and related risk factors brought on by natural disasters in Bangladesh.

Study design: Systematic review.

Methods: Between April to May 2024, a systematic search was conducted across many databases, including PubMed, following the PRISMA guideline. Ultimately, 17 publications were included in this study.

Results: The findings reveal that depression, anxiety, stress, suicidal ideation, post-traumatic stress disorder, major depressive disorder, generalized anxiety disorder and sleep disturbances are found as major risk factors for natural disasters. Prevalence of depression, anxiety and, stress, suicidal ideation ranges from 16.3% to 92.71%, 6% to 92.19%, 32.41% to 58%, 10.9% to 57.5% among people as consequences of natural disasters like heatwaves, cyclones, flood, river bank erosion etc. There are some associated risk factors which provoke prominent mental health problems, including (i) Demographic factors (age, gender, marital status, number of children, lower education, living location, living infrastructure, family conflicts, family member death, land for cultivation, loss of domestic animals), (ii) socio-economic factors (environmental settings, social support, disaster warning system, displacement, food crisis, financial support, income loss, vulnerable livelihoods) (iii) behavior and health-related factors (behavior pattern, physical injury during natural disaster, physical disability), (iv) other factors (increased temperature, living together, lower social class). People affected by natural disasters are often viewed in terms of their physical damage, while their mental health is always ignored.

Conclusion: Calculative measures are needed to create an overall picture of the effect of natural disasters on people's mental health in Bangladesh. Therefore,

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Literature Review

Navigating the Psychosocial Challenges and Coping Mechanisms of Parents Raising Children With Autism Spectrum Disorder in Bangladesh

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Abstract

Autism spectrum disorder (ASD) is characterized by persistent difficulties in interpersonal interaction and socialization across many contexts, accompanied by restricted and recurrent patterns of behaviors, interests, or activities. This narrative review explores the psychosocial challenges faced by parents of children with ASD in Bangladesh and the coping strategies they use to manage these challenges. A comprehensive search of PubMed, PsycINFO, ScienceDirect, Google Scholar, CINAHL, and Web of Science databases was conducted, yielding 75 relevant studies. We used the Preferred Reporting Items for Systematic Reviews and Meta-Analyses checklist to guide us as we extracted and tallied the data. After applying inclusion and exclusion criteria, 15 studies were selected for analysis. Findings reveal that Bangladeshi parents experience significant social stigmatization, exclusion, religious misconceptions, and negligence in healthcare settings. Many parents report being marginalized within their families and communities, leading to high levels of psychological distress, including depression, anxiety, and suicidal thoughts. Mothers, in particular, are more vulnerable to these challenges, reporting severe levels of stress and depression due to societal pressures. Parents also struggle with a lack of adequate support services and professional guidance, especially in rural areas. Despite these difficulties, parents employ various coping strategies, such as building peer support networks, improving their knowledge of ASD, practicing religious spirituality, and using problem-focused approaches. The study underscores the need for improved mental health services, public awareness campaigns to reduce stigma, and policy initiatives to provide better support to parents of children with ASD. These measures are essential to alleviate the psychological and social burdens faced by families, particularly parents, in Bangladesh.

Keywords

autism spectrum disorder, parental challenges, coping strategies, stigma, mental health, Bangladesh

Introduction

Autism spectrum disorders (ASD) encompass a range of cognitive and developmental problems characterized by challenges in communication, socializing, and adherence to rigid routines and obsessions (American Psychiatric Association, 2013). The initial documentation of Autism occurred in 1943 (Gilson et al., 2018), and it was subsequently referred to as ASD. It is a condition that affects a child's capacity to engage in social interactions, perform effectively, and acquire knowledge (National Institute of Mental Health, 2024). It may emerge in early childhood, identified especially in the first 5 years of a child's life, and a few things like development and behavior-oriented factors play key roles in diagnosing ASD. Understanding the incidence and effect of ASD requires complex and context-specific approaches, as recent research suggests that a mix of genetic, neurological, and environmental variables contribute to its development (Guerrera et al., 2024; Shimomura et al., 2022). Simultaneously, children with ASD with familial history are at greater risk of infection with ASD (Brian et al., 2019; Shimomura et al., 2022). Furthermore, ASD is distinguished by enduring impairments in interpersonal communication and social engagement in many

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Research Paper

Suicide attempts and depression associated factors among the male child sexual abuse survivors in Bangladesh☆

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ABSTRACT

In Bangladesh, male child sexual assault is seldom ever reported. Due to cultural standards, sexual assault survivors often refrain from talking about their experiences. Depression therefore overtakes them. Their mental health declines and their chance of committing suicide rises. The goal of this study was to explore depression and suicide attempts among Bangladeshi male child sexual assault survivors. An online survey was conducted, and data was collected using the Patient Health Questionnaire (PHQ-9) and one suicide attempt item. Descriptive analysis, Pearson chi-square test, and a binary logistic regression model were fit to analyze the data. A total of 61 participants participated. All the participants were depressed, with 67.21 % having severe depression. 21.31 % of the survivors attempted suicide at least once. Disclosure rates were relatively low, with only 14.75 % of participants reporting affirmative disclosure, Furthermore, a significant proportion of participants experienced repetitive abuse (73.77 %), and the prevalence of physical abuse was also notable, with 78.69 % reporting such experiences. To safeguard children and adolescents, parents as well as government stakeholders must be aware of male child sexual abuse. Public discourse regarding the subject is recommended. To stave off suicide and safeguard victims, experts advise seeking professional assistance.

1. Introduction

Any sexual act, sexual contact, or sexual exploitation (i.e., noncontact sexual interaction) of a minor by a caretaker to a child is considered childhood sexual abuse (CSA). Sex Act Sexual actions include child-to-child contact in the mouth, penis, vulva, or anus. Sexual actions also include hand, finger, or object penetration into the anal or genital entrance, however little (Leeb et al., 2008). Male child sexual abuse (MCSA) is defined as the same. When it comes to situations of sexual abuse of men, the very cultural norm is broken; this means that a guy is placed in a subordinate position when he is persecuted either by a male or a female sexual perpetrator (Du and William, 1998). Instances of physical abuse have been seen to occur in conjunction with cases of sexual assault, with victims often choosing not to reveal such incidents to others (Easton et al., 2014; Gries et al., 1997). This causes serious psychological injury. These consequences included an increased risk of developing posttraumatic stress disorder (PTSD), major depression, aggressive behavior, poor self-image, suicide, and legal trouble (Aebi et al., 2015; Burgić Radmanović, 2020; Easton and Kong, 2017; Gartner, 2017; Mugabe et al., 2016; Oppong Asante and Andoh-Arthur, 2015; Pérez-González and Pereda, 2015; Spataro et al., 2004).

Annually, the number of individuals who perish as a result of suicide surpasses 700,000 worldwide, and men are more likely to commit suicide than females (Murphy, 1998; WHO, 2021). A mounting body of research has identified MCSA as a noteworthy risk factor for subsequent suicide attempts among adolescent and adult males (Bedi et al., 2011; Dube et al., 2005; Martin et al., 2004; Paolucci et al., 2010). The reported incidence of MCSA among adult males is subject to

☆ Data Availability Statement: The data that support the findings of the study are available from the corresponding author upon reasonable request.

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ORIGINAL RESEARCH

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Post-COVID-19 internet addiction, depression, and pornography addiction among adolescents: Findings from a nationwide study in Bangladesh

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Abstract

Background and Aims: Regulations response to COVID-19 has increased internet addiction (IA), depression, and pornography addiction (PA) among adolescents worldwide. The objective of this nationwide study was to assess the current prevalence rate of IA, depression, and PA after the post-COVID-19 period among school-going adolescents in Bangladesh.

Methods: A total of 8832 male and female adolescents participated in this research. The cross-sectional study was conducted online using a simple random sampling method. Including the sociodemographic variables, Young's IA Test (IAT-20) Scale, Patient Health Questionnaire (PHQ-9), and Pornography Craving Questionnaire (PCQ-12) were used to measure IA, depression, and PA. By SPSS version 25.0, the prevalence and correlation between IA, depression, and PA were analyzed using the Chi-square test, binary logistic regression, and a bivariate co-relation matrix.

Results: Sixty-three percent, 76.6%, and 62.9% of the students were suffering from IA, depression, and PA respectively. Depressive and anxious symptoms were significantly associated with IA. Female students were more depressed than males. Males were more addicted to pornography than females. Students who utilized social media but didn't exercise had greater depression and PA. IA, depression, and PA were correlated.

Conclusion: The research emphasizes the need for comprehensive mental health treatments, digital literacy programs, and family and teacher participation to reduce IA, depression, and PA among adolescents post-COVID-19. Promotion of physical exercise and supporting policies to build safer online settings for adolescents are also encouraged.

Irin Pervin, Md. Khalid Syfullah, Akher Ali, and Al Mahmud are contributed equally to this study.

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biology

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Review

Haploid Production in *Cannabis sativa*: Recent Updates, Prospects, and Perspectives

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Simple Summary: *Cannabis sativa*, commonly known as cannabis or hemp, produces many important compounds with medical benefits. However, breeding high-quality cannabis plants is challenging because the species naturally produces both male and female plants, and unwanted pollination reduces the concentration of valuable compounds. One promising solution is a method called haploid culture, which allows scientists and breeders to grow plants from single cells that contain only one set of genetic material. These special plants can then be doubled to create completely uniform, pure lines in just one generation—something that normally takes several years through traditional breeding. In this study, we highlight how haploid culture could help produce stable and consistent cannabis plants more quickly. We also discuss new tools that can work together with haploid culture to make the process more efficient, such as advanced gene editing. While this technology is still developing in cannabis, it offers great promise for improving the speed, precision, and quality of cannabis breeding. This approach could benefit both farmers and patients by making the production of medical cannabis more reliable, controlled, and suited to specific needs.

Abstract: *Cannabis sativa* L. is a dioecious species known to produce over 1600 chemical constituents, including more than 180 cannabinoids classified into 11 structural groups. These bioactive compounds are predominantly synthesised in the glandular trichomes of female inflorescences. However, sex determination in *C. sativa* is influenced by both genetic and environmental factors, often leading to the development of male flowers on female plants. This unintended fertilisation reduces cannabinoid yield and increases genetic heterogeneity and challenges in medical cannabis production. Haploid and doubled haploid (DH) technologies offer a promising solution by rapidly generating homozygous lines from gametophytic (e.g., unpollinated ovaries and ovules) or sporophytic tissues (e.g., anthers and microspores) via in vitro culture or chromosome reduction during hybridisation. In land plants, the life cycle alternates between a diploid sporophyte and a haploid gametophyte generation, both capable of mitotic division to form multicellular bodies. A single genome regulates this phase transition and encodes the molecular, genetic, and epigenetic mechanisms that precisely control the developmental processes unique to each generation. While the application of haploid technology in *C. sativa* remains limited,

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Multi-omics integration uncovers the zinc metabolic regulatory network in the hyperaccumulating ecotype of *Sedum alfredii* Hance

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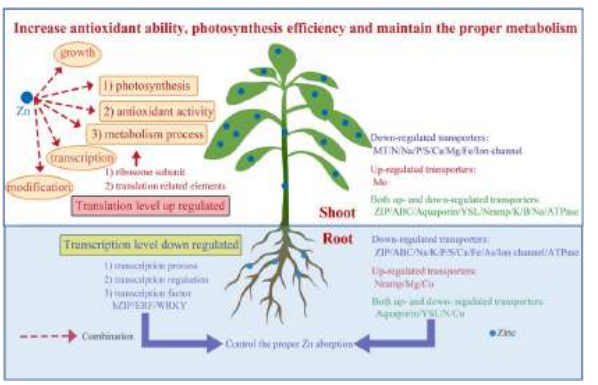
HIGHLIGHTS

- Integration of Multi-Omics reveals Zn homeostasis mechanism in *S. alfredii* hyperaccumulator.
- Enhanced photosynthesis and anti-oxidative capacity are key for Zn adaptation.
- Zn chelation and stress mitigation involve flavonoids and phenolic compounds.
- Carbon and sulfur metabolism play vital roles in Zn hyperaccumulation processes.
- Findings support applications in bio-fortification, phytoremediation, and crop safety.

GRAPHICAL ABSTRACT

We integrate state-of-the art four omics technologies (transcriptomics, proteomics, metabolomics and ionomics) to uncover the Zn metabolic regulatory network in hyperaccumulating plant *Sedum alfredii* Hance. Our findings prove that the plant needs changes in several biological and physiological pathways to adapt for Zn hyperaccumulation. The current study provides a starting point for further research into the gene-protein-metabolite-ion network with a focus on functional genomics and facilitates biotechnological applications of Zn hyperaccumulation traits for biofortification, phytoremediation, and food crop safety.

The mechanism of maintaining Zn homeostasis in hyperaccumulating ecotype of *Sedum alfredii* Hance.



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Article

Health Risk Assessment of Tetracyclines Contamination in Soil-Cabbage (*Brassica campestris* L. ssp. *chinensis*) System

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Abstract: Tetracyclines (TCs) pollution in vegetable fields is a widely recognized concern, yet the health and ecological risks of TCs residues in the soil–cabbage food chain remain unclear. This study used enzyme-linked immunosorbent assay (ELISA) to investigate the health risks associated with TCs contamination in soil–cabbage (*Brassica campestris* L. ssp. *chinensis*) systems to better understand TCs accumulation in soil–cabbage and its impact on human health. The human health risks of the edible parts of Chinese cabbage and the ecological risks of TCs-contaminated soils were assessed using the health risk quotient method (RQ) and risk quotient method, respectively. The results showed that after 65 days of tetracycline (TC), chlortetracycline (CTC), and oxytetracycline (OTC) treatments, the degradation rates of TCs in soil were higher in black soil than in purplish clay soil, following the order of OTC > CTC > TC. As the three types of TCs concentration increased (0–20 mg kg^{-1}), their accumulation in the leaves and roots of Chinese cabbage in purplish clay soil was generally higher than in black soil. The health risk values of the three types of TCs in Chinese cabbage were also higher in purplish clay soil than in black soil, following the order of TC > CTC > OTC. Under controlled pot experimental conditions, the TC content in Chinese cabbage grown in purplish clay soil posed moderate risks to children aged 1–6 years (0.1 < HQ < 1.0), while the CTC and OTC contents in Chinese cabbage leaves indicated low risks to both adults and children (HQ $\leq$ 0.1). Additionally, all three TCs in both soils posed high ecological risks (RQ $\geq$ 1.0), with risk values being higher in purplish clay soil than in black soil, following the order of TC > CTC > OTC. Consequently, more fertile soils can help mitigate the impact of TCs pollution on human health and ecological safety.

Keywords: tetracyclines; soil; health risk assessment; ecological risk assessment; vegetables

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1. Introduction

Tetracyclines (TCs), among the most widely used antibiotics in China, are increasingly contaminating soils [1], and can enter the human body through the food chain, posing a threat to human health [2]. Chinese cabbage, a widely cultivated and high-yielding

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Lentil adaptation to drought stress: response, tolerance, and breeding approaches

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Lentil *(Lens culinaris* Medik.) is a cool season legume crop that plays vital roles in food and nutritional security, mostly in the least developed countries. Lentil is often cultivated in dry and semi-dry regions, where the primary abiotic factor is drought, which negatively impacts lentil growth and development, resulting in a reduction of yield. To withstand drought-induced multiple negative effects, lentil plants evolved a variety of adaptation strategies that can be classified within three broad categories of drought tolerance mechanisms (i.e., escape, avoidance, and tolerance). Lentil adapts to drought by the modulation of various traits in the root system, leaf architecture, canopy structure, branching, anatomical features, and flowering process. Furthermore, the activation of certain defensive biochemical pathways as well as the regulation of gene functions contributes to lentil drought tolerance. Plant breeders typically employ conventional and mutational breeding approaches to develop lentil varieties that can withstand drought effects; however, little progress has been made in developing drought-tolerant lentil varieties using genomics-assisted technologies. This review highlights the current understanding of morpho-physiological, biochemical, and molecular mechanisms of lentil adaptation to drought stress. We also discuss the potential application of omics-assisted breeding approaches to develop lentil varieties with superior drought tolerance traits.

KEYWORDS

abiotic stress, morphology, pulse crop, plant growth, omics, water-deficit

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ORIGINAL PAPER

Evaluating farmers' satisfaction from high-yielding rice (*Oryza sativa*) variety cultivation in boro season: evidence from adaptive trials in Bangladesh

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Abstract
Farmer satisfaction with high-yielding rice varieties (HYVs) in head-to-head adaptive trials (HHATs) was carried out over different agroecological zones (AEZs) during the boro season in Bangladesh. Despite the agronomic viability of high-yielding rice varieties (HYVs), there is a paucity of empirical data about the influence of institutional coordination and agronomic support on farmer satisfaction during the adaptation process. This study seeks to address this gap through a mixed-methods methodology. Using a structured questionnaire, primary data was collected from 280 farmers. A purposive sampling method was employed for a cross-sectional study. The study used descriptive statistics, reliability analysis, exploratory factor analysis (EFA), confirmatory factor analysis (CFA), and structural equation modeling (SEM) to estimate variables and identify causal relationships. The EFA identified four leading factors influencing satisfaction: agro-technical support, institutional support and coordination, input quality and seed performance, and farmers' satisfaction and implementation success. CFA validated institutional oversight (IO) and agro-technical efficiency (ATE), which retained for SEM analysis. Overall, farmers' satisfaction is effectively anticipated by SEM, exposing satisfactory fit indices (CFI = 0.917, RMSEA = 0.091, GFI = 0.99) with both factors ATE ($\beta = 0.684$, $p < 0.001$) and IO ($\beta = 0.259$, $p < 0.05$). NVivo (v14.0)-based qualitative analysis revealed by highlighting primary impediments like labor shortages, irrigation challenges, and climate risk for successful HHATs implementation. This research supports Sustainable Development Goals (SDGs) 2 (Zero Hunger), 13 (Climate Action), and 17 (Partnerships for the Goals) through the promotion of climate-resilient and inclusive agricultural transformation. This study employs participatory innovation approaches through HHATs to offer evidence-based recommendations to enhance acceptance and satisfaction with HYVs in different areas of Bangladesh. These findings reinforce ongoing policy discussions around sustainable rice intensification in South Asia.

Keywords HYVs · HHATs · Farmers' satisfaction · Rice farming · Implementation success

1 Introduction

In recent decades, Bangladesh is a land of agriculture has significantly improved rice production, mostly due to the implementation of high-yielding varieties (HYVs), especially in the boro season, accounts for over 55% of the nation's total rice production (BBS 2022). In Bangladesh, December to May is the length of the boro season, which is known for dry winter conditions and reliance on irrigation, depicts a critical opportunity for maximizing yield and ensuring food security. Rice serves as the principal staple crop, occupying approximately 78% of agricultural land in Bangladesh (Islam et al. 2023; Sarkar et al. 2022. Farmer satisfaction is shaped by some aspects like yield performance, input requirements,

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Article

Immune Responses of Mango Callus Infected by *Agrobacterium tumefaciens* Inhibited Transformation

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Abstract: Mango is a vital fruit crop in tropical and subtropical regions, yet pests and diseases cause 30–70% production losses. Developing disease-resistant cultivars through transgenic methods could mitigate these issues. *Agrobacterium*-mediated callus transformation is a common genetic engineering approach, but successful transgenic mango plants from callus remain unreported due to severe browning and necrosis post-infection. We hypothesized that *Agrobacterium*-induced immune responses trigger callus death, hindering transformation. To improve efficiency, we engineered an *Agrobacterium* strain carrying the type III secretion system (T3SS) and effector gene *AvrPto*. Compared to controls, infected calluses exhibited elevated reactive oxygen species (ROS), along with up-regulated ROS-related, gallic acid biosynthesis, and defense genes. Calluses infected with T3SS-*AvrPto*-harboring *Agrobacterium* showed delayed browning and necrosis versus those infected with the empty vector (NV). The transformation rate with *Agrobacterium* (T3SS-*AvrPto*-EGFP) reached 1.6%, while *Agrobacterium* (NV-EGFP) failed entirely. These findings demonstrate that T3SS and *AvrPto* enhance mango transformation efficiency, offering a promising strategy for breeding multi-resistant varieties.

Keywords: browning; gallic acid; infection efficiency; reactive oxygen species (ROS); type III secretion system gene cluster (T3SS)

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1. Introduction

Mango (*Mangifera indica* L.) is the world's second-largest tropical fruit in yield annually (2023 data from the Office of Tropical Crops in Southern Asia, Ministry of Agriculture, China). The global mango planting area exceeds 10 million hectares annually (data from the Food and Agriculture Organization of the United Nations). India is the largest mango producer, with a planting area of 2.625 million hectares. In 2023, China's mango planting area was 386,200 hectares, and the mango output value in 2021 was CNY 21.14 billion. Other major

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Review

Phage treatment of multidrug-resistant bacterial infections in humans, animals, and plants: The current status and future prospects

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Phage cocktail
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ABSTRACT

Phages, including the viruses that lyse bacterial pathogens, offer unique therapeutic advantages, including their capacity to lyse antibiotic-resistant bacteria and disrupt biofilms without harming the host microbiota. The lack of new effective antibiotics and the growing limitations of existing antibiotics have refocused attention on phage therapy as an option in complex clinical cases such as burn wounds, cystic fibrosis, and pneumonia. This review describes clinical cases and preclinical studies in which phage therapy has been effective in both human and veterinary medicine, and in an agricultural context. In addition, critical challenges, such as the narrow host range of bacteriophages, the possibility of bacterial resistance, and regulatory constraints on the widespread use of phage therapy, are addressed. Future directions include optimizing phage therapy through strategies ranging from phage cocktails to broadening phage host range through genetic modification, and using phages as vaccines or biocontrol agents. In the future, if phage can be efficiently delivered, maintained in a stable state, and phage–antibiotic synergy can be achieved, phage therapy will offer much needed treatment options. However, the successful implementation of phage therapy within the current standards of practice will also require the considerable development of regulatory infrastructure and greater public acceptance. In closing, this review highlights the promise of phage therapy as a critical backup or substitute for antibiotics. It proposes a new role as a significant adjunct to, or even replacement for, antibiotics in treating multidrug-resistant bacterial infections.

1. Introduction

Bacteriophages, or phages, are specialized viruses that infect bacteria for replication. As shown in Fig. 1, phages possess a protein capsid that protects their genetic material and facilitates entry into host cells.[1] The tail structure resembles a syringe and aids attachment and injection of their genetic material. Specific phages feature complex baseplates with receptor-binding proteins for effective docking.[2] After successful attachment, as depicted in Fig. 2 the phage injects its DNA into the bacterial cell, using the host's machinery to replicate. Eventually, new phages emerge, often destroying the host and continuing the infection cycle. Phage therapy, using bacteriophages to treat bacterial infections, was first identified by Félix d'Herelle in the early 20th century. Although promising initially, development was virtually eclipsed by the advent of antibiotics in the western world.[3] However, Eastern Europe and the former Soviet Union continued to use phage therapy extensively, generating a rich source of empirical data.[4] Phages operate through two primary life cycles: the lytic cycle, in which phages replicate within and then lyse bacterial cells, and the lysogenic cycle, in which phage DNA integrates into the bacterial genome and is replicated along with it, until the phage is triggered to re-enter the lytic phase. This specificity allows phages to target and eliminate bacterial pathogens without affecting human cells or the beneficial microbiota.[4]

Abbreviations: MDR, multidrug-resistant; CF, cystic fibrosis.

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Review

CRISPR–Cas systems as emerging tools for precision biofilm control for food safety: Mechanisms and applications

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ABSTRACT

Biofilms on food-contact surfaces pose persistent challenges to sanitation, safety, and product quality within food processing. Traditional cleaning methods and broad-spectrum antimicrobials often fail to disrupt the resilient matrix and multispecies communities characteristic of these biofilms. Clustered regularly interspaced short palindromic repeat (CRISPR)–CRISPR-associated (Cas) systems offer a transformative approach to enhancing food safety, enabling precise modulation of microbial gene networks with applications in diagnostics, programmable sanitation, and targeted microbial control. This review synthesizes recent advances in CRISPR–Cas technology, encompassing Cas9/Cas12-based gene editing, Cas13-mediated RNA targeting, and dead Cas9 (dCas9)-based transcriptional regulation (CRISPR interference/activation, CRISPRi/a), and evaluates their relevance to biofilm prevention and eradication in food environments. We critically assess delivery platforms, including plasmids, nanocarriers, phagemids, and conjugative systems, for their efficiency in complex biofilm settings. The review highlights innovations such as multiplexed repression of redundant pathways, activation of latent antibiofilm functions. These genetic strategies are increasingly being integrated with omics-based analytics (e.g., transcriptomics, proteomics, metabolomics) to reveal systems-level cellular responses and regulatory shifts triggered by biofilm-targeted interventions. We also address the practical limitations, such as delivery barriers, off-target effects, regulatory hurdles, and ethical considerations specific to food applications. Ultimately, we propose a framework for translating CRISPR–Cas technology into scalable, safety-compliant tools for precision control of biofilms in food processing environments. This review aims to guide future research and inform stakeholders on leveraging CRISPR–Cas technology for safe, sustainable, and targeted management of food-associated biofilms.

1. Introduction

Microbial biofilms remain a persistent challenge in food processing environments, where they compromise food safety, sanitation, and product quality. Biofilms are structured microbial communities embedded in extracellular polymeric substances (EPS) that adhere to diverse food-contact surfaces such as stainless steel, plastic, silicone, and rubber. Their complex architecture and protective matrix confer high tolerance to disinfectants, mechanical removal, and environmental stress, allowing biofilms to act as reservoirs for pathogens and spoilage organisms (Rahman, Akter, Ashrafudoulla, et al., 2025). These properties allow biofilms to act as reservoirs for pathogenic and spoilage microorganisms, leading to persistent contamination, repeated batch failures, and serious economic losses in food production facilities (Akter et al., 2024).

Food-processing biofilms impose substantial, recurring costs and safety risks. Recent estimates place biofilm-related losses in the global agrifood sector at ~$324 billion/year; U.S. foodborne illnesses alone cost about $17.6 billion/year, while an average recall costs ~$10 million in direct expenses. CRISPR-guided antimicrobials and CRISPRi/a

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Antibiofilm potential of naringenin against *Pseudomonas aeruginosa* and *Escherichia coli* on food-processing surfaces

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ABSTRACT

Biofilms formed by *Pseudomonas aeruginosa* and *Escherichia coli* on seafood and processing surfaces pose serious food safety risks. This study evaluates naringenin, a citrus-derived flavonoid, for its antibiofilm potential against both pathogens on biotic (shrimp) and abiotic surfaces (stainless steel, aluminum, silicone rubber, and polyethylene terephthalate). The minimum inhibitory concentrations (MICs) of naringenin were 64 μg/mL for *P. aeruginosa* and 128 μg/mL for *E. coli*. Naringenin significantly reduced 24- and 72-h biofilms in a dose-dependent manner, with complete removal at 4MIC. Mechanistic studies revealed inhibition of initial adhesion, suppressed adenosine triphosphate (ATP) production, increased reactive oxygen species (ROS), and disruption of cellular respiration (via TTC assay). Protein leakage, carbon-13 nuclear magnetic resonance (^{13}C NMR), and reverse transcription-polymerase chain reaction (RT-PCR) confirmed membrane disruption and downregulation of biofilm-related genes (*algU*, *rhlR*, *exoS*, *rpoS*, *csgA*, and *luxS*). Confocal laser scanning microscopy (CLSM) and field-emission scanning electron microscopy (FE-SEM) further validated biofilm disruption. In conclusion, naringenin demonstrates strong multi-targeted antibiofilm activity and holds promise as a natural intervention for improving seafood hygiene and surface sanitation.

1. Introduction

Biofilms are structured microbial communities encased in a self-produced matrix of highly hydrated extracellular polymeric substance (EPS) and adhered to biotic or abiotic surfaces (Akter et al., 2025). Considerable numbers of both spoilage and pathogenic microorganisms may reside within a biofilm (Rahman et al., 2025) In the food industry, biofilms can form on processing equipment, packaging materials, and food-contact surfaces, posing major public health and food safety challenges, including jeopardizing product safety and shelf life (Setiyawan et al., 2023). Biofilms serve as persistent sources of cross-contamination and are difficult to remove by conventional cleaning and disinfection measures, including antimicrobials, which exhibit an eradication outcome on planktonic cells (Akter et al., 2024).

Among the various biofilm-forming microorganisms, *Pseudomonas aeruginosa* and *Escherichia coli* are particularly significant. They exhibit strong biofilm-forming capacity and high levels of antimicrobial resistance, making them difficult to eliminate from food-processing environments (Hall & Mah, 2017). Their presence on food-contact surfaces further complicates sanitation efforts, as biofilms formed on these surfaces resist mechanical removal and chemical disinfection. *E. coli,* particularly pathogenic strains, such as Shiga toxin-producing *E. coli* (STEC) and enterohemorrhagic *E. coli* (EHEC), pose a major food safety threat. *E. coli* adheres to various food-contact surfaces and co-expresses biofilm and virulence genes, contributing to its persistence and pathogenicity in food systems (Wang et al., 2021). *P. aeruginosa* is an opportunistic, psychrotrophic bacterium commonly isolated from aquatic and seafood environments (Akter et al., 2024). Among different seafoods, shrimp has been frequently reported to harbor both *P. aeruginosa* and *E. coli*, making it an ideal model food matrix for biofilm studies (Losito

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REVIEW ARTICLE

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Biofilm–microplastic interactions in food safety: mechanisms, risks, and control strategies

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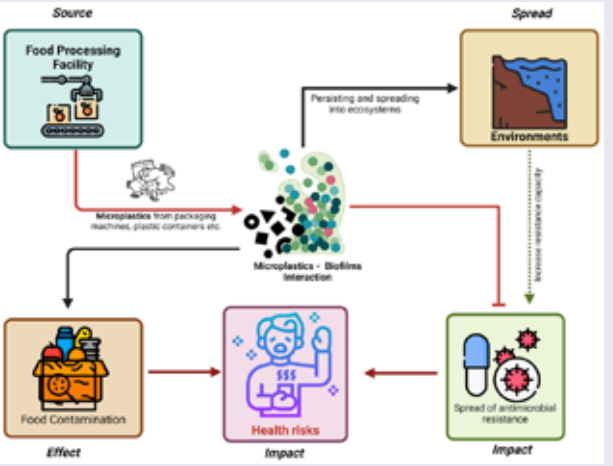
ABSTRACT

The pervasive use of plastics in the food industry has led to significant microplastic contamination, heightening food safety concerns. Microplastics not only infiltrate food systems but also provide optimal substrates for biofilm formation due to their hydrophobic and rough surface properties, which enhance microbial attachment. These biofilm–microplastic complexes protect embedded bacteria from disinfection efforts and facilitate the dissemination of pathogens and antibiotic-resistance genes, posing substantial risks to human health. This review investigates the mechanisms of biofilm formation on various plastic materials and elucidates how these interactions contribute to antimicrobial resistance and contamination in food systems. It also evaluates preventive and remedial strategies, including the development of alternative packaging materials, advanced cleaning protocols, and detection techniques for monitoring biofilm–microplastic complexes. Understanding these interactions is crucial for developing targeted interventions to mitigate contamination risks and enhance food safety and security. By integrating recent findings and proposing innovative strategies, this review aims to guide future research and inform policy development, supporting safer and more sustainable food production practices.

GRAPHICAL ABSTRACT



KEYWORDS
Biofilm; food safety; food system; microplastics

Introduction

The extensive use of plastics in the food industry has resulted in significant microplastic contamination. In 2019, global plastic production reached approximately 370 million tonnes, with a substantial portion used for food packaging, equipment, and single-use items (PlasticsEurope 2020). As of recent estimates, annual plastic production has surged to around 450 million metric tons, and is projected to double by 2045 if current consumption trends continue, underscoring the urgent need for sustainable

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Overcoming risk of bacterial biofilm challenges in cultured meat production: Innovative strategies for safety and sustainability

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ABSTRACT

Background: Cultured meat, produced by cellular agriculture, offers a sustainable, ethical, and resource-efficient alternative to conventional meat. The production of cultured meat involves growing animal cells under optimal culture conditions in controlled bioreactors. However, microbial contamination, especially biofilm formation, poses a significant challenge. Biofilms are microbial communities encased in a matrix of extracellular polymeric substances (EPS) that adhere to production surfaces, scaffolds, and bioreactor walls, complicating cleaning, reducing production efficiency, and increasing food safety risks.

Scope and approach: This review assesses biofilms as a potential food safety risk in cultured meat production. It explores critical production components—cells, culture media, scaffold, and bioreactors—and their role in biofilm formation. Bacterial penetration mechanisms are highlighted, such as scaffold defects and enzymatic matrix degradation, with a focus on key contaminants like *Listeria monocytogenes*, *Salmonella* spp., and *Escherichia coli*. In addition, the influence of surface materials, scaffold design, and bioreactor configuration on biofilm persistence is also discussed.

Key findings and conclusions: While direct evidence of biofilm prevalence in cultured meat systems is limited, biofilm control remains essential. Effective strategies include surface modifications, enzymatic treatments, and quorum-sensing inhibitors. Advanced detection tools like biosensors, metagenomics, and artificial intelligence (AI)-driven monitoring offer proactive solutions. Regulatory alignment, hygiene protocols, and traceability are vital for commercialization, enhancing food safety, operational efficiency, and sustainability.

1. Introduction

The world's population is growing at an unprecedented rate, currently standing at 8.1 billion and projected to reach around 9.7 billion by 2050 (FAO, 2015; Worldometer, 2022). This rapid growth has significant implications for global food security. Historically, meat has been a central component of the human diet for over 2.6 million years, evolving from hunting wild animals to the domestication of livestock and poultry, such as chickens, pigs, and cattle. With rising global food demands, there is an urgent need for sustainable meat alternatives to bridge the supply–demand gap (Samad et al., 2024). Cultured meat represents a paradigm shift in meat production, addressing critical challenges associated with traditional livestock farming, including environmental degradation, animal welfare, and food security. It eliminates the need for animal slaughter and lowers water use and land requirements, aligning with global sustainability goals (Habowski & Sant'Ana, 2024). Beyond its ethical and ecological benefits, cultured meat provides an opportunity to meet the nutritional needs of a growing population without the resource-intensive drawbacks of conventional meat production.

Cellular agriculture, in the context of cultured meat production, replicates the natural development of muscle tissue. The process

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Biofilm formation and analysis of EPS architecture comprising polysaccharides and lipids by *Pseudomonas aeruginosa* and *Escherichia coli* on food processing surfaces

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Spectroscopy

ABSTRACT

Biofilms are silent but formidable threats in seafood processing, where *Pseudomonas aeruginosa* and *Escherichia coli* can quickly transform contact surfaces into reservoirs of contamination. This study explores the dynamic biofilm formation on aluminum, silicone rubber, stainless steel, and polyethylene terephthalate over 24 and 72 h. Quantitative assays including Colony Forming Unit (CFU), Crystal Violet (CV), 3-(4,5-Dimethylthiazol-2-yl)-2,5-Diphenyltetrazolium Bromide (MTT) revealed a significant increase in biofilm density, particularly on aluminum and silicone rubber. Fourier-Transform Infrared Spectroscopy (FTIR) and ^{1}H Nuclear Magnetic Resonance (NMR) analyses showed that biofilm EPS exhibits an evolving amphiphilic nature, with stable polysaccharides and increasing lipid content enhancing resilience. Confocal Laser Scanning Microscopy (CLSM), and Field Emission Scanning Electron Microscopy (FE-SEM) captured the shift from early attachment to mature, dense biofilms. These findings underscore the crucial impact of surface material on biofilm growth and the pressing need for tailored cleaning protocols to curb contamination risks in food processing environments.

1. Introduction

A biofilm is a complex formation triggered by the attachment of bacterial cells to a surface and composed of extracellular polymeric substances (EPS) in which the associated bacterial cells are embedded (Rahman et al., 2025). This densely colonized matrix poses a formidable challenge for the food industry as it is recalcitrant to conventional prevention and destruction techniques (Rahman et al., 2025). Biofilms contribute to the acquisition of nutrients and the adherence to the associated surface, prevent desiccation because the EPS retains water, and provide a protective niche for microorganisms, which is key to their persistence (Akter et al., 2025; Ashrafudoulla et al., 2024).

Bacterial inhabitants of biofilms are known to collaborate and coordinate activities, such as enzyme secretion, luminescence, and virulence factor production, to enhance their survival and pathogenicity (Gautam et al., 2024). In food processing environments, biofilms harboring pathogenic and spoilage microorganisms can create persistent reservoirs of contamination and compromise food safety (Bridier et al., 2011). Biofilms also compromise food hygiene by reflecting lapses in sanitation practices and food suitability by reducing the quality and shelf life of food products. These distinctions are critical for understanding the multifaceted impact of biofilms in the food industry. These biofilms are often implicated in cross-contamination by transferring bacteria to food during handling and processing (Nahar et al., 2021). Cross-contamination in the food production and supply chain (Gautam et al., 2024), which can occur when biofilm-associated bacteria detach from surfaces and transfer to food (Simões et al., 2010), significantly increases the risk of foodborne illnesses and leads to substantial global economic losses.

A wide range of pathogenic and spoilage bacteria contribute to biofilm formation in food processing environments, including *Vibrio* spp., *Shigella* spp., *Salmonella* spp., *Yersinia* spp., *Klebsiella* spp., *Escherichia coli*, *Pseudomonas aeruginosa*, and *Streptococcus iniae* (Toushik et al., 2021). It is important to distinguish between foodborne pathogens,

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REVIEW ARTICLE

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Mechanistic and bibliometric insights into *RpoS*-mediated biofilm regulation and its strategic role in food safety applications

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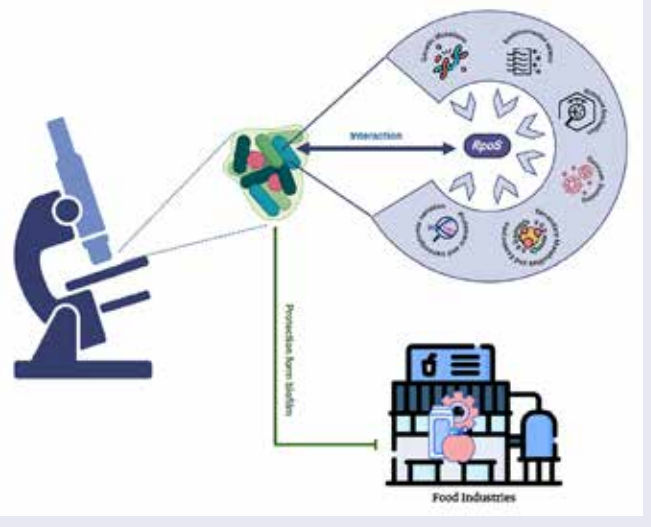
ABSTRACT

Biofilm, complex structures formed by microorganisms within an extracellular polymeric matrix, pose significant challenges in the sector by harboring dangerous pathogens and complicating decontamination, thereby increasing the risk of foodborne illnesses. This article provides a comprehensive review of the sigma factor, *rpoS*'s role in biofilm development, specifically in gram-negative bacteria, and how the genetic, environmental, and regulatory elements influence *rpoS* activity with its critical role in bacterial stress responses. Our findings reveal that *rpoS* is a pivotal regulator of biofilm formation, enhancing bacterial survival in adverse conditions. Key factors affecting *rpoS* activity include oxidative and osmotic stress and nutrient availability. Understanding *rpoS*-mediated regulatory pathways is essential for developing targeted biofilm management strategies to improve food quality and safety. Furthermore, a bibliometric analysis highlights significant research trends and gaps in the literature, guiding future research directions. Future research should focus on detailed mechanistic studies of *rpoS*-mediated biofilm regulation, the development of specific *rpoS* inhibitors, and innovative approaches like biofilm-resistant surface coatings. This knowledge can lead to more effective contamination prevention and overall food safety enhancements.

KEYWORDS

Biofilm; *RpoS*; sigma factor; bibliometric analysis; food industries

GRAPHICAL ABSTRACT



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Full-Length Article

Targeted insights into *Aeromonas hydrophila* biofilms: Surface preferences, resistance mechanisms, and gene expression

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ARTICLE INFO

Keywords:
A. hydrophila
Biofilm
Antibiotic resistance
Gene expression
Food contact surface

ABSTRACT

This study provides a comprehensive analysis of biofilm formation, antibiotic resistance, motility, and gene expression in four *Aeromonas hydrophila* strains—ATCC 15467, ATCC 7966, KCTC 2358, and KCTC 11533—on stainless steel (SS), silicon rubber (SR), polyethylene terephthalate (PET), and high-density polyethylene (HDPE) surfaces over 24, 48, 72, and 96 h. Biofilm formation peaked at 72 h, with ATCC 7966 demonstrating the highest biofilm density on PET (6.50 ± 0.08 log CFU/cm^2), underscoring PET's role as a favorable substrate for biofilm development. In contrast, HDPE consistently exhibited the lowest biofilm levels, reflecting its potential as a biofilm-resistant material. Antibiotic susceptibility profiling revealed multidrug resistance (MDR) in ATCC 15467 and KCTC 11533 (MARI = 0.80), particularly against beta-lactams, aminoglycosides, and fluoroquinolones while ATCC 7966 and KCTC 2358 displayed moderate resistance. Motility assays highlighted strain-specific capabilities, with KCTC 11533 exhibiting the highest swimming motility (76.0 ± 6.6 mm) and KCTC 2358 excelling in swarming (47.7 ± 3.5 mm). Genetic analysis confirmed the presence of *luxS* and *ahyR* in all strains, while *csgA* was exclusive to ATCC 7966, correlating with its superior biofilm formation. Confocal microscopy revealed biofilm maturation dynamics, with red fluorescence indicating cell death and aging at 96 h, while SEM images captured intricate surface-specific biofilm architectures. These findings elucidate the critical interplay between strain characteristics, surface properties, and incubation time, providing a foundation for developing targeted strategies to control *A. hydrophila* biofilms in food processing environments.

Introduction

Biofilms, intricate conglomerates of microorganisms ensconced within a self-generated extracellular matrix (ECM), pose a formidable challenge across diverse sectors, including healthcare, water systems, food production and the poultry industry (Rahman et al., 2023). These biofilms, acting as persistent reservoirs for pathogens, are resistant to cleaning and disinfection measures, posing significant threats by enabling long-term survival and dissemination of the bacterium on food contact surfaces, which can lead to contamination and outbreaks of foodborne illnesses, particularly in the food and poultry industries (Ashikur Rahman, et al., 2024; El-Hossary, et al., 2023). *Aeromonas hydrophila*, a Gram-negative bacterium, stands out among biofilm-forming microorganisms for its remarkable adaptability and resilience, thriving in diverse ecological niches such as aquatic environments, soil, sewage, and food processing facilities, while forming tenacious biofilms on a wide range of surfaces under varied environmental conditions (Akter, et al., 2025; Grilo, et al., 2020; Rahman, et al., 2019).

In the poultry sector, *A. hydrophila* presents a dual threat. During production, it can cause localized and systemic infections in poultry, resulting in significant economic losses. Post-harvest, the bacterium contaminates carcasses and water used in processing plants, further compromising food safety. Its transmission often occurs through the

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Seafood and biofilm: Mitigation strategies for food safety

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ABSTRACT

Seafood is essential for achieving the United Nations Sustainable Development Goals (SDGs), particularly in enhancing food security and supporting sustainable livelihoods. However, the seafood industry faces challenges due to the short shelf life of its products, primarily caused by microbial contamination and biofilm formation, which increase resistance to conventional preservation methods. This review examines the microbial hazards associated with seafood, focusing on the complexities of biofilm formation on seafood and processing equipment. It explores advanced non-thermal decontamination technologies, such as electron beam irradiation, cold plasma, and ultrasonication, alongside natural antimicrobial strategies, including plant extracts, biosurfactants, and antimicrobial peptides. These innovative methods show potential for enhancing seafood safety, extending shelf life, and preserving nutritional quality. The review emphasizes the need for ongoing research into effective biofilm control, improved detection methods, and robust regulatory frameworks to ensure the production of safe, high-quality seafood. Additionally, a bibliometric analysis highlights current research trends and key focus areas within this field, providing a comprehensive overview of the evolving scientific landscape related to seafood safety and biofilm management, and identifying critical opportunities for future research and innovation.

1. Introduction

Seafood, encompassing all aquatic foods sourced from oceans, estuaries, lakes, rivers, streams, and those cultivated in tanks or other artificial environments, is widely recognized for its nutritional benefits (Chintagari, Hazard, Edwards, Jadeja, & Janes, 2017). As a rich source of omega-3 fatty acids, selenium, vitamin D, and iodine, seafood is often considered a superior alternative to other animal proteins (Ali et al., 2020; Wallin, Orsini, Forouhi, & Wolk, 2018). Numerous studies suggest that regular consumption of seafood can reduce the risk of cardiovascular diseases, including myocardial infarction, hypertension, atherosclerosis, and stroke (Troell, Jonell, & Crona, 2019; Zhang & Abatzoglou, 2020). Seafood is not only nutrient-dense but also environmentally sustainable, making it a crucial component in global food security and nutrition strategies (Cai & Leung, 2022). The global per capita consumption of aquatic animal foods has almost doubled, increasing from 9.1 kg in 1961 to 20.7 kg in 2022, driven by factors such as rising production, economic development, urbanization, and growing consumer preference for healthier diets (FAO, 2024).

However, despite its benefits, fresh seafood is highly perishable, with a short shelf life due to microbial growth, enzymatic reactions, and physicochemical changes (Kontominas, Badeka, Kosma, & Nathanailides, 2021). According to the Centers for Disease Control and Prevention (CDC), between 2001 and 2021, seafood-related foodborne outbreaks in the U.S. led to 19,554 incidents, resulting in 371,962 illnesses, 18,723 hospitalizations, and 445 deaths. During this period, *Salmonella* was responsible for approximately 83% of seafood-related outbreaks, causing 75,845 illnesses, 10,420 hospitalizations, and 106 deaths. Looking ahead, the CDC forecasts around 218 future outbreaks of vibriosis from contaminated seafood, which could result in 1699 illnesses, 101 hospitalizations, and 3 fatalities (CDC, 2024; Roy et al., 2024). Similarly, in Korea, the Ministry of Food and Drug Safety (MFDS) recorded 3157 cases of foodborne illnesses between 2015 and 2024, with 114 directly linked to seafood pathogens like *Vibrio*

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RESEARCH

Impacts of Tropical Cyclone Sitrang on the Shrimp Industry: A Case Study from the Coastal Region of Bangladesh

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Abstract

Shrimp farming regions of Bangladesh are highly vulnerable to natural disasters like cyclones due to their geographical location. This study aimed to investigate the impact of Cyclone Sitrang on shrimp farming in a sub-district of Satkhira district of southwest Bangladesh, the epicenter of Sitrang. The research focused on 58 shrimp farms directly affected by the cyclone, with data collected between December 2022 and January 2023. A structured questionnaire was used to assess the demographic, economic, and disease burden following clinical sign (from possible environmental disruption) impacts of Cyclone Sitrang on shrimp farming and the local farming community. Results indicate that Cyclone Sitrang significantly reduced the profitability of both primary species (*Penaeus monodon*) and co-cultured secondary species (*Catla catla*, *Labeo rohita*, *Oreochromis mossambicus*, *Labeo boga*, *Lates calcarifer*, *Chelon subviridis*, *Ctenopharyngodon Idella*, *Macrobrachium rosenbergii*), primarily due to disruptions in local supply chains and transportation networks. In the wake of Cyclone Sitrang, shrimp farms of various sizes have significantly increased their seasonal employment to address infrastructural damage while retaining permanent staffing levels. This has resulted in a notable rise in the number of seasonal workers: small farms by 352%, medium farms by 227%, and large farms by 556%, leading to an overall average increase of 396%. From financial perspective, cyclone Sitrang impacted both non-fixed costs (slightly increased) and net income (significantly decreased) for small, medium, and large farms in the post-Sitrang period. The benefit-cost ratio (BCR) declined significantly across all farm sizes, indicating reduced financial variability of shrimp farming post-Sitrang. Farmers reported increased incidences of shrimp disease including white spots, yellow discolouration and shell abnormalities, likely exacerbated by the Cyclone. These health issues further disrupted farm operations and financial outcomes. These findings highlight the vulnerability of the shrimp farming industry in Bangladesh to cyclones and underscore the need for strategies to enhance resilience.

Keywords Shrimp farming · Natural disaster · Disease burden · BCR, economic burden

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Research article

Exploring sustainable livelihood options for COVID-impacted rural communities in Bangladesh

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ABSTRACT

The COVID pandemic paralyzed all economy-generating sectors of Bangladesh, putting abrupt pressure on livelihood-making. In this study, two sequential surveys were conducted in the Mymensingh district of Bangladesh to gain a deep understanding of the impacts of COVID on job status and post-COVID job preference. The effectiveness of preferred occupations in livelihood resilience within the Sustainable Livelihood Approach (SLA) framework was also empirically analyzed and people-driven policies were recommended for sustaining livelihoods. About 35.96 % of respondents experienced short-to long-term unemployment and migrated to rural areas. The groups most severely affected were predominantly engaged in both formal and informal employment, characterized by lower levels of education, older age brackets, and predominantly female (45 out of 114). In the COVID situation, a large portion of respondents adopted agriculture (18.42 %), aquaculture (10.53 %), livestock farming (5.26 %), and small businesses (13.27 %) as their means of livelihood. However, for post-COVID preferences, respondents remained limited to only 13 job categories, considering aquaculture (22.02 %), agriculture (19.90 %), and livestock farming (26.22 %) as their most desired sectors. Considering all five capitals within the SLA framework, aquaculture and livestock farming were found to be more effective in bringing livelihood resilience within COVID-affected rural communities than agriculture. However, the greater advantages that aquaculture offers in achieving post-COVID livelihood led the authors to consider aquaculture as a decisive choice for policy recommendation. Therefore, the study proposed 28 people-oriented policies under four broad categories (financial support, technical assistance, marketing and logistics, and governance and institutional) in making sustainable livelihoods from aquaculture where financial support takes precedence as their top priority.

1. Introduction

Since the outbreak of COVID, the economy-generating sectors in almost all countries and territories around the world have been impacted [1,2], edging towards a long and challenging economic recession [3]. The shock from COVID has devastated the world economy, even in the most economically resilient countries, causing global economic growth to decline by 4.9 % since the second half of 2020 [4]. Heading to the new normal, measures initiated by most countries to elevate GDP have been considered the most robust

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Potential of integrated multitrophic aquaculture to make prawn farming sustainable in Bangladesh

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Farmed freshwater prawn (*Macrobrachium rosenbergii*) and black tiger shrimp (*Penaeus monodon*) comprise a significant portion of Bangladesh's seafood exports, raising concerns about their environmental impacts. Freshwater prawn farms, which require a relatively high amount of feed supply, release 1.0 MT CO_2-equivalents/year, equating to 18.8 kg CO_2e/MT prawn, contributing significantly to global warming and climate change risks. Integrated Multi-Trophic Aquaculture (IMTA) offers an alternative farming method to conventional prawn farming systems, as it minimizes greenhouse gas (GHG) emissions and climate change impacts. Systematically reviewing 112 scientific articles on IMTA, this article offers recommendations for adopting IMTA to promote sustainable freshwater prawn farming in Bangladesh. IMTA is undergoing extensive experimentation and practice in many parts of the world, offering economic benefits, social acceptability, and environmental sustainability. In addition to native prawn species, various indigenous organic extractive freshwater mollusks, and inorganic extractive plants are available which can seamlessly be used to tailor the IMTA system. Extractive organisms, including aquatic mollusks and plants within prawn farms, can capture blue carbon effectively lowering GHG emissions and helping mitigate climate change impacts. Aquatic mollusks offer feed for fish and livestock, while aquatic plants serve as a dual food source and contribute to compost manure production for crop fields. Research on IMTA in Bangladesh was primarily experimented on finfish in freshwater ponds, with the absence of studies on IMTA in prawn farms. This necessitates conducting research at the prawn farmer level to understand the production of extractive aquatic mollusk and plants alongside prawn in the prawn-producing regions of southwestern Bangladesh.

KEYWORDS

integrated multitrophic aquaculture, prawn farming, GHG emission, climate change, sustainability, Bangladesh

sustainability

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Article

Identification of Aquatic Plant Species Suitable for Growing in Integrated Multi-Trophic Aquaculture Systems in Southwest Bangladesh

Alif Layla Bablee [1,2,*], Abul Bashar [1,2], Md. Mehedi Alam [3], Neaz A. Hasan [4], Mohammad Mahfujul Haque [1], Lars Hestbjerg Hansen [2] and Niels O. G. Jørgensen [2,*]

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Abstract: Giant freshwater prawn (*Macrobrachium rosenbergii*) farming in Bangladesh began in the 1970s and has become a significant export industry. Despite its potential, there are concerns about the environmental sustainability of prawn farming due to its high greenhouse gas (GHG) footprint, but implementation of integrated multi-trophic aquaculture (IMTA) may help minimize the GHG emission. A key element in IMTA is using plants to take up inorganic nutrients released by the prawns, producing valuable plant products and cleaning the water. Using a quadrat sampling method, we conducted a field study in combined prawn and shrimp ponds, aquaculture fishponds, and non-aquaculture waters in south- west Bangladesh to characterize plant diversity and identify suitable species for IMTA in prawn farms. A total of 38 plant species were identified with densities ranging from 4.5–6.1 plants/m^2 in the aquaculture ponds to 11.6–17.1 plants/m^2 in the prawn/shrimp and the non-aquaculture ponds. Free-floating plants were the most abundant, followed by emergent, floating anchored, and submerged plants. Most plants have commercial values as food, fodder, fish feed, fertilizer, or medicines to local people. Our results suggest that species within the *Oxalis*, *Ipomoea*, *Azolla*, and *Lemna* genera are suitable extractive aquatic plants for the implementation of IMTA in prawn farms and may improve the sustainability of prawn production.

Keywords: integrated multi-trophic aquaculture; aquatic plants; prawn farming; GHG emission; southwest Bangladesh

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1. Introduction

The farming of giant freshwater prawn (*Macrobrachium rosenbergii*) was introduced in Bangladesh in the 1970s for the first time. Later, it was commercialized in the early 1990s, leading to a significant increase in exports to the USA and Europe [1]. In recent years, studies on this farming practice indicate that it has unexpected environmental impacts, especially in terms of greenhouse gas (GHG) emissions [2]. In addition to CO_2 emission, the highly potent GHG methane may be produced at anoxic sites in prawn ponds. Additionally, nitrogen in organic debris, such as undigested feed and feces from prawns, as well as nitrogen-based fertilizers (added to stimulate phytoplankton growth as supplementary feed for the prawns) may contribute to the release of another potent GHG, nitrous oxide. Integrated multi-trophic aquaculture (IMTA) has been postulated to function as a climate-resilient and sustainable technique for the reduction in GHG emissions in coastal Bangladesh [2–4].

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REVIEW ARTICLE OPEN ACCESS

Current Status of Hilsa (*Tenualosa ilisha*) Fisheries in Bangladesh and Implications for Future Research and Development

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ABSTRACT

Hilsa shad (*Tenualosa ilisha*) is an anadromous fish, making the single largest wild fishery in Bangladesh, supporting the livelihoods of about 2% of the population and contributing 1% to the national GDP. Several studies reported positive outcomes associated with its catch status, biology, ecology, nutritional profile, conservation and management and socio-economic impacts. However, significant knowledge gaps exist in hilsa fisheries, particularly in the areas crucial for research and development. In this article, we conducted a systematic review of literature to identify and address the knowledge gaps, challenges and research priorities in hilsa fisheries to ensure their sustainable management and production. Recent data from the Department of Fisheries (DoF) indicate rising production of hilsa in Bangladesh, sparking debate about its accuracy. Reliable data are essential to avoid miscalculations that could lead to risk of overfishing or underfishing of this important fish. Hilsa matures at 6–12 months, lives 2–6 years, feeds primarily on phytoplankton and spawns mostly during full moon of September and October. The abundance of brood hilsa in the river systems before and after the peak breeding season suggests further research is needed to refine breeding period for sustainable production. Although recent molecular studies have mapped the complete genome of hilsa, there remains a lack of comprehensive knowledge on its biology, ecology, conservation and life cycle—the key areas for sustainable catches and domestication. Enhancing global demand for this species requires value addition, such as removing sharp pin bones in the flesh. DoF has implemented various policies and projects, including establishment of sanctuaries to protect and conserve hilsa fisheries for sustainable exploitation. However, these measures have sparked controversy due to their adverse impacts on income and livelihoods of fishermen. Addressing these challenges and knowledge gaps requires focused research and development initiatives to ensure sustainable hilsa fisheries in Bangladesh.

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Seeking environmentally sustainable solutions for inland aquaculture in Bangladesh

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ABSTRACT

Inland fresh- and brackish aquaculture is a key component of global food security, however, its rapid growth has impacted adversely on the environment. The future growth of the aquaculture industry will need to balance food production more effectively against the exploitation of natural resources. This review considers the case for inland aquaculture in Bangladesh – currently the world's fifth-biggest inland aquaculture producer with nearly 3 million tonnes of aquaculture production (2022). Current practices associated with different forms of inland aquaculture in the country are outlined, with their associated demands on the environment highlighted. Future projections for aquaculture expansion are assessed for their potential to impact on and be limited by the availability and quality of natural resources, including freshwater, and concerns for its contamination and salinisation. The effects of land use changes, exploitation of wild populations, introduction of invasive species, and spread of diseases on potential production are also examined. The paper addresses how these challenges may be met, both for achieving production aspirations and for limiting impact on nature. The review offers a viewpoint on potential collective actions for sustainable aquaculture, aligned with Bangladesh's socioeconomic characteristics, and in collaboration with in-country partners. To achieve the projected 14% increase in production by 2025, Bangladesh's aquaculture sector must balance growth with the effective management of finite freshwater and land resources. Key recommendations include prioritising adaptations by farmers for sustainable intensification of their production and facing changing climate impacts. Aquaculture policy needs to support the provisioning of the necessary knowledge, tools, and adequate resources to enable farmers to implement resource-efficient management strategies.

1. Introduction

Globally, seafood consumption has risen five-fold since the 1960s, while the output from capture fisheries has remained relatively constant since the 1990s (FAO 2022). This has mainly been facilitated by an increase in aquaculture production, which in 2020 accounted for 56% of aquatic foods produced, and is expected to grow a further 22% by 2030 (FAO 2022). However, achieving this projected increase for inland (freshwater and brackish) aquaculture sustainably will be challenging and likely to require both spatial expansion and intensification (Zhang et al. 2022). By 2050, land and freshwater requirements for aquaculture are estimated to be approximately 440,000 km^2 and 469 km^3 respectively, with an additional 616,000 km^2 of space required for growing aquafeeds (Mungkung et al. 2014, Waite et al. 2014). Historically, the expansion of some aquaculture systems has resulted in extensive degradation of aquatic ecosystems, including widespread degradation of

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| Microbial Pathogenesis | Announcement

Draft genome sequencing of human pathogenic *Vibrio fluvialis* BD001 strain isolated from shrimp (*Penaeus monodon*) in Bangladesh

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ABSTRACT We report the isolation and genome sequence of *Vibrio fluvialis* BD001 from shrimp in Bangladesh. The assembled genome of BD001 strain is ~4.8 Mbp in size, with 50% GC content and 99× coverage depth. The genome reveals insights into antibiotic resistance, virulence, and potential human pathogenicity.

KEYWORDS *Vibrio fluvialis*, shrimp, *Penaeus monodon*

Vibrio fluvialis is a water- or seafood-borne pathogen that causes gastroenteritis and extraintestinal infection, with the potential to become endemic in Bangladesh and pose a serious public health risk (1). This report presents the first known isolation of *V. fluvialis* from shrimp (*Penaeus monodon*) samples in Khulna, Bangladesh, emphasizing its possible emergence as a pathogen of concern for food safety and aquaculture. *P. monodon*, the country's main farmed shrimp species (2–5), is largely export-oriented and supports the seafood supply chain, economic growth, and foreign exchange with major export destinations to European countries, including Italy, the United Kingdom, Germany, the Netherlands, Portugal, and Belgium (6, 7).

To isolate BD001, intestinal samples were collected from shrimp and transferred to Brain Heart Infusion (BHI, Oxoid, UK) broth with 2% NaCl (FUJIFILM Wako Pure Chemical Corporation, Japan). After overnight bacterial enrichment at 37°C, samples were streaked multiple times onto thiosulfate-citrate-bile salts-sucrose agar (Oxoid, UK) to obtain pure colonies (8). Afterward, BD001 was phenotypically characterized by yellowish, round-shaped, and gram-negative staining (9). For genomic DNA extraction, a single colony from the original stock was cultured in BHI broth (2% salt) at 37°C for 10 h (10), followed by DNA isolation using the GeneJET Genomic DNA Purification Kit (Thermo Fisher Scientific, USA), according to the manufacturer's instructions. DNA purity and quantity were measured by Nanodrop (Thermo Fisher Scientific, USA). DNA library was prepared using the Nextera XT Library Prep Kit (Illumina, San Diego, CA, USA), and sequencing was performed on the Illumina MiSeq platform with UDPO101 adapters, where strain BD001 produced 1,012,822 paired-end spots and 471.1 million bases. Read quality was assessed using FastQC v.0.12.1 (11), and low-quality sequences were trimmed using Fastp v. 0.24.0 (12). High-quality reads were assembled into *de novo* genomes using SPAdes v.4.0.0 (13), and QUAST v.5.3.0 evaluated the assembly quality (14). Annotation was performed with NCBI Prokaryotic Genome Annotation Pipeline (15) and CheckM version 1.2.3 assessed completeness and contamination (16). Antibiotic resistance genes (ARGs), plasmids, and virulence factor genes were identified using ResFinder, PlasmidFinder, and VFDB, respectively, within the ABRicate tool on the Linux command line (17–19). RAST v2.0 web server was used to identify subsystems (20), and PathogenFinder v1.1 evaluated pathogenicity (21). BAGEL4 (22), gutSMASH v1.0 (23), and antiSMASH v7.0 (24)

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| Microbial Genetics | Announcement

Draft genomes of multidrug-resistant *Providencia manganoxydans* strains isolated from shrimp (*Penaeus monodon*) in Bangladesh

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ABSTRACT *Providencia manganoxydans is* gaining interest in aquaculture for its manganese-oxidizing function, with possible roles in detoxifying water and enhancing shrimp health. We initially report the genome sequencing of *P. manganoxydans* strains BD001 and BD002 (4.7 Mbp each) isolated from shrimp, with 40.7% and 40.0% GC contents, and 80× and 130× sequencing depths, respectively.

KEYWORDS draft genome sequence, *Providencia manganoxydans*, *Penaeus monodon*

Shrimp aquaculture is a developing global industry with a multiform set of farming systems (1–6) that are all impacted by various microbial communities (7–10). Both Gram-negative and Gram-positive bacteria frequently afflict such systems and either positively or negatively influence shrimp health and production (11). *Providencia manganoxydans* is a Gram-negative, manganese-oxidizing bacterium that has gained interest in shrimp aquaculture and has potential role in improving water quality and promoting shrimp health (12, 13). It converts soluble Mn(II) into insoluble Mn(IV), helping detoxify manganese-rich environments common in intensive aquaculture systems (14), reduces mineral stress, and limits harmful heavy metals bioavailability, which negatively impact shrimp (12). Although it has been less studied than traditional probiotics, unique manganese-oxidizing function highlights its potential as microbial tool for environmentally friendly shrimp farming practices.

P. manganoxydans was isolated from *Penaeus monodon* intestine, collected from a shrimp farm in Khulna, Bangladesh. Shrimp were dissected under sterile conditions, and intestinal tracts were aseptically removed using sterile forceps. The pooled intestinal samples were homogenized and enriched in Brain Heart Infusion (BHI, Oxoid, UK) broth supplemented with 2% NaCl. After overnight incubation at 37°C, enriched cultures were plated on Thiosulfate-Citrate-Bile Salts-Sucrose agar (TCBS, Oxoid, UK), yielding pure colonies (15). Identification of *P. manganoxydans* was done based on its characteristic colony morphology (yellowish, round shape) and Gram-negative staining (16). Species identification was further confirmed using the VITEK-2 System (v9.01) (17). Antibiotic susceptibility testing (AST) was performed using the disc diffusion method, following the CLSI and EUCAST 2024 guidelines (18). Genomic DNA was extracted using the GeneJET Genomic DNA Purification Kit (Thermo Fisher Scientific, USA) from the cultured broth, and quantity and purity were measured with Nanodrop (Thermo Fisher Scientific, USA). A DNA library was prepared using Nextera XT Library Prep Kit (Illumina, San Diego, CA, USA), and sequencing was performed on Illumina MiSeq platform with UDPO101 adapters, where strain BD001 produced 1.3 million paired-end reads (376.3 million bases), and strain BD002 generated 2.1 million paired-end reads (613.4 million bases). Quality control of the raw reads was conducted using FastQC v0.12.1 (19), and low-quality sequences were trimmed using Fastp v0.24.0 (20). The

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Influence of Weather and Water Quality Parameters on Aquatic Plant Production in Different Freshwater Ponds: Understanding Through Multiple Linear Regression Analysis

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ABSTRACT

Bangladesh is endowed with rich water resources and favorable climate conditions and ranks among the leading global countries of fish production. Despite this, the aquaculture industry of the country focuses mainly on finfish and shellfish, overlooking the potential of aquatic plants. Integrating aquatic plants into aquaculture in Bangladesh could promote sustainability, innovation, and ecological balance. To explore this potential, a six-month study was conducted using a 1m² standard quadrat sampling method across aquaculture, non-aquaculture, and derelict ponds to assess aquatic plant diversity and abundance. Employing a multiple linear regression (MLR) model, the study examined the relationship between plant abundance and environmental variables, including weather and water quality parameters. Thirteen aquatic plant species from ten taxonomic families were identified, with *Pistia stratiotes* (50%) being the most dominant, followed by *Lemna minor* (20%) and *Spirodela polyrrhiza* (7%). Free-floating species accounted for 78.2% of all plants observed, with the highest abundance found in derelict ponds. The MLR model had R^2 values of 0.670, 0.780, and 0.922 for aquaculture, non-aquaculture, and derelict pond, respectively. The independent variable (Number of plants/quadrat) showed a significant relationship with dependent variables, including rainfall, air temperature, water temperature, water depth, pH, dissolved oxygen, transparency, and for non-aquaculture and the derelict ponds, excluding the aquaculture pond. These findings indicate that aquatic plant diversity and abundance vary across water body types and are influenced by both climatic and physicochemical factors. Moreover, the results suggest that aquatic weeds hold considerable potential for integration into aquaculture systems through Integrated Multi-Trophic Aquaculture (IMTA) approaches.

INTRODUCTION

Aquaculture is one of the fastest-growing sectors in global food production, having overtaken capture fisheries as the leading source of aquatic foods

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RESEARCH ARTICLE

Prevalence and intersecting burdens of reproductive health morbidities among female fish farmers in the coastal region of Bangladesh

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ABSTRACT

Background: Female fish farmers in coastal Bangladesh face significant reproductive health (RH) challenges due to occupational, nutritional, and sociocultural factors. However, their health burdens have been largely overlooked in labor and health policies.
Objectives: This study aims to investigate the prevalence, severity, determinants, and emotional and relationship consequences of RH morbidities among female fish farmers in Shyamnagar, Satkhira, Bangladesh.
Methods: A cross-sectional survey with structured questionnaires was conducted among 297 female fish farmers. Data were supplemented by rural appraisal activities. Descriptive statistics, chi-square tests, Poisson regression, and Structural Equation Modeling were used for analysis.
Results: The study found that 59.60 % (177/297) of participants suffered from moderate to severe uterine issues, remarkably menstrual irregularities (92.65 %, 164/177), backache (59.32 %, 105/177), pelvic and fatigue pain (42.37 %, 75/177), anemia (28.24 %, 50/177), with the "21–30" year age group bearing a higher physiological burden with greater relational and emotional disruptions than "31–40" year age group, and "41–50" year age group women. High exposure to occupational chemicals (81.82 %, 243/297) and lack of personal protective equipment (93.94 %, 279/297) were key contributors. Access to formal healthcare is limited due to financial hardships (85.86 %, 255/297), social stigma (51.52 %, 153/297), and inadequate health services (46.47 %, 138/297). Structural Equation Modeling results also revealed significant associations among RH morbidities, emotional distress, social isolation, and diminishing well-being.
Conclusion: The study highlights the urgent need for integrated health policies addressing reproductive care, occupational safety, and mental health support for female fish farmers in coastal Bangladesh. Addressing these issues will improve their health, well-being, and resilience.

1. Introduction

Reproductive health (RH) is a fundamental human right and essential pillar of gender equity and sustainable development worldwide. Yet, millions of women in low-income and rural settings witness RH morbidities aggravated by socio-economic privation, environmental stressors, and occupational invisibility.[1] According to the World Health Organization and United Nations Population Fund, reproductive morbidities disproportionately affect women due to inaccessible RH care in rural and disaster-prone regions globally, with at least 257 million women lacking safe reproductive healthcare, concentrated in remote areas across South Asia and Sub-Saharan Africa.[2–4] These inequalities reflect structural separation,[5] methodical underinvestment in women's health,[6] and socio-cultural taboos[7] creating an "invisible crisis" for women's health documented in global health literature. In South Asia, including Bangladesh, where this burden is evident in sectors like husbandry,[8,9] aquaculture,[10,11] and cotton industries,[12,13] where women's labor is critical yet invisible. While studies on women in various industries such as brickfields,[14] tea colonies,[15] and husbandry[16] constantly shows an advanced rate of gynecological problems, aquaculture-specific risks have received much less attention, despite evidence that women handle fish feed, chemicals, and pond water without protective gear.[17,18] A recent study showed that 78 % of fisherwomen endured reproductive symptoms yet fewer than 10 % accessed formal care, highlighting a critical gap in research and intervention.[19] Beyond the occupational hazards, social and structural barriers prevent women's access to formal health-

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Review

Building Climate Resilient Fisheries and Aquaculture in Bangladesh: A Review of Impacts and Adaptation Strategies

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Abstract

This study examines the impacts of climate change on fisheries and aquaculture in Bangladesh, one of the most climate-vulnerable countries in the world. The fisheries and aquaculture sectors contribute significantly to the national GDP and support the livelihoods of 12% of the total population. Using a Critical Literature Review (CLR) approach, peer-reviewed articles, government reports, and official datasets published between 2006 and 2025 were reviewed across databases such as Scopus, Web of Science, FAO, and the Bangladesh Department of Fisheries (DoF). The analysis identifies major climate drivers, including rising temperature, erratic rainfall, salinity intrusion, sea-level rise, floods, droughts, cyclones, and extreme events, and reviews their differentiated impacts on key components of the sector: inland capture fisheries, marine fisheries, and aquaculture systems. For inland capture fisheries, the review highlights habitat degradation, biodiversity loss, and disrupted fish migration and breeding cycles. In aquaculture, particularly in coastal systems, this study reviews the challenges posed by disease outbreaks, water quality deterioration, and disruptions in seed supply, affecting species such as carp, tilapia, pangasius, and shrimp. Coastal aquaculture is also particularly vulnerable to cyclones, tidal surges, and saline water intrusion, with documented economic losses from events such as Cyclones Yaas, Bulbul, Amphan, and Remal. The study synthesizes key findings related to climate-resilient aquaculture practices, monitoring frameworks, ecosystem-based approaches, and community-based adaptation strategies. It underscores the need for targeted interventions, especially in coastal areas facing increasing salinity levels and frequent storms. This study calls for collective action through policy interventions, research and development, and the promotion of climate-smart technologies to enhance resilience and sustain fisheries and aquaculture in the context of a rapidly changing climate.

Keywords: fisheries and aquaculture; climate vulnerability; adaptation strategies; resilience; food security; Bangladesh

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1. Introduction

Climate change is reshaping human and natural systems worldwide, affecting not only ecosystems but also social formations, economies, and cultural relations [1]. The global

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Review

An Overview of Fish Disease Diagnosis and Treatment in Aquaculture in Bangladesh

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Abstract

Aquaculture has rapidly become a vital sector for ensuring global food security by meeting the growing demand for animal protein. Bangladesh, one of the world's leading aquaculture producers, recorded a production of 4.91 million MT in 2022–2023, largely driven by inland farming systems. Despite this remarkable growth, the sector is highly vulnerable to disease outbreaks, which are aggravated by different factors. Pathogens such as bacteria, viruses, fungi, and parasites cause significant losses, while conventional disease diagnosis in Bangladesh still depends mainly on visual assessment and basic laboratory techniques, limiting early detection. This narrative review highlights recent advances in diagnostics as molecular tools, immunodiagnostics, nanodiagnostics, machine learning, and next-generation sequencing (NGS) that are widely applied globally but remain limited in Bangladesh due to infrastructure gaps, lack of skilled manpower, and resource constraints. Current treatment strategies largely rely on antibiotics and aquaculture medicinal products (AMPs), often misused without proper diagnosis, contributing to antimicrobial resistance (AMR). Promising alternatives, including probiotics, immunostimulants, vaccines, and enhanced biosecurity, require greater adoption and farmer awareness. The near-term priorities for Bangladesh include standardized disease and AMR surveillance, prudent antibiotic stewardship, phased adoption of validated rapid diagnostics, and investment in diagnostic and human capacity. Policy-level actions, including a national aquatic animal health strategy, stricter antimicrobial regulation, strengthening diagnostic infrastructure in institution, are crucial to achieve sustainable disease management and ensure long-term resilience of aquaculture in Bangladesh.

Keywords: aquaculture disease; diagnostics; molecular tools; disease management; antibiotics; antimicrobial resistance (AMR); sustainability; Bangladesh

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1. Introduction

The rapid expansion of the global human population, increasing urbanization, and modern technology are transforming the world at a rapid pace and significantly increasing pressure on food production systems [1]. As a result, aquaculture has become a vital source of protein, responding effectively to this rising global demand [2–4]. Currently, aquaculture stands as the fastest-growing and most productive segment within the food production sector, exhibiting substantial potential to significantly boost fish output to meet future global

viruses

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Review

Combating White Spot Syndrome Virus (WSSV) in Global Shrimp Farming: Unraveling Its Biology, Pathology, and Control Strategies

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Abstract

White Spot Syndrome Virus (WSSV) is one of the most devastating viral pathogens affecting shrimp, causing severe economic losses to the global farmed shrimp trade. The globalization of live shrimp trade and waterborne transmission have facilitated the rapid spread of WSSV across major shrimp-producing countries since its initial emergence. The present review gives an updated account of WSSV biology, pathology, transmission dynamics, and recent developments in control measures. The virus, a double-stranded DNA virus of the *Nimaviridae* family, utilizes advanced immune evasion strategies, resulting in severe mortality. Shrimp lack adaptive immunity and hence rely predominantly on innate immunity, which is insufficient to mount an effective response against severe infections. Traditional disease control measures such as augmented biosecurity, selective breeding, and immunostimulants have, despite extensive research, achieved only limited success. New biotechnological tools such as RNA interference, CRISPR-Cas gene editing, and nanotechnology offer tremendous potential for disease mitigation. In parallel, the development of DNA and RNA vaccines targeting WSSV structural proteins, such as VP28, holds significant promise for stimulating the shrimp immune system. This review highlights the urgent need for a convergent approach to sustainable disease management in global shrimp aquaculture, with interdisciplinarity playing a pivotal role in shaping the future of WSSV control.

Keywords: WSSV; shrimp farming; co-infection; transmission dynamics; immunology

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1. Introduction

Shrimp aquaculture emerged as an international enterprise during the latter part of the 20th century, delivering nutrition- and protein-dense seafood to meet growing global market demand. With the boom of shrimp farming throughout much of Asia and beyond came a formidable foe: White Spot Syndrome Virus (WSSV), now one of the most virulent pathogens of shrimp in aquaculture. Since the emergence of WSSV in 1992, the global shrimp sector has suffered an estimated USD 8–15 billion in economic losses from this single disease [1,2]. For the Asian shrimp industry, a loss of about USD 20 billion due to WSSV

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Seasonal dynamics and factors shaping microbiomes in freshwater finfish earthen aquaculture ponds in Bangladesh

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Abstract

Background The pondwater microbiome is believed to play a key role in fish health, including shaping mucosal surface microbiomes that help to protect against disease. How different physiochemical features relating to season, geographical locations, as well as crop species shape the pond water microbiome in the finfish aquaculture system, is not well established. Pangasius (*Pangasianodon hypophthalmus*) and tilapia (*Oreochromis niloticus*) are two of the most widely farmed fish species and disease is a major impediment to the expansion of their production. We applied 16S and 18S rRNA metabarcoding to assess how pond physicochemistry and geographical location shape water microbiomes in pangasius and tilapia aquaculture earthen ponds in Bangladesh.

Results Planctomycetota, Pseudomonadota and Actinomycetota were the dominant bacterial phyla while Stramenopiles and Alveolata were the dominant microeukaryotes (divisions) in the pangasius and tilapia ponds water. The relative abundance of Planctomycetota was higher in the pangasius ponds compared with tilapia ponds, and Actinomycetota, and Pseudomonadota were relatively higher in tilapia ponds. Tilapia pond water also exhibited a higher microbial diversity compared to that in pangasius ponds. The pondwater microbial diversity was at its lowest in winter (and/or in monsoon) and highest in the pre-monsoon period. The microbial community structures differed across the different seasons, geographical locations, culture systems, and crop species, with season and geographical locations showing the strongest effects. Of the water physicochemistry features assessed, temperature and pH were found to have a weak but significant effect on the water microbiome content for both pangasius and tilapia ponds. Pangasius and tilapia ponds shared over 46% of ASVs, and around 30% of ASVs were shared across the different study geographical locations.

Conclusion Our findings demonstrate that microbial communities in pangasius and tilapia aquaculture systems in Bangladesh are shaped by season, geographical location, crop species, as well as effects from water physicochemistry. Our results provide insights into the dynamic nature and environmental influences on water microbiomes that may

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Regular Article

Living with vulnerability: Triple burden through the eyes of urban slum women in Bangladesh

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ABSTRACT

The urban residents who live in slums in Bangladesh are a marginalized group who live below the poverty line and are frequently deprived of standard livelihood amenities. The primary source of income of urban slum women is limited to a few options such as working in the garment industry, temporary domestic assistant (*chuta bua*), beggar, cleaner, street hawkers, brick-breaking in construction work, prostitution, etc., which are incredibly low-status and poorly paid work. They are excluded from mainstream society and thus are deprived of fundamental human rights such as nutrition, safe shelter, education, health services, electricity, healthy careers, and lifestyle. Unlike others, they lead highly miserable lives due to poverty, lack of capital, social negligence, stigma, crime, and violence. Additionally, their traditional roles, such as reproductive and productive works and community activities, force them to bear extra burdens. These roles became their utmost burden during the recent COVID-19 pandemic. On the one hand, they provide sufficient time, energy, and dedication to fulfill their responsibilities. On the other hand, they are highly undervalued in society. Therefore, this endeavor has focused on urban slum women who are marginalized and stigmatized by stereotypical patriarchal social structures. For that reason, 80 women from different occupations and age groups who live in various slums in Dhaka megacity were chosen as the sample. This study explains their triple burden by deconstructing their experiences through intensive research.

1. Introduction

Life is not a bed of roses for anybody; however, some humans on earth encounter the uttermost obstacles throughout their lives due to particular social structures. The urban slum dwellers in Bangladesh are one of that kind. The urban slum settlements mushroomed near industrial and commercial projects (Rahman, 2016). The sudden extension of the urban population is fueled by rural-to-urban migration in search of better opportunities and cash employment (Kamruzzaman & Hakim, 2016). On arrival, such poor people started to live in slum settlements located mainly on cheap and temporary vacant land (Panday, 2020). Slums are locally addressed as '*bastees*' which means a cluster of settlements that grow unsystematically and haphazardly on vacant land with poor living standards and a lack of basic amenities (Abascal et al., 2022; Latif et al., 2016; Rashid, 2009). They tend to migrate from the peripheral area of a country and are forced to live in unhygienic slums for economic reasons because they have no other affordable option (Ahmed, 2006). Most of them are resettled in slum areas due to poverty, better livelihood and job opportunities, river erosion, forced abandonment, and eviction (Hossain & Wadood, 2020). The high density of the population, absence of basic amenities, unhygienic sanitation, polluted environment, malnutrition, poor medical services, contaminated water, lower literacy rate, crime, and moral degradation, acute and chronic disease, and social stigma constitute a significant part of the livelihood of slum settlers (Alamgir et al., 2009; Rashid, 2009) (see Table 1).

Bangladesh is the eighth most densely populated country in the world, with around 168 million citizens. The growth rate of the population in this country has increased by 34% in 2015 and is expected to extend to 56% by 2050. (World Population Review, 2019). In the past 40 years, the urban population in Bangladesh has increased from 5% to 28% (Afsana & Wahid, 2013). Only in the capital city of Bangladesh, Dhaka, around 18.2 million people live, where approximately 1.06 million people live in slum areas, which is 24.39% of the total slum population of the country (Hossain & Wadood, 2020). There are

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Depression Intensity Identification using Transformer Ensemble Technique for the Resource-constrained Bengali Language

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ABSTRACT

Depression is an ordinary mental health-related disorder that hampers people's daily activities, and sometimes, it destroys an individual's life. It is one of the major social issues at present. Since depressed people use various social networking sites for sharing their thoughts and feelings, many scholars have tried to identify depression texts in highly resourced languages like English; however, only a small quantity of papers are detected in the resource-constrained Bengali language. This paper focuses on developing a depression intensity detection system from Bengali text data. In this regard, this study experiments on a 2,596 sample-sized dataset with four levels of depression by utilizing five state-of-the-art transformer models, including multilingual Bidirectional Encoder Representations from Transformers, DistilmBERT, XLM-RoBERTa, Bangla-BERT-Base, and BanglaBERT, and suggests a new ensemble method called MaxOfAvgProb. This method goes beyond the performance of the previous work on the same dataset, scoring 63.47% F1-score and 62.90% accuracy. To increase the reliability of the proposed method, we utilize this approach on another available dataset with 4,897 entries. In this case, our recommended method also surpasses the performance of the existing work on the same dataset, with accuracy at 86.45% and F1-score at 86.35%. Identifying the intensity of depression, depressed people may get proper counseling or treatment from their respected guardians or psychologists according to the victims' level of depression.

Keywords: Bengali, Classification, Depression, Resource-constrained Language, Transformer Ensemble.

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1 Introduction

Depression is a prevalent and severe mental condition that exerts a significant effect on individuals. It undermines people's self-worth, positive thinking, and motivation, making it more challenging to make progress towards self-improvement. It is also a chronic illness that disrupts day-to-day functioning. Depression can be influenced by a complex interplay of factors, including genetic predisposition, adverse life experiences (including both traumatic events and childhood trauma), social isolation, and certain personality traits. Worldwide, depression is considered the leading cause of suicide. Furthermore, more than 70 million people lose their lives to suicide every year. Moreover, the fourth most common cause of mortality for people aged 15 to 29 is suicide [1].

The worldwide landscape reveals a concerning occurrence of moderate to severe levels of depression, which stands at 43%, with anxiety affecting 63% and stress impacting 41% of the population [2]. While the discourse on mental health issues may not be as widespread, the growing threat is particularly evident in low- and middle-income countries such as Bangladesh.

In the context of mental health in Bangladesh, as indicated in [3], the range of prevalence for mental illnesses in adults is 6.5% to 31.0%, and for children, it is 13.4% to 22.9%. According to a recent study, over 7 million people in Bangladesh, mostly in urban and metropolitan areas, struggle with anxiety and depression, which highlights the severity of the issue [4]. Numerous studies have demonstrated the high frequency of depression among college and university students, which is noteworthy [5]. Moreover, a survey emphasizes the dual effect, showing that 24% of students experience both anxiety and depression at the same time [6].

At present, people from all around the world share their sorrows and pains on different social media platforms, such as Facebook, Twitter, and others. The people of Bangladesh are no exception to this use. As a result, we concentrate on text data in Bengali that has been collected from well-known social networking platforms like Facebook. Many machine learning (ML), deep learning (DL), and transformer models are exploited to classify Bengali text data in different domains like cyberbullying [7], accident-related news [8], and others. We have also identified numerous scholarly works regarding the detection of depression. However, the majority of these studies used traditional ML and DL classifiers to study binary classification problems (depression or not) [9]–[13]. A few investigations dealt with multi-class classification problems from emotional perspectives, such as anger, fear, disgust, sadness, joy, surprise, and others [14], [15]. Moreover, a few scholars developed depression severity detection systems [15]–[17]. Consequently, this research employs five transformer models, including multilingual Bidirectional Encoder Representations from Transformers (mBERT), DistilmBERT, XLM-RoBERTa (XLM-R), Bangla-BERT-Base, and BanglaBERT, and designs an effective depression intensity recognition system using a transformer ensemble method, MaxOfAvgProb, from the Bengali text data. The key contributions of this paper are outlined below:

- Rigorous experimenting on the Bengali depression severity dataset with four classes.

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Effect of Defect Density Variation in Cdte Solar Cell Using Cu as A Hole Transport Layer and Back Contact

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Abstract – *Cadmium Telluride (CdTe) solar cells have the potential to achieve high efficiency, but material defects present a significant challenge to their performance. These defects act as recombination sites, capturing electrons and holes, thereby hindering current flow and reducing the overall efficiency of the CdTe solar cells. Addressing these defects is crucial for enhancing charge carrier transport and optimizing efficiency. This research paper analyzes the effect of defect density numerically using SCAPS-1D simulation software on SnO_2/CdTe/CdS/Cu multi-junction structural solar cells. The performance parameters of the proposed cell are optimized by varying different numerical particulars. Our analysis reveals that by varying the defect density from 10^{12} to 10^{18} cm^{-3}, the efficiency of the proposed solar cells varies from 17.65% to 2.56%, with the open-circuit voltage (Voc) at 0.85V, short-circuit current density (Jsc) at 26 mA/cm², and fill factor (FF) at 82%. The efficiency optimization is attributed to the conduction band effective density of states, $Nc = 2.2 \times 10^{18}$ cm^{-3}, and valence band effective density of states, $Nv = 1.8 \times 10^{19}$ cm^{-3} of the donor material (SnO_2). The cell's power conversion efficiency is optimized when the absorber has a balanced concentration of neutral, acceptor, and donor defects at 1×10^{14} cm^{-3}. At an operating temperature of 300 K, an efficiency of 18% is achieved.*

Keywords: *Cadmium telluride (CdTe) solar cell, Defect density, Recombination sites, Solar cell performance*

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I. Introduction

Research on CdTe solar cells has been ongoing since the mid-20th century to improve their efficiency for enhanced solar energy utilization [1]. These cells are of great interest due to their excellent performance. Recent studies have shown that their efficiency can exceed 22% [2] – [4]. CdTe solar cells are considered to be one of the most promising solar cell technologies for the future. They are relatively inexpensive to manufacture due to abundant raw materials, simple manufacturing processes, thin-film technology requiring less material, and scalable production and have a high absorption coefficient of 5×10^5 cm^{-1}, which means that they can absorb a large amount of sunlight approximately 400 to 800 nanometers (nm). The direct band gap of CdTe (1.5 eV) is also well-matched to the solar spectrum, which means that it can absorb photons from a wide range of wavelengths. This makes CdTe solar cells a very efficient way to convert sunlight into electricity [5] – [6]. Incorporating desirable attributes of CdTe's absorption characteristics, the presence of n-type material is imperative for the optimal formation of a high-quality p-n junction. Notably, Cadmium Sulphide (CdS) stands out as a prominent candidate, showcasing exceptional capabilities due to its direct band-gap of approximately 2.42 eV within the visible spectrum.

The transparent nature of CdS enables solar irradiation to transmit through the CdTe layer, thereby enhancing the photovoltaic response. [7] – [8]. Conversely, the heterojunction CdTe/CdS solar cell necessitates the integration of a transparent conducting oxide (TCO) layer at its front contact. This strategic inclusion allows photons to enter the cell, with the active interface acting as an electrode to efficiently collect the generated current. [9] – [11]. Notably, transparent conducting oxide (TCO) layers commonly employed for this purpose include Fluorine-doped Tin Oxide (SnO_2:F or FTO) and Aluminum-doped Zinc Oxide (ZnO: Al or AZO) [12] – [13]. These materials play a pivotal role in enabling photon transmission and effectively harnessing current at the active interface of the heterojunction CdTe/CdS solar cell [14] – [15]. Incorporating a high-resistive transparent (HRT) film

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Design and simulation of HTL-free $CuBi_2O_4$ based thin film solar cells for performance efficiency above 36%

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Abstract – *The quest for efficient and sustainable energy solutions has propelled the exploration of novel materials and strategies for enhancing the performance of thin-film solar cells (TFSCs). This work presents a comprehensive investigation into the potential of $CuBi_2O_4$ based TFSCs as a viable candidate for high-efficiency photovoltaic devices. Through rigorous numerical simulation utilizing the SCAPS-1D software, this study delves into the intricate interplay of material properties, layer characteristics, and design strategies to unlock the untapped potential of $CuBi_2O_4$ based SCs. The study extensively investigates the influence of thickness, doping levels, and defect densities of each absorber on electrical properties like open-circuit voltage (V_{oc}), short-circuit current density (J_{sc}), fill factor (FF), and power conversion efficiency (PCE). The simulation results reveal a remarkable achievement, with a recorded efficiency of 36.04%, FF of 81.11%, J_{SC} of 32.15 mA/cm², and V_{OC} of 1.38 V. These findings point to the potential of thin-film SC based on $CuBi_2O_4$ as a greener and more efficient photovoltaic option. As an absorber material for next-generation SC, $CuBi_2O_4$ exhibits potential with an efficiency of 36.04%. This investigation advances $CuBi_2O_4$-based thin-film SC and provides light on sustainable energy solutions.*

Keywords: $CuBi_2O_4$, ZnS, ETL, Solar cell, SCAPS-1D.

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I. Introduction

A huge and noticeable shift is taking place in energy production and consumption patterns across the globe as a result of the growing demand for sustainable and environmentally friendly alternatives. Solar power stands out among these options as the most promising long-term energy solution since it is dependable, safe for the environment, and sustainable [1].

Solar energy stands out as a crucial renewable resource on a global scale, offering a promising solution to address the impending energy challenges. The market of global photovoltaic (PV) devices has grown rapidly over the last decade. Thin-film solar cells (SC) represent a promising avenue within the realm of solar energy technologies. A substrate, which can be made of materials like metal, glass, or plastic, is covered with a single or several thin layers of photovoltaic material to generate second-generation SC [2]. Second-generation SC using cadmium telluride (CdTe) and copper indium gallium selenide (CIGS) has achieved 21% and 21.7% efficiency, respectively [3], [4], [5], [6]. Commercially,

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Development of Chitosan-Based Hydrogel Containing Polyvinyl Alcohol, Cellulose, and ZnO Nanoparticles for Potential Biomedical Applications

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Abstract

Waste materials such as chitosan-rich shrimp shells and cellulose-containing sugarcane bagasse are discarded in substantial quantities worldwide. These by-products hold untapped potential for creating sustainable biomaterials, such as hydrogels, for biomedical applications. This research bridges sustainable development and biomedical engineering by producing a biocompatible, thermally stable, mechanically optimized, and infection-resistant hydrogel. The study examines a composite hydrogel formulated from chitosan, polyvinyl alcohol (PVA), Tannic acid (TA),and zinc oxide nanoparticles (ZnONP), with glutaraldehyde and gelatin powder as a cross-linking agent. Glutaraldehyde enhances cross-linking with chitosan's amine groups, improving the hydrogel's thermal stability, while ZnONP functionalization enhances its antibacterial properties. Comprehensive evaluations covered structural integrity, cell viability, swelling ratio, water vapor transmission rate, pore size, and mechanical and thermal properties. Analytical techniques such as FTIR and XRD confirmed favorable swelling ratios, porosity, and water vapor permeability, highlighting the hydrogel's suitability for wound dressings. By achieving optimal degrees of swelling (DSR) and water vapor transmission rates (WVTR), the chitosan-based PVA/cellulose/ZnONP hydrogel demonstrates promise for advanced wound healing applications, supporting both skin restoration and infection control. The novelty lies in the way of approach to bring sustainability and biomedical engineering together.

Keywords: Hydrogel, Chitosan, Tannic acid, ZnO nanoparticles, Cellulose fiber.

I. Introduction

To address the high demand for sustainable materials, this research focuses on developing a chitosan-based hydrogel from recyclable, natural materials, specifically chitosan derived from shrimp shells and cellulose from sugarcane bagasse. The primary goal is to bridge the gap between sustainability and biomedical applications, contributing to environmental preservation and potential advancements in wound care. Wound healing is a complex physiological process involving a sequence of cellular events to repair damaged tissue[1]. In recent years, hydrogels have emerged as promising candidates for wound dressings due to their high biocompatibility, moisture retention, and capacity to maintain a conducive environment for wound healing[2]. Among these, chitosan-based hydrogels are particularly notable for their biodegradability, biocompatibility, and inherent antibacterial activity, properties that make them especially suited for chronic wound care[3,4]. Natural antibacterial effect of chitosan, derived from its polycationic structure, can help to prevent and control infections at the wound site[5]. To further enhance the functionality of chitosan hydrogels, researchers have explored involving additional components such as polyvinyl alcohol (PVA) and cellulose, which improve mechanical strength, water absorption, and durability[6].

Tannic acid (TA), a special kind of polyphenol, has cyclic glucose and five digalloyl groups[7,8]. TA possesses weak acidity because of its large number of phenolic hydroxyl groups and it ionizes at a pH value higher than 4.5, and it will possess negative charges in an aqueous solution after ionization[9,10]. TA can be considered a good modifier to improve the surface properties because it is negatively charged in solution and has high adhesiveness on various nonporous or porous substrates[11-13]. So, TA addition does improve the quality of biomaterials in general.

A key advancement in hydrogel formulation involves the addition of ZnONPs, known for their potent antibacterial activity and ability to stimulate tissue regeneration. ZnONPs have shown effectiveness against a broad spectrum of bacterial pathogens, making them ideal for wound care applications, where infection control is critical[14,15].

An ideal hydrogel's biocompatibility, coupled with its tunable porosity, makes it applicable for tissue engineering

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In Silico Molecular Docking Studies and Pharmacokinetic Property Analysis of Phytocompounds from *Camellia sinensis* Targeting MCM2 Protein as Anti-Cancer Agent

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Abstract

Minichromosome Maintenance Complex Component 2 (MCM2) is a replicative helicase system subunit that is a major prognostic and proliferation marker for gastric, oral, breast, and colon cancers. During the replication procedure, it combines with histones named H3 and H4 by their N-terminal domain to help the assembly and disassembly of nucleosomes on DNA. MCM2 inhibition slows tumor cell growth and causes G0/G1 phase arrest, but it has little effect on cell apoptosis. Due to its complex structural composition and crucial involvement in DNA replication and regulation interface, MCM2 is a potential target for drug discovery. Traditional herbs are gradually gaining popularity. Beneficial functions of phytochemicals include low toxicity, low cost, availability, antioxidant activity, antibacterial action, regulation of detoxification enzymes, regulation of hormones, etc. The signaling pathway of many diseases alters simultaneously, and mutations happen in new ways, due to these reasons, discovering new drug candidates has become badly needed. Through Molecular docking study of compounds, pharmacokinetic property analysis, quantitative structure-activity relationship analysis, and drug-protein interaction against MCM2 protein, this work proposes phytochemical screening of the green tea plant (*Camellia sinensis*) to select the most potential drug compound to inhibit MCM2 protein.

Keywords: MCM2, phytochemicals, *Camellia sinensis*, antioxidant activity, antibacterial action, detoxification enzymes.

I. Introduction

Despite there are several advances in treatment procedures, cancer occupies the first position in global mortality. Effective conventional therapies that lack specificity cause adverse side effects as well as systemic toxicity. This limitation has spurred the pursuit of targeted therapies aimed at specific molecular pathways critical for tumor growth and survival. The Minichromosome Maintenance Complex Component 2 (MCM2) protein has become a promising target. An MCM family member, MCM2 helps build the replication initiation complex[1]. Proteins of 101,896 Da and 904 amino acids are encoded[2]. MCM2 directly binds to DNA replication origins and regulates gene expression to unwind DNA or start replication[3]. MCM2 is the most extensively studied MCMs and is a biomarker for carcinoma diagnosis. High expression of MCM2 is found in solid tumors but is suppressed in normal samples, making MCM2 a potential marker for carcinoma groups. MCM2 is constitutively expressed in, for example, lung cancer tissue samples[4] and ovarian cancer tissue samples, making it a potential therapeutic target[5]. According to these studies, MCM2 knockdown significantly improved ovarian cancer chemoresistance to carboplatin and olaparib. Recent studies have shown that MCM2 is recognized as a key molecule in various cancer-causing genes such as CAMKK2 and MEK1[6].

Plants have served as a foundational source for medicine throughout history, and many contemporary pharmaceuticals are derived from or inspired by plant-based compounds[7,8]. Developing a new drug is complex, often involving high costs and extended timelines, with multiple clinical trials required to ensure safety and efficacy. *Camellia sinensis*, or green tea, is a widely researched plant biochemically rich in epigallocatechin gallate (EGCG), epicatechin, and catechin with antioxidant, anti-inflammatory, and anti-cancer properties. EGCG has been shown to inhibit the growth of cancer cells by modulating key signaling pathways, such as the ones in PI3K/AKT and MAPK pathways[9]. Still, the efficacy of C. sinensisphytocompounds in inhibiting the function of MCM2 protein is untouched.

Previous studies have highlighted the importance of MCM2 as a potential target for therapy. For example, Su(2021) demonstrated that synthetic small molecules can effectively disrupt the MCM2-MCM7 complex, decreasing cancer cell proliferation[10]. Likewise, Wang (2020) recognized MCM2 as a biomarker for cancer progression and a promising target for early treatment. However, there is still a limited exploration of natural products, especially phytocompounds, as MCM2 inhibitors. This gap in the literature is significant, as natural products provide unique benefits, such as structural diversity and lower toxicity[11].

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Research paper

Perturbation method for laminar flow of viscous incompressible fluid between two porous boundary walls

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Abstract

The present study focuses on the investigation of the velocity profile of viscous fluid between two parallel porous walls while fluid is being ejected from both channel walls at the same rate. The distributions of velocity, pressure and shear stress were determined theoretically for incompressible, steady, fully developed laminar flow past a porous boundary wall. Due to the pressure difference across the porous wall, there is ejection or injection into the wall. The velocity specified as the boundary condition at the wall has been used to explore fluid flow phenomena in porous tubes and ducts. The variable wall velocity is based on the pressure differential across the wall, the fluid characteristics, the thickness of the wall, and the permeability of the structure. An appropriate wall condition must take these factors into account. This paper discusses a Reynolds number solution. We seek formulas for the velocity component. The perturbation approach is used to solve the governing differential equation and the general solution of the velocity is obtained for higher terms of Re. Fifth term of perturbation is used in the perturbation method. The velocity of the fluid is analyzed for different values of Re for a boundary condition. Finally, the result is analysis graphically for the range of Re from .1 to 50. In addition, another strategy is used to keep the Reynolds number constant when the diameter of the hole in the porous wall changes, i.e., changing the value of λ.

Keywords: *Laminar Flow; Perturbation Method; Reynolds Number; Dimensionless Parameter; Newtonian Fluid.*

1. Introduction

The problem of laminar flow in channels or paths with porous boundary walls has numerous applications in various branches of engineering and technology, such as boundary layer control, transpiration cooling problems, extraction of plastic sheets, cooling of infinite metallic plates in a cool bath, liquid film condensation process and fields of glass and polymer industry. Due to the vast range of applications to particular engineering issues, the fluid flow via porous surfaces, pipes, and channels has studied. It has been analytically examined and used to lower the wall temperature of combustion chambers in rocket motors and to cool reentry bodies by injecting coolant through porous walls. It has proven possible to control boundary layers by draining fluid via porous surfaces. Other engineering issues that have seen widespread use of cellular surfaces include wave attenuation in fluidic circuits, gaseous diffusion processes, and jet engine noise reduction. The solution for the velocity profile and pressure distribution in a porous channel were firstly proposed by Berman (1953) for small suction value assuming no sliding at the porous wall. This was later extended to large suction and injection values by White et al. (1958) and Terrill (1964). Beavers and Joseph (1967) demonstrated the existence of shear velocities at porous boundaries, in their mass flow experiments. Analytical expressions for the velocity profile and axial pressure drop were reported by Singh and Laurence (1979) for small values of wall suction allowing fluid to slide at porous walls. Kaviany (1991) provides an excellent review of previous work in related areas. They presented the solution of the two-dimensional Navier-Stokes equation for shear flow in a channel with two equal porous walls at any arbitrary wall speed allowing for both suction and injection forces. J.L. Lage, M.J.S de Lemos, and D.A. (2002) Nield research on transport phenomena in porous media which was based on the studies of Antohe, B.V and Lage, J.L. (1997) , Bear, J.(1972) where they studied on turbulence model for incompressible flow in porous medium and Dynamics of fluid in porous medium. Later on, Ochoa Tapia, J.A and Whitaker, S (1995) studied on the momentum transfer at the boundary between a porous medium. The limitations of the Brinkman-Forchheimer equation in modeling flow in a saturated porous medium was studied by Nield, D.A. (1991) also Convection in porous media was studied by Nield, D.A. and Bejan, A. (1999).

The flow of a viscous fluid through a porous channel with a rectangular cross-section, when the Reynolds number is low, was investigated and a disturbance solution assuming equal normal velocities of the walls was obtained. Berman (1953). Vafai K and S. J. Kimi (1990) studied the fluid mechanics of the interface region between the porous medium and the liquid layer - an exact solution. Saffman P.G. (1971) studied boundary conditions on the surface of porous media. Das S.S. and UK Tripathy (2010) studied the effect of periodic suction on three-dimensional flow and heat transfer through a vertical foam plate embedded in a porous medium. Terrill (1964) studied laminar flow

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Prevalence and Determinants of Stress among University Students in Bangladesh: Insights from a Study at Gopalganj Science and Technology University

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Abstract

Stress is a significant mental health concern among university students globally, yet research in Bangladesh often addresses it alongside other mental health issues, leaving stress-specific insights underexplored. This study focuses on stress as an independent factor, examining its prevalence and the associated determinants among students at a Bangladeshi university. A cross-sectional survey was conducted among 384 students from Gopalganj Science and Technology University, Gopalganj, Bangladesh, using the BDASS-21 scale to measure stress levels. To ensure a representative sample, the researchers employed a stratified random sampling technique. Chi-square and two-sample t-tests were employed to assess the relationship between stress levels and independent variables. A logistic regression model identified significant predictors of stress, with a 5% level of significance applied to determine statistical relevance. The prevalence of stress was 62.50% among the surveyed students. Logistic regression analysis revealed several significant predictors of stress. Students from joint families were found to be four times more likely to experience stress (OR = 4.05, 95% CI: 1.43–11.42, p = 0.01) compared to those from nuclear families. Engagement in a relationship (OR = 3.91, 95% CI: 1.28–11.99, p = 0.02) and smoking habits (OR = 4.51, 95% CI: 1.46–13.92, p = 0.01) were also associated with elevated stress levels. Additionally, lack of physical exercise and dissatisfaction with social life were significant contributors to stress. Over half of the university students in this study reported experiencing stress, with higher risks observed among those engaged in relationships, from joint families, and with smoking habits. Targeted interventions addressing these high-risk groups, including promoting healthy lifestyles and social support, are recommended for policymakers and university authorities to mitigate stress and improve student well-being.

Keywords: Stress, BDASS-21, Mental Health, University Students, Cross Sectional.

AMS Classification: 62P15, 62P25.

1. Introduction

Mental health disorders, identified by the World Health Organization (WHO) as significant contributors to global disability, account for three of the top ten causes of disability among

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Circulating Non-Esterified Free Fatty Acids in Bangladeshi Patients with Type-2 Diabetes: A Cross-Sectional Analysis

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ABSTRACT

Background and Objectives: Free fatty acids (FFA) significantly influence the relationship between obesity, insulin resistance, and type 2 diabetes. Elevated plasma FFA levels, common in obese individuals, inhibit insulin-stimulated glucose uptake in muscle tissue, indicating peripheral insulin resistance. This study examines the levels of non-esterified free fatty acids (NEFAs) in type 2 diabetes patients in Bangladesh to understand their role in the disease and inform management and treatment strategies.
Materials and Methods: In this cross-sectional study, 134 participants were involved: 100 had previously been diagnosed with type-2 diabetes and 34 served as a non-diabetic control group. Among the diabetic individuals, 60% were newly diagnosed with type-2 diabetes mellitus, 28% had been previously treated but had uncontrolled diabetes, and 11% had been treated and had controlled diabetes and 0.75% had gestational diabetes. The sample included 42.5% males and 57.5% females. Sociodemographic and health data, including BMI, hypertension, cardiovascular history, and lifestyle habits, were collected through questionnaires. Blood pressure was measured per ACC/AHA guidelines. Blood samples were analyzed for glucose, NEFA, and lipid profiles using automated analyzers. NEFA estimation followed specific reagent procedures, while lipid profiling assessed total cholesterol, HDL, LDL, and triglycerides per ADA guidelines. Data were analyzed using Excel and SPSS, with significance set at $p<0.05$.
Results: NEFA levels were significantly higher in diabetic patients (647 µM/L) compared to healthy controls (331.5 µM/L). Significant associations were found between NEFA levels, insulin resistance, and diabetes. Controlled diabetics had lower NEFA levels than uncontrolled ones. Lifestyle factors like work hours and exercise habits correlated with NEFA levels, highlighting their importance in diabetes management.
Conclusion: Elevated NEFA levels are common among diabetic patients in Bangladesh, influenced by disease control status and lifestyle factors. Effective diabetes management

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Editorial

Unveiling the intriguing role of nuclear microRNA-34a: A journey from discovery to functional exploration

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Abstract

MicroRNAs (miRNAs) are endogenous ~22 nt RNAs. miRNAs are traditionally considered primarily cytoplasmic molecules that regulate gene expression posttranscriptionally by targeting mRNAs for degradation or translational repression. In the canonical pathway of biogenesis, pri-miRNAs are transcribed from DNA sequences inside the cell nucleus. Pri-miRNAs are then processed by Drosha into pre-miRNAs and exported to the cytoplasm via the exportin 5 (XPO5)/RanGTP complex. Pre-miRNAs are then processed into mature miRNA duplexes by the RNase III endonuclease Dicer. In the intricate world of molecular biology, the discovery of mature microRNA-34a (miR-34a) inside the nucleus of atypical rat kidney epithelial cells (karyomegalic cells) has ignited scientific curiosity, revealing its multifaceted roles in cellular processes. This perspective embarks on a journey, beginning with the groundbreaking work and culminating in the recent breakthrough, shedding light on the association of miR-34a with cell proliferation and its exploration within the nuclear landscape. Other examples of mature miRNAs that have been reported to be present inside the nucleus include miR-21, miR-122, miR-223, and miR-29b.

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MicroRNAs (miRNAs) are endogenous ~22 nt RNAs. miRNAs are traditionally considered primarily cytoplasmic molecules that regulate gene expression posttranscriptionally by targeting mRNAs for degradation or translational repression (Bartel, 2004). In the canonical pathway of biogenesis, pri-miRNAs are transcribed from DNA sequences inside the cell nucleus. Pri-miRNAs are then processed by Drosha into pre-miRNAs and exported to the cytoplasm via the exportin 5 (XPO5)/RanGTP complex. Pre-miRNAs are then processed into mature miRNA duplexes by the RNase III endonuclease Dicer (O'Brien *et al.*, 2018). In the intricate world of molecular biology, the discovery of mature microRNA-34a (miR-34a) inside the nucleus of atypical rat kidney epithelial cells (karyomegalic cells) has ignited scientific curiosity, revealing its multifaceted roles in cellular processes. This perspective embarks on a journey, beginning with the groundbreaking work of Dutta *et al.* (2007) and culminating in the recent breakthrough by Ohno *et al.* (2022), shedding light on the association of miR-34a with cell proliferation and its exploration within the nuclear landscape. Other examples of mature miRNAs that have been reported to be present inside the nucleus include miR-21, miR-122, miR-223, and miR-29b (Billi *et al.*, 2024).

Dutta *et al.* (2007) laid the foundation for our understanding of miR-34a by revealing its nuanced relationship with cell proliferation. Their pioneering research illuminated how dysregulation of miR-34a profoundly influences cell proliferation, prompting extensive investigations into its regulatory mechanisms and downstream effects.

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Through meticulous in situ hybridization experiments, they revealed a striking pattern: while mature miR-34a exhibited robust expression in approximately 50% of human cancers, its presence was nearly negligible in many others. This finding underscores the context-specific nature of the impact of miR-34a, suggesting a sophisticated view of its functional role. The work of Dutta *et al.* (2007) not only expanded our comprehension of miR-34a but also set the stage for subsequent breakthroughs in the field.

Dutta *et al.* (2007) revealed the unexpected presence of mature miR-34a within the nucleus of rat kidney cells (karyomegalic cells) during their in situ microRNA detection experiment with rat kidney cells. Subsequently, Ohno *et al.* (2022) elucidated the involvement of nuclear miR-34a in facilitating the release of paused RNA polymerase II (Pol II) through the DDX21-CDK9 complex. These findings expand our understanding of miR-34a beyond its established role in the cytoplasm, revealing a novel layer of regulatory control within the nucleus. The identification of nuclear miR-34a has challenged the conventional notion that microRNAs predominantly function in the cytoplasm, opening avenues for further exploration.

The journey from Dutta *et al.* (2007) seminal observations of mature miR-34a in the nucleus to Ohno *et al.* (2022)'s recent insights underscores the dynamic nature of miR-34a. The nuclear localization of miR-34a prompts intriguing questions about its specific targets and the regulatory networks it modulates within the nucleus. Recent studies suggest that nuclear miR-34a may regulate genes involved in crucial cellular processes, including DNA repair, cell cycle progression, and apoptosis. Its interaction with the DDX21-CDK9 complex may play a role in modulating the transcriptional landscape by facilitating the release of paused RNA Pol II. This was the first experimental demonstration that miR-34a functions in RNA activation (RNAa). RNAa is a process in which small RNAs such as miRNAs upregulate gene expression rather than suppress it. This newfound dimension adds complexity to the functional implications of miR-34a, urging

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Editorial

The gradual discovery of cell-type and context specificity of microRNAs

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Abstract

The discovery of microRNAs (miRNAs) has revolutionized our understanding of gene regulation, particularly through their cell-type and context-specific functions. This perspective explores the gradual realization of miRNA specificity, beginning with the identification of *lin-4* in *Caenorhabditis elegans* and progressing to the discovery of tissue-specific miRNAs such as miR-122 in the liver and miR-1 in muscle. A central focus is miR-34a, one of the most studied miRNAs, which exemplifies the importance of cellular context in miRNA function. miR-34a's role in tumor suppression via the p53 pathway, demonstrating that its ability to induce apoptosis and cell cycle arrest depends on the cellular environment. miR-34a overexpression can have diverse effects on cell proliferation, ranging from strong suppression in certain cell types to minimal or paradoxical responses in others. In situ analysis of rat tissues revealed tissue-specific expression of miR-34a, with high levels in cerebral neurons and Purkinje cells and faint expression in renal, hepatic, and myocardial tissues. These findings suggest that miR-34a plays distinct roles depending on the tissue, contributing to homeostasis in some contexts while exhibiting a lesser regulatory role in others. This review synthesizes key studies that underscore the critical role of miRNAs, such as miR-34a, in regulating gene expression in a tissue and context-specific manner, providing insights into both normal physiology and disease pathogenesis.

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Since their discovery in the early 1990s, microRNAs (miRNAs) have emerged as pivotal regulators of gene expression, influencing a wide range of biological processes. Early studies focused on understanding the general regulatory functions of miRNAs, but subsequent research has revealed their intricate cell-type and context-specific roles. This gradual process of discovery has unveiled the complexity of miRNA regulation and their functional specificity, contributing significantly to our understanding of development, disease, and tissue-specific regulation.

The journey of miRNA research began with the landmark discovery of *lin-4* in *Caenorhabditis elegans* by Lee *et al.* (1993). This small RNA was found to regulate the *lin-14* gene, introducing the world to miRNAs. However, it was not until subsequent studies that the tissue-specific roles of these molecules were revealed.

A major breakthrough in tissue-specific miRNA expression came with the identification of miR-122 as a liver-specific miRNA by Lagos-Quintana *et al.* (2002). This finding linked miRNAs to organ-specific functions, shedding light on their role in tissue homeostasis and metabolic regulation. Subsequently, the identification of miR-1 as muscle-specific highlighted the importance of miRNAs in organ development, particularly in muscle differentiation and growth (Chen *et al.*, 2006).

These early discoveries were crucial in shifting the focus of miRNA in different tissues. The realization that miRNAs could have distinct expression patterns depending on the tissue or organ marked the beginning of the concept of miRNA specificity in biological systems.

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One of the most studied miRNAs, miR-34a, exemplifies the importance of cellular context in miRNA function. Its role in tumor suppression, particularly through the p53 pathway, was demonstrated in a seminal paper by He *et al.* (2007). The study showed that miR-34a could induce apoptosis and cell cycle arrest, but these effects were dependent on the cellular context. miR-34a's ability to mediate different outcomes based on the cell type it operates in underscores the complexity of miRNA regulation.

The context-dependent nature of miR-34a activity was further underscored by Dutta *et al.* (2007). We demonstrated that miR-34a overexpression could elicit diverse effects on cellular proliferation, depending on the cell type. Our research revealed that miR-34a, a well-established tumor suppressor, exerts variable influences on cell growth. In certain contexts, miR-34a inhibits proliferation by down regulating targets involved in cell cycle regulation and apoptosis. However, the study revealed that miR-34a overexpression does not universally suppress cell growth. In specific cell types, the response was minimal or even paradoxical, suggesting that miR-34a's effects are intricately tied to the cellular environment.

Dutta *et al.* (2007) also conducted an *in situ* analysis of healthy rat tissues, providing additional evidence for the tissue-specific expression of miR-34a. They observed significant variations in miR-34a levels across different tissues, with cerebral neurons and Purkinje cells exhibiting the highest expression. In contrast, normal renal tubules, hepatocytes, and myocardial cells showed faint expression. This differential expression suggests that miR-34a plays distinct functional roles depending on the tissue type. In tissues where miR-34a is highly expressed, it may be involved in maintaining homeostasis by regulating cell turnover. Conversely, in tissues with lower miR-34a expression, its regulatory role might be less pronounced. These findings reinforce the notion that miR-34a's effects on cellular processes, including proliferation and cell cycle regulation, are intricately linked to the local cellular context.

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Review Article

CRISPR-dCas9-mediated CpG island editing: A potential game-changer for diabetes treatment

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Abstract

Type 2 diabetes mellitus (T2DM) is a chronic metabolic disorder characterized by hyperglycemia. Current therapeutic strategies primarily manage symptoms, leaving a substantial unmet need for curative interventions. This review explores the potential of CRISPR-dCas9-mediated CpG island editing as a promising therapeutic approach for T2DM. CpG islands, DNA regions enriched in cytosine-guanine dinucleotides, play a pivotal role in gene regulation. Their methylation status significantly influences gene expression. By targeting specific CpG islands within genes involved in glucose metabolism and insulin signaling, CRISPR-dCas9 can modulate gene expression and restore metabolic homeostasis. A particular focus is placed on the TXNIP gene, implicated in T2D pathogenesis. Reprogramming TXNIP expression using CRISPR-dCas9 offers potential therapeutic benefits, including protecting pancreatic beta cells, enhancing insulin sensitivity, and mitigating inflammation. While the potential of CRISPR-dCas9-mediated CpG island editing is clear and evident now, further steps are imperative to translate this approach into effective and safe therapies for T2DM patients.

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1. Introduction

Advances in epigenetic editing technology have paved the way for novel therapeutic approaches in various diseases, including diabetes. One promising approach is the CRISPR-dCas9-mediated editing of CpG islands, which could potentially target gene expression through epigenetic modifications. This review explores the role of CpG islands, their involvement in gene regulation, and how CRISPR-dCas9 can be used to edit these regions for potential diabetes treatment, focusing specifically on the TXNIP gene.

CpG islands are short stretches of DNA that are densely packed with cytosine-guanine (CpG) dinucleotides. They are commonly found near gene promoters, playing a critical role in gene regulation due to their influence on transcriptional activity (Bird *et al.*, 1985; Bird, 1986). The unique feature of CpG islands is their high CpG density, their largely unmethylated state, and their strong association with active gene promoters (Gardiner-Garden and Frommer, 1987). Methylation of CpG islands, however, can lead to transcriptional silencing, making these regions key targets in epigenetic regulation.

Several computational tools have been developed to identify CpG islands within genomic sequences, including CpG Island Searcher, IslandPicker, and PromoterScan (Deaton and Bird, 2011). These tools use algorithms that search for high CpG density, appropriate sequence length, high GC content, and an observed/expected CpG ratio greater than a specific threshold (Choy *et al.*, 2010). These features are essential for accurate identification and analysis of CpG islands, particularly in their role in regulating gene expression.

DNA methylation, the addition of methyl groups to the cytosine base in CpG dinucleotides, is a powerful epigenetic modification that silences gene expression when it occurs in gene promoters (Lee and Lee, 2012). Methylation interferes with transcription factor binding and recruits proteins that compact chromatin, thus reducing gene expression. Conversely, unmethylated CpG islands are typically associated with actively transcribed genes (Lee *et al.*, 2015; Yoo *et al.*, 2021). Factors influencing CpG island methylation include DNA methyltransferases (DNMTs), Ten-Eleven Translocation (TET) enzymes, chromatin accessibility, and environmental conditions.

In Dutta *et al.* (2005), identified a CpG island within the TXNIP gene's promoter region. This CpG Island, rich in cytosine and guanine dinucleotides, is a common target for epigenetic modifications, particularly DNA methylation. DNA methylation, the addition of a methyl group to cytosine residues in CpG dinucleotides, typically silences gene expression by hindering transcription factor binding or promoting chromatin compaction. Aberrant methylation patterns are implicated in various diseases, including diabetes.

Dutta *et al.* (2005) pioneered the discovery that hypermethylation of this CpG island correlates with decreased TXNIP expression in kidney cancers. Conversely, under normal conditions, the CpG Island is typically hypomethylated, leading to increased TXNIP levels. This dynamic regulation is essential for maintaining balanced cellular proliferation in both normal and cancerous kidney tissues (Dutta *et al.*, 2005; Kim *et al.*, 2021; Zhang *et al.*, 2017).

A similar methylation pattern is observed in diabetic conditions. Hypomethylation of TXNIP correlates with elevated expression and disrupted glucose homeostasis (Zhang *et al.*, 2017; Kim *et al.*, 2021).

The methylation status of the cg19693031 site within the TXNIP gene has been linked to fasting blood glucose regulation in non-diabetic Taiwanese adults (Tsai *et al.*, 2022). The relationship between TXNIP-cg19693031 DNA methylation (DNAm) and type 2 diabetes (T2D) is well-established, with strong correlations to HbA1c, insulin, and fasting glucose levels (Tsai *et al.*, 2022). Hypomethylation at TXNIP-cg19693031 has been robustly associated with T2D, as well

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Review Article

The discovery and functional implications of mitochondrial Thioredoxin-Interacting Protein (TXNIP)

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Abstract

Mitochondrial Thioredoxin-Interacting Protein (TXNIP) has emerged as a pivotal regulator in cellular redox homeostasis, influencing a spectrum of physiological and pathological processes. Initially identified for its role in modulating thioredoxin (TRX) activity, recent discoveries highlight TXNIP's mitochondrial localization, significantly broadening its functional landscape. This review elucidates the discovery of mitochondrial TXNIP, its regulatory mechanisms, and its implications across various diseases. The groundbreaking identification of TXNIP within mitochondria underscored its critical involvement in oxidative stress responses and mitochondrial integrity. TXNIP interacts with mitochondrial TRX2, inhibiting its antioxidant activity, thereby promoting reactive oxygen species (ROS) accumulation. This interaction not only disrupts redox balance but also triggers apoptotic pathways via cytochrome c release and caspase activation, underscoring TXNIP's dual role in cell survival and programmed cell death. Furthermore, TXNIP's role extends to regulating ferroptosis, mitophagy, and inflammasome activation. Its contribution to ferroptosis involves modulation of mitochondrial labile iron and ROS, while in mitophagy, TXNIP governs the clearance of damaged mitochondria, impacting diseases like diabetic retinopathy. TXNIP also facilitates NLRP3 inflammasome assembly, linking oxidative stress to inflammatory responses. Pathologically, TXNIP is implicated in myocardial infarction, diabetes, retinitis pigmentosa, nephrotic syndrome, and cancer. It exacerbates myocardial injury by amplifying oxidative stress and inflammation, promotes beta-cell apoptosis in diabetes, and influences neurodegeneration and kidney damage through redox dysregulation. In conclusion, mitochondrial TXNIP serves as a crucial nexus connecting redox imbalance to disease pathogenesis. Understanding its multifaceted roles offers promising avenues for therapeutic interventions targeting oxidative stress-related disorders.

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1. Introduction

Mitochondrial Thioredoxin-Interacting Protein (TXNIP) has emerged as a crucial regulator of cellular redox homeostasis, significantly influencing oxidative stress responses, apoptosis, and metabolic regulation. Initially identified as a negative regulator of thioredoxin (TRX), TXNIP plays a pivotal role in modulating thioredoxin (TRX) activity (Nishiyama *et al.*, 1999). The discovery of TXNIP's localization in mitochondria further expanded its functional landscape, linking it to critical cellular processes such as reactive oxygen species (ROS) regulation, mitochondrial integrity, and cell death pathways (Dutta *et al.*, 2005; Saxena *et al.*, 2010).

Mitochondria serve as the primary site for ROS production, generating approximately 90% of cellular ROS (Balaban *et al.*, 2005). The thioredoxin system, particularly mitochondrial TRX2, acts as a major antioxidant defense mechanism to counteract oxidative stress. TXNIP inhibits TRX2 activity, leading to increased ROS accumulation, mitochondrial dysfunction, and activation of apoptotic pathways (Saxena *et al.*, 2010). This dysregulation of redox balance has been implicated in several pathological conditions, including myocardial infarction, diabetes, neurodegeneration, and nephrotic syndrome (Nakayama *et al.*, 2021; Park *et al.*, 2022).

Beyond apoptosis, TXNIP has been linked to ferroptosis, an iron-dependent form of cell death driven by lipid peroxidation (Dixon *et al.*, 2012). Studies have demonstrated that TXNIP modulates mitochondrial labile iron levels and ROS, thereby influencing ferroptotic pathways in various disease contexts (Karmi *et al.*, 2021; Chen *et al.*, 2024). Furthermore, TXNIP plays a vital role in mitophagy, a selective process that removes damaged mitochondria to maintain cellular homeostasis. Its dysregulation has been associated with retinal disorders such as diabetic retinopathy (Devi *et al.*, 2017).

Another significant aspect of TXNIP's function is its involvement in inflammasome activation. TXNIP directly interacts with the NLRP3 inflammasome in response to mitochondrial ROS, leading to inflammatory cascades that exacerbate disease progression in conditions such as myocardial infarction and kidney injury (Zhou *et al.*, 2010, 2011; Schroder and Tschopp, 2010).

Despite substantial advances in understanding mitochondrial TXNIP, the precise molecular mechanisms underlying its pathological roles remain incompletely understood. This review aims to consolidate current knowledge on mitochondrial TXNIP, highlighting its regulatory mechanisms, physiological significance, and implications in various diseases. Understanding TXNIP's role in mitochondrial dysfunction and redox imbalance may pave the way for novel therapeutic strategies targeting oxidative stress-related disorders.

2. The discovery of mitochondrial localization of TXNIP

The first localization of Thioredoxin-Binding Protein-2 (TBP-2), also known as TXNIP, in the mitochondria was reported by Dutta *et al.* (2005). This groundbreaking research provided evidence of TBP-2's

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Original Research Article

Epidemiology, genotypic diversity and age-specific risk pattern of circulating human papillomavirus in Dhaka City, Bangladesh: a five-year study (2020-2024)

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ABSTRACT

Background: Human papillomavirus (HPV) is among the most prevalent sexually transmitted illnesses globally, particularly with certain high-risk genotypes known as the predominant etiological agents of cervical carcinoma, which remains a considerable public health threat, especially in low- and middle-income countries (LMICs), like Bangladesh.
Methods: This study investigated the frequency, characteristics, and distribution of HPV genotypes among women in Dhaka City, Bangladesh, from 2020 to 2024. The HPV genotypes were detected by real-time polymerase chain reaction (PCR) from extracted DNA of cervical swab samples.
Results: Among 2049 tested participants, the overall HPV prevalence was 4.01%, with significant temporal variations observed throughout the study period. The highest number of positive cases, 29 (4.71%) out of 587, was recorded in 2024, while 2020 showed the lowest incidence, 1 (2.5%) positive case out of 39 cases. Seasonal analysis revealed higher case numbers during Winter (29%) and Autumn (30%), followed by Summer (26%), with Spring showing the lowest incidence (15%). Age distribution analysis indicated that middle-aged adults (35-50 years) represented the largest group with 37 cases, followed by adults aged 25-34 years (25 cases). The most prevalent genotype combination was HPV 16/31 (55 cases), followed by HPV 18/45 (16 cases).
Conclusions: This unique genotype distribution pattern differs from global trends and has important implications for vaccination strategies in Bangladesh. The findings suggest the need for broader-spectrum vaccines and age-specific screening programs, while highlighting the importance of considering seasonal variations in public health interventions.

Keywords: HPV, Real-time PCR, Genotype distribution, Prevalence, Urban health, Temporal distribution, Seasonal variation, Women's health, Cervical swab, Epidemiology

Plant Trends

ORIGINAL ARTICLE

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An efficient approach of *in vitro* plant regeneration and propagation of mungbean [*Vigna radiata* L. (Wilczek)]

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Keywords
Cotyledonary node, *In vitro* shoot regeneration, Legumes, Micrografting, Rooting.

ABSTRACT

Mungbean [*Vigna radiata* L. (Wilczek)] is a valuable legume crop in Bangladesh. However, it faces severe difficulties forming viable roots during the growth stage. The successful root production of mungbean through an efficient tissue culture system has not been well established. Therefore, this study aims to investigate the problem of unsuccessful root formation in mungbean plants and to develop a very efficient method of *in vitro* regeneration using micropropagation. The BARI Mung-3 mungbean variety was used as an explant. Several shoots were produced from cotyledonary node (CN) explants obtained from 3-day-old seedlings that were germinated *in vitro*. The plant samples were cultivated on MSB5 medium enriched with 5.0 μM BAP. Shoot generation efficiency per plant was 5.36 ± 0.56 (80.08%). However, the viable root generation in a regulated setting was unsuccessful despite employing multiple combinations of rooting media, including full and half-strength MSB5 medium with different concentrations and combinations of auxins. To resolve this issue, a micrografting approach was applied with scion 3.0 cm in length and 14-day-old mungbean rootstocks. This system resulted in efficient shoots where the viable root generation efficiency rate was 55%. Interestingly, the micro-grafted plantlets successfully produced viable seeds. The successful micropropagation with viable root generation in mungbean plants successfully overcomes the difficulties in rooting and offers an efficient method for successful mungbean production. These new findings open new options for efficient plant generation with mass propagation for ready-smart mungbean production.

INTRODUCTION

Mungbean [*Vigna radiata* L. (Wilczek)], is commonly called green gram and is considered a highly significant pulse crop globally. This organism belongs to the Fabaceae family and the Papilionaceae subfamily. Legumes are regarded as the second most considerable food crop for humans. Legume seeds are a vital component of the human diet due to their high content of proteins, bioactive compounds, minerals, and vitamins. Compared to grains, legumes are often referred to as "the poor man's meat" [1]. This legume crop is highly significant and widely cultivated, occupying over 6 million hectares globally (around 8.5% of the total pulse area). It is a staple in Asian families [2]. The mung bean is rich in a well-balanced combination of nutrients, such as protein, dietary fiber, minerals, vitamins, and substantial quantities of bioactive substances [3]. Mungbean grains are also widely popular for their high digestibility and good flavor. Mungbean sprouts are regarded as a vegetable high in vitamin C and contain 12 times as much iron as regular Mungbean seeds [4]. Nevertheless, the productivity of Mungbean varieties grown in various regions worldwide varies, and their potential yields are known to be influenced

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OPEN ACCESS I Research Article

Microbial Load Analysis and Characterization of Drug-Resistant Bacteria from Raw Meats in Gopalganj District

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Abstract

Antimicrobial resistance is a significant threat to people and animals around the world. Microorganisms are becoming more resistant to antibiotics, according to researchers. This is because more antibiotics are being used on animals and fowl. The main goal of this study was to look at and explain the types of bacteria resistant to antibiotics found in raw beef in a lab setting. For this study, two pieces of raw beef meat were bought from local shops in Gopalganj, Bangladesh. Once the bacteria were grown and put on selective media, they were identified using Gram staining and different biochemical tests. They were also tested for drug resistance using standards from the Clinical and Laboratory Stan. The Kirby-Bauer disc diffusion method was utilized to conduct antibiotic susceptibility testing for eight antibiotics, namely Ampicillin (Amp), Amoxicillin (Amx), Azithromycin (Azm), Cefotaxime (CTX), Ciprofloxacin (CIP), Erythromycin (E), Streptomycin (S), and Kanamycin (K). The resistance or susceptibility patterns of *Staphylococcus aureus, Escherichia coli, and Klebsiella pneumoniae* isolates were subsequently determined. The disc diffusion antimicrobial susceptibility assay showed that the S. aureus isolates were not susceptible to ciprofloxacin. The *E. coli* and *K. pneumoniae* isolates were not susceptible to ampicillin and amoxicillin, commonly used to treat severe bacterial infections in humans. These results show that eating tainted beef is terrible for your health and that there needs to be stricter rules about food safety, especially when it comes to using antibiotics on animals. The study stresses the importance of monitoring drug resistance in dangerous pathogens so that bacteria not susceptible to antibiotics don't spread.

Keywords: Foodborne pathogens, Antibiotic resistance, Beef meats, and *Staphylococcus aureus*.

1. Introduction

Meat is widely acknowledged as one of the most perishable food items (Mohebi & Marquez, 2015). These things happen because of the chemicals that are in it. These chemicals encourage the growth of germs to levels that are not acceptable. This makes the meat go bad much faster. When raw meat contains a high concentration of bacteria, it goes through changes that make it unattractive and unfit for human eating (Doulgeraki *et al.,* 2012). The consumption of meats is a common nutritional practice that provides a vital supply of essential micronutrients and macronutrients necessary for human growth and development. Meat is a very perishable product due to its high-water content (0.99 water activity) and abundance of proteins,

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Discover Plants

RESEARCH Open Access

Small heat shock proteins: key genes for regulating heat stress responses in rice

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Abstract
Small heat shock proteins (HSPs) play an important role in rice plants by protecting cells from thermal damage during heat stress (HS). Although various types of heat-tolerant small HSPs have been reported in rice, the key genes (KGs) for HS in rice remain elusive. Hence, in this investigation, we selected 23 critical small HSPs of rice response to HS from the literature and sorted out six uncloned KGs (*OsHSP23.6*, *OsHSP26.2*, *OsHSP22.3*, *OsHSP18.6*, *OsHSP23.2*, and *OsHSP16.0*) by analyzing five CytoHubba algorithms, including degree, closeness, bottleneck, MCC, and DMNC. The KGs expression results revealed that the six KGs are heat-induced heat-tolerant genes and play crucial roles in rice responses to HS. Moreover, GO (gene ontology) enrichment pathway analysis found that the KGs are involved in responses to reactive oxygen species (ROS), response to heat, unfolded protein binding, and protein folding. The expressology tree analysis indicated that the six KGs might have various functions under development and stress conditions. The tissue specific expression patterns exhibited the various expression levels of six KGs in different tissues under abiotic stress, including temperature stress. Relative gene expression results revealed that these KGs are heat-inducible and play critical roles to tolerate heat stress in rice. Therefore, these KGs have potential roles in the development of heat-tolerant varieties.

Keywords Heat stress, HSPs, Gene ontology, Gene expression, Rice

1 Introduction

Heat stress poses a significant environmental challenge to crop productivity, directly influencing growth and yield [1]. Several studies projected that a 1 °C rise in global temperatures would result in yield reductions of 3.2% for rice (*Oryza sativa*), 6% for wheat (*Triticum aestivum*), 3.1% for soybean (*Glycine max*), and 7.4% for maize (*Zea mays*) [2]. Consequently, developing thermotolerant crop varieties has become crucial for ensuring agricultural sustainability. Rice is a fundamental staple crop worldwide, serving as a primary source of nutrition for over half of the global population and playing a crucial role in food security [3]. Alarmingly, rice yields are projected to decline by up to 10% for each 1 °C increase in land surface temperature [4]. Given the growing prevalence of

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ORIGINAL RESEARCH

Glucosinolates and Indole-3-carbinol from *Brassica oleracea* L. as inhibitors of *E. coli* CdtB: insights from molecular docking, dynamics, DFT and in vitro assay

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Abstract

Escherichia coli (*E. coli*), a common human gut bacterium, is generally harmless but capable of causing infections and contributing to diseases like urinary tract infections, sepsis/meningitis, or diarrheal diseases. Notably, *E. coli* is implicated in developing gallbladder cancer (GBC) either through ascending infection from the gastrointestinal tract or via hematogenous spread. Certain *E. coli* strains are known to produce toxins, such as cytolethal distending toxins (CDTs), that directly contribute to the genetic mutations and cellular abnormalities observed in GBC. Broccoli (*Brassica oleracea*) is known for its health-promoting properties, including antimicrobial, antioxidant, and immunomodulatory effects, and is rich in essential compounds. Our study investigates the potential of the phytochemicals of *B. oleracea* to inhibit the CdtB (PDB ID: 2F1N) protein of *E. coli* which plays a significant role in the pathogenesis of GBC. By employing in silico molecular docking, Glucosinolates and Indole-3-carbinol emerged as promising inhibitors, demonstrating strong bonding affinities of -8.95 and −8.5 Kcal/mol, respectively. The molecular dynamic simulation showed that both compounds maintained stable interaction with CdtB with minimal conformational changes observed in the protein-ligand complexes. Additionally, the ADMET analysis provided evidence for the drug-likeness properties of the lead compounds. Furthermore, the DFT (Density Functional Theory) revealed that Indole-3-carbinol is more chemically stable but less reactive than Glucosinolates, with HOMO-LUMO gaps of 5.14 eV and 4.50 eV, respectively. Finally, the in vitro antibacterial assessment confirmed the inhibitory effect of Glucosinolates and Indole-3-carbinol against *E. coli* through disc diffusion assay with the zone of inhibition 34.25 ± 0.541 and 28.67 ± 0.376 mm compared to the control ciprofloxacin. Our study provides crucial data for developing novel therapeutic agents targeting *E. coli*-associated GBC from the phytochemicals of *B. oleracea*.

Keywords *E. coli* · Cytolethal distending toxins (CDTs) · Gallbladder cancer · *Brassica oleracea* · Molecular docking · Molecular dynamics · DFT · In vitro antibacterial activity

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Ethnomedicinal and ethnobotanical uses of aquatic flora by local inhabitants of Gopalganj District, Bangladesh

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DOI: https://doi.org/10.22271/plants.2024.v12.i1b.1639

Abstract
The current work was intended to carry out ethnomedicinal research of aquatic flora or hydrophytes in Gopalganj district, Bangladesh in order to gather evidence of its therapeutic benefits through conversations with the local residents and practitioners. Extensive empirical surveys were conducted on frequently to gather samples of aquatic plants and interviews with local inhabitants and herbalists were accomplished during November 2022 – November 2023. Documentation was done on the fundamentals of traditional applications of medicinal plant as well as their various ethnobotanical purposes. An aggregate of 60 plant species belonging to 33 families were identified as having ethnomedical uses in the treatment of various human illnesses and ailments, including skin conditions, asthma, gonorrhea, ulcers, stomach pain, and piles. These hydrophytes were found to play vital functions in material culture, agricultural purposes and ritual manners. Wetland resources, particularly those with ethnomedicinal and ethnobotanical significance require care because the existence of these natural wetlands species is in jeopardy.

Keywords: Ethnomedicinal, ethnobotanical, hydrophytes, traditional knowledge

1. Introduction
Bangladesh is surrounded by the Buriganga river which is a tide-influenced river forming the western and southern boundaries of Dhaka City. It is home to a vast expanse of wetlands, which include freshwater lakes, marshes, rivers, streams, flooded agricultural fields, estuarine systems with large mangrove swamps, haors, baors, and beels. Moreover, a district of Bangladesh called Gopalganj is part of the Dhaka Division [1]. This district is situated at 23°00’47.67" N 89°49’21.41" and located alongside the Madhumati river. It is 1,490 km^2 in size and residence to 1,172,415 people [2]. This area lies in southern part of Bangladesh which is also blessed with a plenty of freshwater wetlands such as riverine, lacustrine and palustrine along with man-made wetlands. These wetlands are rich in hydrophytes, which make up one of the most abundant natural vegetation types.
Hydrophytes also known as aquatic macrophytes, are plants that are visible to the naked eye and have the ability to grow and survive both on the surface and beneath the water bodies. These plants have pigments called chlorophylls so that hydrophytes are able to synthesize food for themselves [3]. Hydrophytes play a crucial role in the ecosystem of wetlands, preserving species diversity and providing food, shelter, and traditional treatments for a variety of aquatic and waterfowl species [4].
Almost 80% of the world population depends on the traditional system for health care [5]. The people from rural communities depends on traditional remedies for ailments such as cough, cold, fever, headache, dysentery etc. without any adverse effects. The local community of Gopalganj district has gathered knowledge about the ethnobotanical and ethnomedicinal use of aquatic plants through observations, intuition, and experimentation. They enriched the knowledge through selection and rejection and transferred it from generation to generation through various channels such as talks, documents and teaching.
Numerous authors have emphasized the potential of aquatic plants as food and feed [6, 7]. In addition, aquatic plants are an intriguing source of a variety of biologically active compounds with anticancer, antimicrobial, antifungal, antiviral, anti-inflammatory properties along with novel functional food ingredients [8]. Several authors have thoroughly recorded observations on the aquatic and marsh plants of Bangladesh [9, 10, 11].

JOURNAL OF CLINICAL CASE STUDIES, REVIEWS & REPORTS

Research Article

Volume 2 | issue 8

Nutraceutical and Nutritional Impacts of Edible Chitosan Coatings on Food Quality and Health

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Abstract

Edible chitosan coatings enhance food quality and health outcomes by providing significant nutritional and nutraceutical benefits. These coatings, which are made from chitin, offer a natural barrier that decreases microbial contamination and deterioration, prolonging the shelf life and preserving the freshness of food. Its bioactive qualities, which include antibacterial and antioxidant activities, improve nutritional profiles. Furthermore, chitosan coatings can provide beneficial chemicals and vital nutrients to food, promoting general health and wellbeing. This review highlights the function that edible coatings based on chitosan play in boosting nutritional value and health benefits while examining the diverse effects of these coatings on food quality.

Keywords: Health, Nutraceutical, Nutritional, Benefits, Edible Coating, Chitosan

Introduction

In recent times, chitosan has been widely employed for an array of biological and medicinal purposes. It can be utilized, for instance, to treat water materials for wound healing pharmaceutical excipients or drug carriers' medication for overweight people and as a framework for tissue engineering [1-6]. Any type of material used to coat various nutrients to extend the shelf life of an item that may be taken with or without additional elimination is known as edible film or coating. Edible films provide fortification and natural layer replacement to prevent moisture loss. This allows for the controlled replacement of vital gases, including as carbon dioxide, ethylene, and oxygen, which are involved in breathing processes. A movie could also provide superficial purity while preserving other important aspects. Typically, the

drugs and drug candidates

MDPI

Review

Beta-Thalassemia: A Pharmacological Drug-Based Treatment

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Abstract: This review was performed to determine the potential of drugs that can remove or decrease the requirements for blood transfusion among beta (β)-thalassemia patients. A comprehensive literature search was conducted to identify clinical trials and studies using PubMed Central, Google Scholar, PubMed, and ScienceDirect archived articles published from 1996 to November 2023. According to this review, clinical trials for a number of drugs, including luspatercept, sotatercept, mitapivat, etavopivat, hydroxyurea, rapamycin, decitabine, thalidomide, and quercetin, have been performed as part of efforts to improve the cure strategy for β-thalassemia. Of these drugs, luspatercept and sotatercept have exhibited particularly promising results and have been granted US Food and Drug Administration (FDA) approval for use in β-thalassemia patients. The mode of action for the drugs luspatercept and sotatercept involves the stimulation of hemoglobin (Hb) production or enhancement of its functionality, thereby decreasing reliance on blood transfusions and enhancing the overall quality of life. In this way, drugs like luspatercept and sotatercept present an opportunity to notably decrease the necessity for blood transfusions in β-thalassemia patients, improving their standard of living and overall prognosis. However, more research is needed to evaluate the effectiveness and safety of these drugs in the long run.

Keywords: non-transfusion thalassemia; β-thalassemia; drug therapy; blood factors

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1. Introduction

Thalassemia is a hereditary blood disease. The causes of thalassemia are mutations in the DNA of cells that transport oxygen throughout the body. Hemoglobin (Hb) qualifies red blood cells to convey oxygen. Thus, in thalassemia, Hb production lessens. There are a few factors that increase the risk of thalassemia, such as a family history of thalassemia, certain ancestries, and nutritional factors [1]. There are mainly two types of thalassemia: these are alpha (α)- and beta (β)-thalassemia. The number of genes absent from the four genes for α-globin or two genes for β-globin determines the severity of the thalassemia [2]. A- and β-thalassemias are usually autosomal recessive, with the first dominant hereditary incidents identified in an Irish family. Both parents must be carriers of the disease, and if a hemoglobinopathy trait is carried by both, the chance of an affected child is 25% for each pregnancy [3].

Hereditary Hb problems present an increasing global public health challenge. Almost 320,000 infants are born each year with Hb disease. About 80% of these births occur in developing countries. Most traditional estimates suggest that at least 5.2% of the global populace (more than 360 million people) has a notable Hb type, and over 100 million suffer from β-thalassemia, with a worldwide prevalence of 1.5%. Compound heterozygous

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Ethnomedicinal Flora Utilized in Traditional Healthcare Practices by Local Inhabitants of Mymensingh, Bangladesh

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Abstract

The present study demonstrated the therapeutic benefits of the medicinal flora utilized by the local healers in the several villages *i.e.* Sadar Upazila, Tarakanda, Haluaghat and Goforgaon of Mymensingh district, Bangladesh. An extensive empirical surveys and interviews were carried out with the local healers between March, 2023 and March, 2024. Documentation was done on the basis of the principles of traditional applications of medicinal plants. In total, 80 plant species belonging to 51 families were identified as having ethnomedical uses in the treatment of various ailments, including skin conditions, dysentery, diarrhoea, asthma, and gonorrhoea, piles and stomach pains. The study reveals that Apocynaceae family is the most frequently used followed by Caesalpiniaceae, Lamiaceae and others. The several plant parts included leaves (37%), fruits (13%), stems (11%), roots (11%), barks (9%), seeds (6%), flowers (3%), shoots (3%), and rhizomes (2%) in addition to whole plants (3%). As well, the most frequent mode of medicine preparation is juice (38%) and paste (26%) of the plant parts in those areas. Care must be taken with regard to those species, especially those having ethnomedicinal significance, as their survival is in danger nowadays. The results and information obtained from this study will be helpful for any upcoming ethnopharmacological research aimed at finding novel medications. This study has the potential to encourage future generations to adopt traditional therapeutic methods and preserve the indigenous knowledge of traditional use of medicinal plants.

Keywords: *Local healers; Ethnomedicinal flora; Inhabitants; Folk medicines; Ailments.*

1. Introduction

Since the beginning of human civilization, plants have been a part of mankind (Phumthum et al., 2020). There is currently a push to record and preserve traditional knowledge about plants that rural and tribal people utilize throughout the world and in many different countries. Therefore, 'Ethnobiology' offers a remarkable scope called 'Ethnobotany' of documenting traditional knowledge about interaction between mankind and plants in health care practices. The study of human interactions with plants is known as ethnobotany which has advanced greatly in recent years (Zereen & Khan, 2012). Medicinal plants are still a significant therapeutic option for treating human illnesses. Ancient civilizations in China, India, Greece, the Arab world, and other places established their own distinctive medical systems, most

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Linking Work-Life Balance Practices with Work-Life Balance Satisfaction and Job Satisfaction: The Mediating Role of Organisational Identification

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Abstract

Purpose: This study examines how work-life balance (WLB) practices affect employees' work-life balance satisfaction (WLBS) and overall job satisfaction (JS), grounded in social exchange theory. It also investigates the mediating role of organisational identification (OI) in these relationships. **Design/methodology/approach:** Data were collected from 528 full-time employees working in private commercial banks across major cities in Bangladesh, with a 66% response rate. Analysis was conducted using SPSS and AMOS. **Findings:** The results reveal that WLB practices significantly enhance both WLBS and JS. Organisational identification partially mediates these relationships, highlighting its role in strengthening employee satisfaction. **Originality/value:** This study is the first to consider work-life balance satisfaction as a distinct outcome and to identify organisational identification as a mediating mechanism between WLB practices and employee satisfaction. These findings deepen understanding of the psychological processes driving WLB outcomes and provide actionable insights for organisational policy.

Keywords

Work-Life Balance Practices, Job Satisfaction, Work-Life Balance Satisfaction, Organisational Identification, Bangladesh

1. Introduction

In the early 20th century, the relationship between work and personal life was largely unquestioned. However, this view shifted in the 1970s due to increasing

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How Perceived Supervisor and Organizational Support Shape Job Satisfaction: The Intervening Role of Work-Life Balance and Organizational Identification

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Abstract

This study examines the influence of perceived organizational support (POS) and perceived supervisory support (PSS) on employee job satisfaction (JS) within the context of Bangladesh's private banking sector. It further investigates the mediating role of work-life balance (WLB) in the relationships between these support mechanisms (POS and PSS) and job satisfaction, as well as the moderating role of organizational identification (OI) in the link between work-life balance and job satisfaction. Data were collected from 634 full-time employees working in private commercial banks through both online and offline surveys and analyzed using SPSS v27 and AMOS v24. The findings indicate that both POS and PSS have a significant positive effect on job satisfaction. Furthermore, WLB mediates the effects of POS and PSS on job satisfaction, while OI positively moderates the WLB-JS relationship. These results underscore the importance of cultivating a supportive organizational climate—both at the institutional and supervisory levels—to enhance employee satisfaction and well-being. Moreover, promoting a healthy work-life balance and fostering stronger organizational identification can further strengthen job satisfaction outcomes. The study also contributes to the literature by integrating Organizational Support Theory (OST) and Social Identity Theory (SIT) within the context of an underexplored emerging economy, offering valuable theoretical and practical implications.

Keywords

Perceived Organizational Support, Perceived Organizational Support, Work-Life Balance, Organizational Identification, Job Satisfaction

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Abusive Supervision and Turnover Intention in Higher Education: Exploring the Role of Emotional Exhaustion and Resilience

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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Original Research Article

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ABSTRACT

Purpose: This study examines the impact of abusive supervision on turnover intention among faculty members at private universities in Bangladesh. It examines emotional exhaustion as a mediator and employee resilience as a moderator. By using Affective Events Theory (AET) and Conservation of Resources Theory (COR), this study addresses the scarcity of research on the dark side of leadership in South Asian higher education, particularly using AET and COR together, and exploring the combined mediation and moderation model in this context.

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Determinants, Impediments, and Opportunities for Organizational Sustainability in Kushtia's Textile Industry

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ABSTRACT

The textile industry in Kushtia district serves as a significant source of revenue for this region of Bangladesh. It offers substantial employment opportunities and produces high-quality fabrics for both national and international markets. Nonetheless, this industry is currently facing multiple challenges and aims to achieve long-term sustainability. This study aimed to assess the problems, obstacles, and opportunities within a sustainable textile sector in the Kushtia region of Bangladesh. This research establishes a distinctive framework for the organizational sustainability of Kushtia's textile industry. This research utilized a systematic literature review and adhered to the PRISMA framework, incorporating a comprehensive analysis to yield practical insights. The Scopus database was utilized to examine published research from 2020 to 2025, focusing on the keywords "organizational sustainability" and "textile industry." The research demonstrates the significance of sustainable leadership, green leadership, organizational learning, and organizational development for Kushita's textile industry. The analysis indicates that Kushita's textile sector in Bangladesh faces obstacles in management and leadership, challenges related to organizational learning and development, and deficiencies in personnel. The industry may leverage organizational learning and development to improve its sustainability. This study addresses the challenges and prospects of the sustainable textile sector in Kushtia, highlighting that environmental, social, economic, and political sustainability is achievable within the industry. This study introduces a novel framework that explores how sustainable leadership, green leadership, organizational learning, and organizational development interact to promote organizational sustainability in Kushtia's textile industry. The research offers industry practitioners and government insights for improving sustainable leadership, green leadership, organizational learning, and organizational development to facilitate an effective transition to organizational sustainability in the textile industry. It can help governments and industry leaders create policies that balance environmental, economic, political, and social concerns. While

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| RESEARCH ARTICLE

Sustainable Organizational Performance and Khulna's Jute Industry: Issues, Challenges, and Opportunities

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| ABSTRACT

The jute industry in the Khulna division of Bangladesh encounters various problems as it seeks to maintain sustainable performance in this sector, particularly from the viewpoint of a developing nation. This article examines strategies to enhance the sustainable jute industry in the Khulna division of Bangladesh by addressing critical issues, challenges, and opportunities regarding technology, innovation, leadership, and digital competencies to achieve sustainable organizational performance. The article also presents a research paradigm for achieving sustainable organizational performance based on a rigorous evaluation of the literature. Utilizing the PRISMA strategy for comprehensive documentation retrieval, the study illustrates the importance of ensuring sustainable organizational performance for the jute industry from the broader perspective of technology, innovation, leadership, and digital literacy. The review focused on developing the research framework for the study and identified deficiencies and opportunities in the current sustainability practices of the jute industry. The analysis indicated that the jute industry in Bangladesh has substantial obstacles to sustainable organizational performance concerning technological innovation, transformational leadership, digital leadership, and digital literacy, as addressed in this article. Similarly, this industry has huge potential in this era of sustainability consideration from an environmental, social, and economic perspective. The study reviews current research on how the jute industry in Bangladesh can perform sustainably and suggests future research directions, aiming to better understand the strategies needed to achieve sustainable performance by promoting technological innovation, transformational leadership, digital leadership, and digital literacy in the jute industry. The paper lacks inquiry into additional dimensions of management, behavioral, and human resources. Conversely, future studies may investigate alternate contexts across various industrial settings.

| KEYWORDS

Khulna's Jute Industry, Technological Innovation, Transformational Leadership, Digital Leadership, Digital Literacy, Sustainable Organizational Performance.

| ARTICLE INFORMATION

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1. Introduction

Sustainable organizational performance (SOP) is an organization's ability to achieve long-term success by balancing economic growth, environmental responsibility, and social well-being. It involves aligning strategic goals with sustainable practices like resource efficiency, ethical governance, innovation, and stakeholder engagement (Owalo and Aosa, 2025; Khan and Sohaib, 2024). Similarly, Rahman et al. (2022b) emphasized organizational sustainability as a complete strategy that improves the ability to handle changes in the environment, society, economy, and politics by encouraging positive leadership, a skilled workforce, resources, organizational behavior, and culture that work together to solve sustainability problems and shape overall

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Challenges And Possibilities Of Human Resource Readiness And AI Self-Efficacy For AI Adoption In Bangladesh's Ready-Made Garments Industry

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Abstract
Artificial intelligence (AI) is increasingly transforming human resource management; however, its application in labor-intensive sectors within developing countries remains markedly constrained. The ready-made garment sector in Bangladesh, which employs over four million working people and is pivotal to national exports, faces significant obstacles in adopting AI, including inadequate digital infrastructure, insufficient technical training, and constant organizational resistance to change. The challenges are intensified by inadequate AI expertise among human resource professionals and employees, gendered barriers to technology access, and widespread anxieties around job displacement, all of which hinder efficient human-centric implementation. This study aims to investigate how human resource readiness, AI self-efficacy, and perceptions of AI's value and usability are interconnected and influence adoption readiness in this context. This study employed a PRISMA-based scoping review process to systematically analyze peer-reviewed publications published between 2020 and 2025, sourced from platforms such as Scopus, Web of Science, Emerald, and Wiley. The analysis indicates that deficiencies in worker competencies, organizational misalignment, and infrastructural inadequacies substantially hinder adoption capacity. In contrast, theoretical insights suggest that fostering digital confidence and organizational readiness is crucial for mitigating resistance. This study proposes a novel conceptual framework that integrates organizational and human readiness attributes, offering insights into how developing countries might implement AI-driven human resource transformations. The novelty of the research lies in its thorough examination of AI adoption in Bangladesh's ready-made garments business, emphasizing human-centric and context-specific challenges often overlooked in existing studies. The practical implications require the prompt creation of equitable AI literacy programs, ethical governance frameworks, reskilling initiatives, and strategic policy measures to enable sustainable technology integration and AI adoption in ready-made garments. The analysis acknowledges its limitations, being geographically restricted to Bangladesh, reliant on secondary literature, and excluding grey sources; yet, it provides a foundation for comparative studies in similar emerging economies.

Keywords: *Artificial Intelligence, Human Resource Readiness, AI Self-Efficacy, Ready-Made Garments, Bangladesh, AI Adoption*

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I. Introduction

The global artificial intelligence (AI) market is witnessing unprecedented growth, with AI adoption in human resource management anticipated to reach USD 26.5 billion by 2033, rising at a spectacular compound annual growth rate of 16.2% (Market.us, 2024). Currently, 75% of enterprises globally have incorporated AI into at least one business function, with AI use in workplaces nearly doubling over the past two years, while 71% of employees remain anxious about AI adoption (Pendell, 2025; Lukan, 2024). This technological revolution has major ramifications for developing countries, particularly in labor-intensive industries where old human resource methods face increasing pressure to adapt. The impact of this change extends beyond mere operational efficiency; it profoundly reshapes worker dynamics, decision-making processes, and competitive positioning in global marketplaces.

The ready-made garments business, which employs over 4 million individuals and accounts for 81.16% of Bangladesh's total exports valued at $32.86 billion in the financial year 2023-24, represents a vital economic sector necessitating technological advancement to maintain global competitiveness (BEPB, 2023). Despite extensive research on AI adoption in affluent economies, there are notable knowledge gaps regarding

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Circular Economy and Corporate Sustainability in Bangladesh's Ready-Made Garment Industry: Problems and Prospects

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Research Article

Abstract

Purpose: *The ready-made garments sector in Bangladesh contributes to 81.82% of national exports and employs well over four million workers. Nonetheless, this sector encounters substantial challenges in implementing circular economy principles to achieve corporate sustainability. This study identifies essential factors that can enhance corporate sustainability in the ready-made garments sector of emerging economies by addressing significant issues, challenges, and opportunities related to supply chain management, technology, government policies, and circular economy principles. The study presents a research paradigm for achieving corporate sustainability based on a rigorous evaluation of the literature.*

Methods: *The study employs systematic reviews using the PRISMA strategy to retrieve comprehensive documentation. This methodology enables a comprehensive scoping of exploratory themes, adjusting search terms repeatedly to gather interdisciplinary perspectives on the integration of corporate sustainability into the circular economy.*

Results: *The research highlights the importance of corporate sustainability within the Bangladeshi ready-made garments sector, focusing on technology, government involvement, supply chain dynamics, and the circular economy. Despite financial limitations, infrastructural challenges, and talent deficiencies, the industry has the potential for environmental, social, economic, and political sustainability.*

Originality: *This study presents a novel framework that examines the interplay of technological capabilities, supply chain flexibility, governmental influence, and the circular economy within Bangladesh's ready-made garment sector, aiming to achieve corporate sustainability.*

Implications*: The research offers industry practitioners valuable insights for enhancing technical training, implementing regulatory reforms, and advancing infrastructure development, thereby facilitating an effective transition to a circular economy. This understanding can help governmental entities and industry leaders craft policies that strike a balance between environmental, economic, political, and social responsibilities.*

Keywords: Circular Economy, Corporate Sustainability, Ready-Made Garments Industry, Technological Capabilities, Bangladesh

1. Introduction

In the evolving global economy, organizations face new challenges and opportunities to achieve sustainability at their own pace. Companies must integrate and adapt organizational structures, procedures,

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Prevalence of Child Labor in Bangladesh: A Case Study on Faridpur District

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ABSTRACT

Child labor is a widespread issue not only in Bangladesh but also in many other developing countries worldwide. The global population of child laborers has increased to 160 million. This issue is exacerbating rather than being resolved. The author conducted this research to determine if child labor is being recruited in Faridpur by Section 34-44 of Chapter 3 of the Bangladesh Labor Act, 2006. In this study, we emphasize key factors about current societal challenges and the consequences of children participating in child labor in the Faridpur district of Bangladesh. For this, we gathered information from 350 respondents spread over 15 wards in Faridpur. The findings demonstrate the implications arising from the inadequate implementation of the regulations outlined in Chapter 3 of the Bangladesh Labor Act 2006, including poverty, parental illiteracy, large families and overpopulation, corruption, and a lack of government initiative. Through the findings, the author has hypothesized that the children would have physical, mental, social, and institutional/socialization suffering more as a result of the failure to comply with the Bangladesh Labor Act, 2006, in the future.

Keywords: Child labor, Faridpur district; hazardous work; economic burdens; government initiatives

INTRODUCTION

In modern Bangladesh, child labor is regarded as a major problem. Child labor is a daily contributor to growing social dysfunction. All forms of illegal employment of children are considered child labor by society and the law. In the broadest sense, child labor is the exploitation of children through any activity that keeps them from getting a full childhood and adolescent education, keeps them from going to school regularly, and hurts their progress in mental, physical, ethical, and social spheres. Child labor is not a curse but a harsh reality for a nation (Lau & Chan, 2021). According to the Bangladesh Labor Act, 2006, a person under 14 years of age is considered a child, and their labor is known as child labor. The concept of child labor is based on the Minimum Age Convention (No. 138) of 1973, which states that child labor consists of all children under the age of 15, including all economically active children under the age of 15, except between 12 and 14 years of age who work less than 14 hours per week, unless their occupations are hazardous by nature or circumstance. Bangladesh has a high prevalence of child labor. Therefore, children under the age of 14 labor in numerous unregulated businesses and are frequently at risk of dying in workplace fires ***(Ahmed, 2013; Anjum, 2021).***

According to the Bangladesh Labor Act 2006, "the employment of children less than the age of fourteen in any profession or establishment is prohibited." A practitioner's certificate of fitness, which must be renewed every

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Original Research Article

AI Applications in Sustainable Banking: A Review of Applications, Challenges and Opportunities

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Abstract: The convergence of Artificial Intelligence (AI) and sustainable banking is transforming the global financial landscape, presenting both extraordinary opportunities and significant challenges. This paper provides an in-depth review of AI applications in the banking sector, elaborating on their role in advancing efficiency, enhancing customer experience and promoting financial inclusion, while also examining their implications for sustainability. Drawing on a thematic analysis of scholarly literature, case studies, industry reports and studies, this analysis identifies key applications of AI in fraud identification, credit risk management, wealth management, customer service automation and regulatory compliance. Further than operational welfare, the review centre is evolving sustainability-focused on uses of AI, comprising environmental, social and governance (ESG) risk calculation and green finance simplification. However, major challenges remain, notably data privacy risks, algorithmic bias, regulatory uncertainty, high operational costs, workforce disruptions and the environmental impact of AI systems. The analysis underscores significant gaps in aligning AI adoption with broader sustainability goals, regulatory expectations and ethical standards. To address the identified loopholes, this research recommends future research strategies focused on the development of accountable AI frameworks, explainable AI, stronger regulatory harmonization and inclusive financial contact. The findings contribute to both theory and practice by combining fragmented insights, providing a structured framework for indulgent AI's dual role in efficiency and sustainability and offering legal guidance for policymakers, regulators and banking authorities. Ultimately, this study highlights AI not only as a driver of operational conversion but also as a catalyst for building a more comprehensive, robust and practical global banking environment.

Keywords: Artificial Intelligence, Sustainable Banking, ESG, Technological Innovation, Explainable Artificial Intelligence.

1. INTRODUCTION

The global banking sector has been undergoing a vital transformation determined by the dual forces of high-tech innovation and long-term necessities (AL-Dosari *et al*., 2024; Rodrigues *et al*., 2022). The financial sector, mainly the banking industry, has historically helped as the backbone of worldwide economies, surfacing endlessly in reaction to technological advancement, regulatory fluctuations and changing customer demands (Roy *et al*., 2025). From branch-based services to the advent of ATM, online banking and mobile banking through mobile applications, financial organizations have gradually embraced digital transformation to improve efficiency and increase customer experiences (Alnaser *et al*., 2023). In recent years, Artificial Intelligence has emerged as the latest frontier in this change, offering unprecedented opportunities for innovation across various banking functions (Alsoukini *et al*., 2025; Paramesha *et al*., 2024). By leveraging ML, NLP, RPA and predictive analytics. At present, banks can process massive datasets, automating routine

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Review

Advancing sustainability: A comprehensive review of green technology innovations and their environmental impact

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Abstract: This comprehensive review examines recent innovations in green technology and their impact on environmental sustainability. The study analyzes advancements in renewable energy, sustainable transportation, waste management, and green building practices. To accomplish the specific objectives of the current study, the exploration was conducted using the PRISMA guidelines in major academic databases, such as Web of Science, Scopus, IEEE Xplore, and ScienceDirect. Through a systematic literature review with a research influence mapping technique, we identified key trends, challenges, and future directions in green technology. Our aggregate findings suggest that while significant progress has been made in reducing environmental impact, barriers such as high initial costs and technological limitations persist. Hence, for the well-being of societal communities, green technology innovations and practices should be adopted more widely. By investing in sustainable practices, communities can reduce environmental degradation, improve public health, and create resilient infrastructures that support both ecological and economic stability. Green technologies, such as renewable energy sources, eco-friendly construction, efficient waste management systems, and sustainable agriculture, not only mitigate pollution but also lower greenhouse gas emissions, thereby combating climate change. Finally, the paper concludes with recommendations for policymakers and industry leaders to foster the widespread adoption of green technologies.

Keywords: green technology; renewable energy; sustainability; environmental impact; waste management

1. Introduction

As the global community grapples with the escalating challenges of climate change and environmental degradation, the role of green technology in advancing sustainability has become increasingly crucial (Agrawal et al., 2024; Sun, 2024). Green technology, also known as clean technology or cleantech (Metawa et al., 2022; Shakeel, 2021),

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REVIEW

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Marketing Strategies and Tactics in the Metaverse: A Systematic Literature Review and Future Research Agenda

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Abstract: Marketing has traversed a long path from traditional to digital marketing to metaverse marketing in Industry 4.0. Different marketing scholars and academicians have predicted that the rules of marketing game are going to take a paradigm shift in the era of metaverse marketing. Hence, the primary objective of this literature review is to understand the application of metaverse in marketing or how marketing strategies and tactics can take place in the metaverse. In order to do this review research, 68 research articles have been identified from two prominent databases: Google Scholar and Scopus. Widely used PRISMA protocol has been used for this research paper identification. After selecting and downloading the papers, authors have manually reviewed each. Finally, the application of marketing strategies and tactics suggested by different researchers identified and recorded with Microsoft Excel and then analyzed with an advanced data visualization software called RAWGraph. The findings indicate that marketing strategies and tactics in the metaverse can be categorized into six (6) major categories. These are (1) segmentation, targeting, and positioning, (2) 4Ps, (3) branding, (4) customer relationship marketing and partner relationship marketing, (5) competitive strategies, and (6) marketing metrics and automation. The contributions of this study are as follows: (a) it developed a timeline map demonstrating the evolution of marketing technology over time and (b) it synthesized existing literature and presented how marketing strategies and tactics can be applied in the metaverse or immersive world.

Keywords: metaverse marketing, marketing strategies, digital marketing, influencer marketing, virtual marketing, metaverse consumer behavior, systematic literature review (SLR)

1. Introduction

There is a very popular question roaming around among the majority of scientists, business professionals, and even politicians what will be the next technological revolution and how it will affect mankind in every aspect. Metaverse is one of the strong candidates to be the answer to this question as it has all the potential to be the next big thing that shapes both our personal and professional landscape by offering immersive experiences with innovative technology integration [1, 2]. Metaverse in interconnection is linked to a virtual environment that combines the physical and the digital space [3]. It provides the ability for users to interact in real time with the computer-generated surroundings as well as the other users [4]. It includes virtually every form of immersive experience: virtual reality (VR), augmented reality (AR), and more [5, 6]. After the announcement of Facebook, a renowned tech giant, in 2021 that the metaverse would offer a digital revolution and even renamed the organization as Meta [7]. Hence, we can say with conviction that metaverse is the going to be a difference-maker in the next decades or so.

Marketing in the metaverse is stronger and more immersive, using interactive, immersive experiences that truly grab viewers' attention [8, 9]. Instead, brands can create virtual environments or even events that allow consumers to interact rather than just passively consume material [10]. It nurtures individualized and powerful experiences that reinforce brand loyalty [11]. Tech-savvy users can be primed for creative advertising in the form of virtual product trials or gamified campaigns [12]. The metaverse transcends the limits of the region and enables worldwide engagement, with the exposure of the brand [13]. Therefore, there is extensive user data that can be leveraged for data-informed marketing tactics [14]. The metaverse is a trend that, when adopted, allows companies to stay at the top of the digital wave, gain new audiences, and build robust, lasting marketing campaigns [15].

Given its role in changing how consumers engage and how traditional advertising platforms are structured, marketing in the metaverse is important [2]. The industry is well aware of the metaverse's potential, but very little research is done on how this immersive technology can be leveraged for improved marketing. It reveals that there exists a clear research gap. To fill this research gap, this study accomplishes this through systematic literature review

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Capitalizing the Power of ChatGPT for Digital Business: Factors Catalyzing its Usage in Marketing

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ABSTRACT

This study aims to synthesize the existing literature on the application of ChatGPT and identify what factors influence the actual use of ChatGPT in Bangladesh. A mixed method approach along with a descriptive research design is employed. Data is collected with a pretested 7-point Likert scale questionnaire disseminated through online media to the 260 marketing executives selected with convenience sampling. Finally, 126 responses were analyzed using regression analysis. The findings indicate that marketers in Bangladesh use ChatGPT for Content_Generation, SEO_Optimization, and writing Product_Description, but Lead_Generation negatively impacts the usage of ChatGPT. Other variables such as Email_Marketing, Socialmedia_Management, Customer_Relationship, and Marketing_Research are not found statistically significant. However, a small sample size inhibits the generalizing of the result. This study contributes by providing a picture of the usage of ChatGPT in the digital marketing sector in Bangladesh. Future research should address the sample size limitation and consider ethical issues and additional variables suggested by TAM and UTAUT models.

Keywords: ChatGPT, Digital Business, Digital Marketing, Artificial Intelligence, Technology Usage, Marketing 5.0, Generative AI
JEL Classifications: M1, M3, M15, O14, O15, O32, O33

1. INTRODUCTION

In recent times, the integration of artificial intelligence (AI) has witnessed a burgeoning presence within the business landscape, and digital marketing has particularly harnessed the advantages of this formidable technology. One notably promising AI technology in this context is the natural language processing model ChatGPT, founded on the GPT-3.5 architecture (Taecharungroj, 2023). As articulated by Hetler (2023), ChatGPT exhibits the capacity to generate responses resembling human-like language, positioning it as an optimal tool for customer engagement and the delivery of personalized content. The transformative potential of this technology in reshaping corporate interactions with audiences and boosting sales has been underscored by Chowdhury (2023). As elucidated by Chowdhury (2023), ChatGPT offers multifaceted enhancements to business processes and performance, a sentiment echoed by various researchers. For instance, Chui et al. (2022) posit that ChatGPT contributes to an enriched customer experience by furnishing personalized responses to inquiries and concerns. Furthermore, personalized service engenders heightened consumer engagement and satisfaction, thereby elevating the overall brand image of the company. Notably, the integration of ChatGPT in content creation and automated responses through chatbots liberates human resources for strategic planning and higher-level tasks (Hariri, 2023). Recognizing customer needs, desires, and demands is elemental for effective marketing and business performance. ChatGPT facilitates companies in identifying consumer perceptions and needs through the analysis of sentiment

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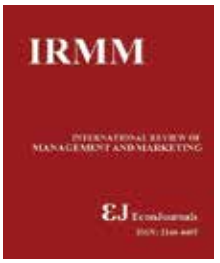

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How Artificial Intelligence Brought a Paradigm Shift in the Digital Marketing Landscape: A Scientometric Mapping and Future Research Directions

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ABSTRACT

This bibliometric and scientometric research aims to comprehensively analyze the application of Artificial Intelligence (AI) in digital marketing. The study uses the Scopus database to identify 355 research papers published between 2000 and 2025. This research intends to provide an overview of the research landscape, including the most cited articles, authors, and journals, to identify the trending topics of the research, and to determine the thematic development in this domain. The findings reveal that research in this field depicts exponential growth after 2017 and will continue to grow in the future and the Journal of Marketing is the most contributing journal. The most commonly used AI technologies in digital marketing include machine learning (ML), natural language processing (NLP), predictive modeling, and chatbots with tools such as ChatGPT, OptiMonkAI, Jasper, Midjourney, Manychat, Zapier, ElevenLabs, and OpusClip. The findings further synthesize that these AI tools and technologies enable marketers to collect and analyze large amounts of real-time data (structured, unstructured, and semi-structured) and are applied to achieve multifold strategic and tactical marketing objectives: To make improved customer segmentation, behavior prediction, and targeting, to enhance customer service, experience, and satisfaction, to ensure marketing efficiency through automation, to create and personalize content, and to efficiently manage social media and personalized email marketing and e-commerce website. However, there are concerns about the potential for the sustainable implication of AI considering data privacy and security and ethical issues. Future research should focus on the application of AI to ensure and enhance sustainable societal well-being (society 5.0) through marketing 5.0.

Keywords: Artificial Intelligence, Digital Marketing, Technology Adoption, Machine Learning, Bibliometric Analysis, Systematic Literature Review
JEL Classifications: M31, M37, 033, C63

1. INTRODUCTION

Today is the age of data, chatbots, and ChatGPT, and people (customers) are generating humongous amount of data, 402.74 million terabytes every day (Fabio Duarte, 2024). According to Bala and Verma, (2018) astute marketers can effectively harness the benefits of this solid data by analyzing it and using it to provide better customer service and experience and to deliver improved customer value.

Artificial intelligence (AI) has rapidly emerged as a revolutionary technology in various fields (Ali et al., 2023; Dwivedi et al., 2022; Haefner et al., 2021; Saura et al., 2021), digital marketing is also

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Review Article

Blockchain is the Future of Financial Services: A Bibliometric Analysis

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Abstract: *In the modern age of global and sustainable information management, blockchain has undergone a revolutionary transformation within financial services. To comprehend this novel trajectory, this study employs a systematic review and bibliometric analysis to investigate key research themes and trends in adopting blockchain technology within the financial services sector. Following the PRISMA approach, the authors meticulously curated relevant articles from the Scopus database. Bibliographic data were then meticulously assembled and analyzed using VOSviewer 1.6.18 to construct various network visualization maps, including co-authorship, citation, co-citation, bibliographic coupling, and term co-occurrence. The resulting network maps provided a comprehensive overview of the scholarly landscape, highlighting influential works, collaborative networks, and thematic clusters. Significant terms were extracted and cross-mapped through this rigorous analysis to identify patterns and interconnections. The authors distilled three overarching themes from the literature, namely decentralization, resiliency, and challenges. These themes encapsulate the transformative potential of blockchain in reshaping traditional financial paradigms. The findings from this study not only contribute to a nuanced understanding of the current state of blockchain adoption but also pave the way for future research directions in addressing challenges and advancing the integration of blockchain technology within the financial services sector.*

Keywords*: Blockchain, Technology, Financial Services, Bibliometric Analysis.*

I. INTRODUCTION

The technology known as blockchain has the potential to be revolutionary and poised to reshape the landscape of financial services. In the dynamic landscape of financial services, the advent of blockchain technology has been heralded as a transformative force, promising unprecedented levels of security, transparency, and efficiency. As financial institutions grapple with the challenges of a rapidly evolving digital era, blockchain stands out as a disruptive innovation with the potential to redefine traditional financial paradigms.

Recent statistics underscore its rapid ascent: The worldwide market for blockchain technology is expected to increase at a Compound Annual Growth Rate (CAGR) of 59.9% from 2023 to 2030, reaching $469.49 billion globally (Fortune Business Insights, May 2023). As the financial sector grapples with the challenges of digitalization and security, blockchain offers a promising solution, offering enhanced security, transparency, and efficiency.

Recent literature underscores the growing importance of blockchain technology in the financial sector. One notable trend is the increasing acknowledgment of blockchain's potential to revolutionize not only transactional processes but also the broader financial ecosystem. A study by Javaid et al. (2022) delves into the practical applications of blockchain in financial services, emphasizing its capacity to streamline cross-border transactions and enhance financial data security.

This work contributes valuable insights into the tangible impacts of blockchain adoption within the industry, providing a foundation for the present research to systematically explore these applications. Moreover, the systematic review and bibliometric analysis conducted by Johnson and Smith (2022) have identified a surge in scholarly interest in blockchain's role in financial services over the past decade (Firdaus et al., 2019). Their findings highlight the diverse array of research themes, including but not limited to regulatory challenges, smart contracts, and the integration of blockchain with existing financial infrastructures. By building on these foundational works, the current research aims to extend the scope and depth of understanding regarding the multifaceted dimensions of blockchain's influence on financial services.

Despite the growing interest in blockchain's potential within financial services, a comprehensive understanding of its trajectory remains elusive. This paper embarks on a journey to fill this knowledge gap through a systematic review and bibliometric analysis of existing literature. Our objective is to shed light on the pivotal role of blockchain in shaping the future of financial services, examining the key themes, trends, and contributions that have paved the way for its adoption.

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The profitability of green banking activities of selected banks (SCBs and PCBs) in Bangladesh: An empirical analysis

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Green banking
Profitability
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ABSTRACT

Global warming is a significant global issue, and Bangladesh is one of the countries most adversely impacted, facing numerous environmental and economic problems. This study addresses these challenges by reviewing existing research to identify gaps in knowledge and aims to assess the profitability of green banking activities in Bangladesh. The research focuses on how green banking activities, guided by specific policy frameworks, can contribute to financial performance. However, it explores not only the profitability of these activities but also the associated challenges and opportunities, providing prospects, suggestions, and recommendations for selected banks. The statistical techniques are used, i.e., descriptive statistics, graphic presentations, ANOVA, post-hoc test (LSD), linear regression in SPSS, and regression for panel data in Gretl, etc. After analyzing the data, the results of this study inform us of the theoretical understanding by statistical proved for areas of policy guidelines of green banking practice and informs us empirical understanding by statistical verified for the profitability of green banking activities regarding policy guidelines of green banking by selected SCBs & PCBs. Finally, it is observed comparatively among SCBs, the RBL is the best performer, and among PCBs, the IBBL is the best performed comparatively, but JBL among SCBs and BAL among PCBs are in the most unfavorable position comparatively. The implications of the empirical analysis on the profitability of green banking activities among selected banks (SCBs and PCBs) in Bangladesh extend beyond the immediate financial realm, encompassing environmental sustainability, regulatory compliance, and the long-term viability of the banking sector.

Contribution/ Originality: Beyond profitability, the study contributes to the discourse on environmental sustainability and regulatory compliance within the banking sector. By linking green banking practices to tangible financial outcomes, the research supports the argument for more sustainable banking operations.

1. INTRODUCTION

The concept of "Green" encompasses a wide range of social, ethical, and environmental aspects (Cepni, Demirer, & Rognone, 2022; Kanamura, 2020; Siddique, Nobanee, Hasan, Uddin, & Nahiduzzaman, 2024). Across

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Original Article

Investigating the Relationship between Emotional Intelligence and Entrepreneurial Intentions

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Abstract: Purpose: *This study aims to explore the relationship between emotional intelligence and entrepreneurial intentions, focusing on how key emotional intelligence dimensions influence an individual's intention to engage in entrepreneurial activities.*
Design/Methodology/Approach: *A quantitative survey was conducted using a structured, self-administered questionnaire based on adapted scales. Data were collected from 190 usable responses between March and May 2025 from students at a public university in Bangladesh. Responses were recorded on a 5-point Likert scale, and data were analyzed using SPSS version 24.0.*
Findings: *Multiple regression analysis revealed that self-awareness negatively influenced entrepreneurial intentions, rejecting the first hypothesis. In contrast, managing emotions, self-motivation, empathy, and social skills showed significant positive effects, supporting the remaining four hypotheses. These findings suggest that key emotional intelligence dimensions strongly predict entrepreneurial intentions.*
Originality/Value: *This study uniquely examines the impact of emotional intelligence dimensions on entrepreneurial intentions within a Bangladeshi university context, enriching the global entrepreneurship literature. It highlights the crucial role of emotional intelligence in entrepreneurial motivation and offers practical insights for enhancing entrepreneurship education through emotional intelligence development.*
Contribution: *Theoretically, this study adds to the entrepreneurship literature by showing how emotional intelligence shapes entrepreneurial intentions. It also supports prior international findings in a Bangladesh context. Practically, it offers guidance for universities and policymakers to foster entrepreneurship through emotional intelligence-focused training, workshops, and student engagement activities.*
Key Recommendation: *Entrepreneurial training should include emotional intelligence development, as emotional intelligence enhances confidence, self-awareness, and the ability to handle challenges. Institutions should integrate emotional intelligence-focused programs to better prepare individuals for entrepreneurship, especially those unsure of their potential, making emotional intelligence a key factor in fostering entrepreneurial success.*

Keywords: *Emotional Intelligence, Entrepreneurial Intentions, Self-awareness, Managing Emotions, Motivating Yourself, Empathy, Social Skills.*

I. INTRODUCTION

Entrepreneurship is an emotional process and provides an extremely emotional context within which to study it (Cardon et al., 2012). The concept itself has increasingly become popular among academics and policymakers across the globe (Kanonuhwa et al., 2018; Keat et al., 2011). The level of dynamism in the working environment has led to the upsurge of opportunities for new entrepreneurial initiatives, making self-employment lucrative (Mortan et al., 2014). In principle, implanting entrepreneurial intention in the minds of students helps build towards future entrepreneurial behavior (Sun et al., 2015). This stems from the notion that intention is generally a desire to engage in a certain behaviour or activity and quite often results in the execution of the behaviour in question (Ahmetoglu et al., 2011). Thus, intention can be viewed as the initial step in the process of venture creation as uncovered by Yao et al. (2012).

It's evident from the previous explanation that entrepreneurship can solve a lot of issues. In developing and recently industrialised nations like South Africa, this is particularly true. In line with this, Malebana (2016) notes how South Africa needs more entrepreneurial intention studies to guide the development of interventions that could fuel entrepreneurial activity in order to reduce unemployment.

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The Salary Structure and Factors of Salary Disparity of Imam in Bangladesh: A Cross-Sectional Study

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ABSTRACT

Imams, as a profession, lagging far behind any other formal or informal profession in terms of work prospects, wage structure, and so on. This research aims to empirically investigate the factors influencing the socioeconomic level and salary disparities of imams in Bangladesh. In this case, we collected data applying questionnaires over a 6-month period. Questionnaires were distributed to 300 Imam who participated in the study voluntarily with oral consent. For quantitative data, we apply a multiple linear regression model, whereas qualitative data is analyzed using descriptive analysis and pivoted chart by using Microsoft excel and SPSS v25.In this research, most imams (61.7%) are between the ages of 21 to 40, 65% have large family. Average income of the respondent is about 10,045 BDT where 62.7% imam fall into lower income group (0-9990) although they all are educated in different level. 64.3 percent of imams have an oral job contract where 69% imam doing their job in full-time basis. In our study, 82% mosque is paka means build by bricks.

The investigation reveals the existence of statistically significant salary differentials in Imam. Prior to run the multiple linear regression model we test our assumption like linearity, multicollinearity, normality of u_i, homoscedasticity, outlier by box plot. In our regression model, the salary (dependent variable) is significantly depends on explanatory variables like education level, education type, job contract, location of the mosque and type of mosque that is statistically significant at 5% and 10% level. The R^2 value of this model is 0.269, indicating that approximately 27% of the variation in the dependent variable can be explained by the independent variables. The F-ratio in the ANOVA table indicates that the independent variables have a statistically significant predictive effect on the dependent variable, with $F(3, 8) = 19.794$, $p(.000) < .05$ (meaning that the regression model fits the data well).

Key words: Salary, Imam, Cross-section, Disparities, Socioeconomic Status, Bangladesh.

INTRODUCTION

According to population and housing census 2022, Bangladesh is evidently a Muslim majority country where 91.04 percent of 165.16 million people are Muslim. It is necessary for every Muslim society to pray at the mosque. In these circumstances according to Annual report 2020-21 of Islamic foundation, Bangladesh has around 3,13,395 mosques. Essentially each mosque has at least an Imam and he is counted as a paid full time or part time worker. Then there is minimum 3,13,395 people associated with Imam occupation which is significant amount of our work force as well as society.

BACKGROUND OF THE STUDY

According to the report of BANBEIS (Bangladesh Bureau of Educational Information and Statistics),Bangladesh is a South Asian developing nation. Bangladesh is widely considered a moderate Muslim democracy with 89.7% Muslims, 9.2% Hindus, 0.7 % Buddhists, and 0.3 % Christians. 0.1% of the population are animism and tribal religious adherents. Islam serves as the religio-cultural identity of the

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Determinants of the Patient Choice of Health Care Provider in Bangladesh

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ABSTRACT

Background: In Bangladesh, people have many choices to get healthcare facilities; like formal and informal health care. Patients are free to select any health care professional, from a licensed physician to a conventional faith healer. The major objectives are to examine the association between health care choice (HCC) and related factors.

Study design and Methods: A cross-sectional survey was conducted randomly with 230 people in Gopalganj district in Bangladesh. Data were collected by interviewing using a self-reported questionnaire who had been sick for the previous six months and field work conducted from July to December 2023. Descriptive statistics were used to explain their socio-demographic characteristics and factors of health care choice. The significance of the association between each component and healthcare choice has been assessed using the Chi-square test.

Results: A chi-square test of independence result, taking into account demographic and socioeconomic variables, indicates that there is a significant relationship between HCC and respondents' education and illness severity (values of $\chi2 = 9.053$, $p = .029$, and $\chi2 = 27.248$, $p = .000$, respectively). Other variables, such as gender, location and family income, are not significantly associated with HCC. Out of the 12 variables related to health care, only three—location, relationship with a doctor, and other medical facilities—are statistically significant at the 1%, 5%, and 10% level. These variable values are $\chi2 = 8.965$, $p = 0.062$, $\chi2 = 8.005$, $p = .090$, and $\chi2 = 10.200$, $p = .037$. The remaining nine variables are not significantly associated with HCC.

Conclusion: The findings demonstrated that patients received a different type of health care choice (HCC) that is significantly depends on their demand perspective, which is ignored in our country. Given the importance of the variables involved, the government ought to focus on improving the quality of doctor-patient collaboration, providing more hygienic facilities, and expanding medical services in innovative ways for patients.

Key words: Health care choice, Patient, Factors, Bangladesh.

BACKGROUND

Bangladesh has a diversified healthcare system that includes both formal, such as that provided by the government hospital, private hospital, non-governmental organizations (NGOs), doner agencies and informal, such as that provided through traditional (untrained practitioners, homeopathic, ayurvedic, and unani medicine, medicine shops, kobiraj, religious beliefs, etc…) health practices (Jennings et al.,2021; Ahmed et al.,2015). One of the primary duties of the state is to improve public health and raise the standard of nutrition by offering balanced health and medical care, as stated in Article 15 of the Constitution (1972). Despite having few resources, Bangladesh has been making an effort to mainstream healthcare services that meet international standards (Ali,2020). Since Bangladesh has the lowest current healthcare expenditures (2.63%), public health

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Persistent budget deficits and sustainable external debt: Long-term impact on economic growth in Bangladesh

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Abstract

Debt sustainability is a critical concern in achieving long-term macroeconomic stability, particularly for developing economies like Bangladesh. This study examines the interrelationship between budget deficits, external debt, and economic growth, utilizing annual data from 1980 to 2021. Employing correlation analysis, multiple regression, and principal component analysis, the study identifies a negative association between budget deficits and external debt. Moreover, while external debt exerts a negative influence on economic growth when considered in isolation, its impact becomes positive when combined with stable and supportive policy variables. These findings underscore the significance of comprehensive fiscal management and macroeconomic stability in leveraging external borrowing for growth. The results offer important policy insights: external debt, when guided by prudent and forward-looking strategies, can catalyze development rather than be a constraint. The study emphasizes the need for institutional capacity-building and efficient public investment to ensure debt sustainability in the face of rising repayment obligations.

***Keywords*:** External debt; budget deficit; economic growth; debt sustainability; fiscal policy; Bangladesh

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Russia's Strategic Shift from European Integration to Eastern Alliances after the War in Ukraine: A Postcolonial Perspective

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Open Access

Abstract

The geopolitical landscape of the 21st century has witnessed significant shifts, none more pronounced than Russia's strategic realignment from a focus on European integration to forging alliances with key Eastern powers. Russia's strategic shift from European integration to Eastern alliances following the Ukraine war, is analysed through a postcolonial perspective. The study aims to assess the historical context of Russia's relationship with Europe, analyse its realignment towards the East, explore the postcolonial implications of rejecting Western-dominated systems, and evaluate emerging alliances with key Eastern powers. The nature of the study was qualitative, utilizing a thematic analysis, content analysis, examining official statements, and relevant scholarly articles from 2002-2023. The findings reveal that the Ukraine crisis acted as a critical turning point, deepening Russia's disillusionment with the West. Western sanctions, imposed after the annexation of Crimea, accelerated Russia's pivot towards the East, fostering stronger economic and political ties with China, India, and other non-Western states. This shift is framed within Russia's broader postcolonial resistance to Western hegemony, where sovereignty and self-determination emerge as central themes. The study further highlights Russia's efforts to challenge Western-dominated institutions by promoting a multipolar world order and Russia's realignment is not only a pragmatic response to isolation but also an ideological assertion of autonomy in the face of perceived Western neo-colonialism. The paper concludes that Russia's evolving alliances with Eastern powers reflect a postcolonial agenda to resist Western dominance and reimagine its global role, underscoring the country's long-term strategy to redefine the international order.

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Social Awareness for Women's Health: A Baseline Study in Gazaria, Munshiganj, Bangladesh

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Abstract

Background: In response to the critical need for addressing women's health issues in marginalized communities, this research undertook a baseline study to assess social awareness related to women's health in Gazaria, Munshiganj, Bangladesh. The study focused on understanding the existing knowledge, attitudes, and practices regarding women's health to inform targeted interventions for improvement. **Objective:** The primary objective of the baseline study was to comprehensively investigate the level of social awareness concerning women's health in Gazaria, Munshiganj, Bangladesh. Specific aims included assessing knowledge gaps, identifying prevalent attitudes, and documenting current health practices among the community members. **Methodology:** This research adopted a cross-sectional study design, utilizing both quantitative and qualitative research methods. A structured questionnaire was administered to a representative sample of individuals from the Gazaria community. Additionally, in-depth interviews and focus group discussions were conducted to gather nuanced insights into social perceptions and practices related to women's health. The study period spanned [insert timeframe], encompassing diverse demographic and socio-economic groups. **Findings:** The baseline study revealed critical insights into the social awareness landscape regarding women's health in Gazaria. Key findings included disparities in knowledge about reproductive health, limited access to menstrual hygiene products, and notable gaps in mental health awareness. Additionally, prevailing socio-cultural norms and economic constraints were identified as influential factors shaping women's health practices. The study highlighted the need for

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Social Awareness for Women's Health: An Endline Study in Gazaria, Munshiganj, Bangladesh

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ABSTRACT

Background: The "Social Awareness for Women's Health: Gazaria Pilot" project aimed to address menstrual health awareness and distribute free sanitary napkins in the Gazaria region. This endline survey evaluates the project's impact on menstrual health practices, knowledge, and socio-cultural barriers among women and girls.

Objective: Baseline data highlighted critical challenges, including limited awareness about menstrual hygiene, widespread use of non-hygienic materials such as old cloths, and significant emotional distress associated with menstruation. Access to reliable menstrual health information was predominantly through informal channels, with cultural taboos further exacerbating the menstrual health crisis.

Methodology: A mixed-methods approach was employed, combining quantitative surveys and qualitative interviews to gather data from community members participating in the Gazaria Pilot project. Surveys were conducted to assess changes in health behaviors and attitudes, while interviews provided insights into community perceptions and experiences with project interventions.

Findings: Following the project's implementation, there was a notable improvement in menstrual hygiene practices. The use of disposable sanitary napkins increased from 5.99% at baseline to 15.36% at endline, reflecting enhanced access and acceptance of sanitary products. Additionally, knowledge about the risks of unclean menstrual practices and the benefits of personal hygiene saw significant gains, with awareness rising from 55.5% to 72.66% and from 62.0% to 75.78%, respectively. Menstruation has decreased emotional reactions, promoting mental well-being, but challenges persist like reliance on old cloths, lack of medical advice, and socio-cultural taboos affecting health behaviors.

Conclusion: The project emphasizes the need for community-based interventions and sustained engagement to improve menstrual health outcomes in Gazaria, highlighting the need for ongoing efforts.

Keywords: Menstrual Health, Menstrual Crisis, Sanitary Napkin, Community-Based Interventions, Socio-

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Social Science Review

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Studying Impacts of ICTs on Youth Culture: Opportunities, Issues, and Challenges in Adopting Mixed Methods

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Keywords
Mixed method approach, ICTs, Youth Culture, Methodological review

Abstract
This article aims to present a comprehensive framework for researchers exploring the impacts of information and communication technologies (ICTs) on youth culture. By reviewing previous studies in this field, the research evaluates methodologies employed to understand how ICTs influence the cultural practices of contemporary youth. Through an examination of relevant literature, the study highlights the effectiveness of various research approaches, emphasizing mixed methods as the most robust strategy for investigating this area. This work serves as a valuable guide for novice researchers, offering insights into designing studies that effectively capture the dynamic interplay between ICTs and youth culture.

Introduction

Methodological reviews that concentrate on study design rather than study findings, have been used in a variety of sectors in order to enhance research practice, enlighten discussion, and uncover islands of practice (Randolph et al., 2013). Methodological reviews help a new researcher to go through an appropriate line in researching a specific area. It shows the opportunities, challenges, and issues that a specific research area may fall on. The current epoch, the contemporary one, is characterized by rapid technical advancement. Information technology has become a revolutionary force that is reshaping the social, economic, and political fabric of the world (Ahmed et al., 2006). One of the powerful factors altering modern society is the cultural trend that travels with the information and communication technologies (Long, 2010). The norms, beliefs, and values of youth, as well as their lifestyle choices and behaviors, are shaped by the influential worldwide media and global culture. Attachment to ICTs of young people may be due to their attractive features, such as the abundance of information they provide and the pleasures they provide. Aside from the youngsters themselves, this connection has repercussions for the larger social interactions in which they are embedded. As they go about their daily lives, they get a taste of both international and neighborhood happenings (Hossin & Mohiuddin, 2015).

Life span of youth is contextual and may be varied along with different countries while most commonly youth refer to the time when a person's body and mind are both actively developing; this represents the accumulation of all the forces necessary for the formation of a healthy adult human being (Matthew, 2007). Youth "are often 'first adopters' of new technologies, and this appears to be the case with ICTs" (Halewood & Kenny, 2008). Rashid, Amin, Arefin, & Rahaman, 2018 found that youth are attached to most used type of ICTs gadgets i.e., mobile phone and computer for more than 4 hours a day. Since young people are more likely to be influenced by ICTs in any given culture, gauging its effects on them is an important event in the present. As time goes on, many noticeable shifts may be traced back to the widespread use of ICTs across society (Amin, 2018). Several studies on the subject have been read, and a pilot study has been conducted, all in an effort to evaluate the efficacy of various approaches to this kind of study. Next, we'll provide examples of the ways other researchers have used, and then we'll discuss the benefits of combining approaches to help a new researcher evaluate the effects of ICTs on young people's cultural practices.

Conceptual framework

Youth Culture

Youth culture, shaped by the interplay of behaviors, values, and practices, is increasingly influenced by digital media and technology. Digital platforms have become central to identity formation, cultural expression, and social interaction among youth. Social media enables young people to share cultural narratives, participate in global conversations, and foster community across borders, resulting in hybrid identities shaped by both local and global influences (Rafalow, 2018; Hasson et al., 2017).

Digital tools have democratized cultural participation, empowering marginalized groups to amplify their voices and engage in cultural resilience. For example, Indigenous youth use digital storytelling to preserve their heritage and assert their identities while fostering intergenerational connections (Walker et al., 2021). Similarly, African American youth challenge stereotypes and assert their identities through digital media, reflecting its role as a tool for cultural expression and activism (Baker et al., 2011).

However, digital engagement also poses challenges. Issues such as anxiety, depression, and sleep disturbances are prevalent among youth, highlighting the need for digital literacy programs to promote safe and responsible online interactions (Good, 2021; Shroff et al., 2023). These initiatives can support mental well-being while equipping youth to navigate misinformation and digital manipulation (Literat et al., 2018).

Digital media also plays a pivotal role in youth political engagement. Social media enables decentralized, real-time activism, transforming how youth advocate for social change and participate in civic activities (Polozhentseva et al., 2021; Dobson, 2023). Additionally, educators are incorporating digital literacy into curricula to prepare youth for the complexities of the digital age, fostering critical thinking and informed citizenship (Hagge, 2023; Chauke, 2024).

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Analyzing the Efficacy of Local Government Initiatives in Alleviating Poverty and Advancing Sustainable Development Goals (SDGs): A Study at Gobra Union in Gopalganj Sadar, Gopalganj

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ABSTRACT

The Union Parishad (UP) is a local government that plays a crucial role in reducing rural poverty and promoting rural development to accomplish the Sustainable Development Goals (SDGs) at the grassroots level. The primary objective of this study was to assess the effectiveness of local government measures in diminishing poverty and promoting progress towards the Sustainable Development Goals (SDGs) in Gobra Union, a sub-region under Gopalganj Sadar. This study adopted a quantitative research methodology and utilized the survey method to collect data on respondents' income, access to basic services, and the implementation of local government programs. We obtained data using the method of simple random sampling and ultimately selected 120 participants from 50 households. The results of our research indicated that Gobra Union has achieved notable progress in reducing poverty and advancing Sustainable Development Goals (SDGs) through various interventions led by the government. These interventions have encompassed income-generating schemes, healthcare efforts, and educational programs. Furthermore, the analysis of data from the local community revealed that a mere 10.8% of respondents were unequivocally confident in the flawless execution of authorities' duties, while the remainder 89.2% have expressed disagreement with this notion. Merely 5% of participants expressed complete satisfaction with the performance of UP's representatives, and 31% expressed dissatisfaction with the overall system. However, the constraints of limited funds, administrative obstacles, and inadequate participation from the community persistently hinder the attainment of absolute success. The study has recommended establishing Gopalganj Sadar as a benchmark for encouraging sustainable development and poverty reduction. This may be achieved by fostering collaboration among local governments, communities, and development organizations.

Keywords: Poverty alleviation, Empowerment, Local Government, Union Parishad, Gobra Union

INTRODUCTION

Union Parishads (UPs) are the local bodies at the lowest level of local government, and they have great potential to alleviate poverty and have been seen as the key collaborator in achieving the Sustainable Development Goals (SDGs) in their own communities. This institution plays a significant role in rural development across a number of fronts, as mandated by the Constitution and Ordinance. In general, people have a strong sense of loyalty and attachment to this organization. Union Parishads (UPs) have traditionally played an important role in local governance and development, and the recently adopted local government (Union Parishad) act 2009 has given them certain new responsibilities (Aminuzzaman, 2014). As a branch of central government, the Union Parishad is crucial in helping to solve the issues plaguing the region. Utter Praise's work to alleviate poverty and improve rural areas has benefited locals in many ways, including the creation of new institutions and the distribution of money, food, medical care, and other essentials. On the

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Prevalence and Predictors of Psychological Distress among Police Personnel in Bangladesh: A Cross-sectional Study

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Keywords
Police personnel, psychological distress, predictors, mental health, Bangladesh

Abstract
The police profession is renowned for its demanding and stressful work environments. Police personnel worldwide face unique stressors that can contribute to psychological distress. This cross sectional study explored the prevalence and predictors of psychological distress among police personnel in Bangladesh. A total of 267 police personnel were purposively selected from three divisions of Bangladesh: Dhaka, Chittagong, and Rajshahi. Data were collected using a self-administered questionnaire survey, incorporating the Bangla versions of the Kessler Psychological Distress Scale (K6), Bergen Insomnia Scale, and Work Family Conflict Scale. Demographic and work-related information was gathered through a personal information questionnaire. To achieve the study objectives, independent sample t-tests, one-way ANOVA, correlation coefficients, and multiple linear regression analyses were conducted. The findings revealed that 73% of the participants experienced severe psychological distress, highlighting the need for continuous mental health support for police personnel's physical and mental well-being. Significant positive correlations were found between working hours, insomnia, work-family conflict, and psychological distress. Multiple linear regression analysis confirmed that long working hours and insomnia significantly predicted psychological distress, explaining 14% of the total variance. An effective national and longitudinal research is required to validate these results, which indicate that work schedule management and proper sleep may be an effective way to reduce distress and support psychological health.

Introduction

Policing is a demanding job that puts a lot of psychological strain on people who work in it. It is one of the most important segments of a society and has to maintain laws and orders that demands

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Article

Empowerment of rural women through microfinance in Bangladesh: Empirical evidence from the Grameen Bank of Bangladesh

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Abstract: The study's goal is to evaluate how microfinance initiatives affect women's empowerment in Bangladesh. For this study, we analyzed data on a variety of women's empowerment-related issues, including both beneficial and detrimental elements that stand in the way of women's empowerment. Therefore, in order to accomplish the specified goal, we choose a suitable and intentional methodology. We employ diverse data gathering approaches to examine the gathered data and achieve the primary goal of the research project. It presents the positive effects of microfinance on women, such as (1) the enhancement of women's authority in financial affairs; and (2) the augmentation of their ability to make decisions in household; and (3) community matters following their participation in the microfinance program. This also provides an analysis of the data pertaining to the adverse effects of microfinance on women. It examines how women encounter various challenges and engage in unethical behaviors after obtaining a loan, leading to heightened levels of stress following their participation in the microfinance program. This study looks into the advantages and disadvantages of Grameen Bank's microcredit program for women. A questionnaire gathered primary data for this study from women participating in the microfinance program in Gopalgonj. To collect information and comprehend respondent behavior, I used case study, analytical and descriptive study design. Regression analysis, correlation, and percentage are used to examine the data. The findings indicate that women's decision-making skills have improved due to their financial stability, but they have also experienced increased life challenges and high levels of stress.

Keywords: microfinance; women empowerment; Grameen Bank; rural area; positive effects; detrimental effects

1. Introduction

"Microfinance" refers to the provision of financial services to marginalized populations. These individuals are unable to access financial services provided by other financial institutions. Microfinance institutions offer a range of services to those that are economically disadvantaged, including but not limited to savings, microcredit, insurance, and remittance. Microfinance, a form of financial services, provides financial assistance to individuals or groups who are unemployed or have low incomes, thereby granting them access to such services that would otherwise be inaccessible. It serves as a financial service provider for entrepreneurs and small enterprises that do not have access to traditional banking services. This service specifically benefits low-income individuals, including women, who are excluded from economic opportunities.

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Pesticides and Public Health: A Field-Level Analysis in Southwestern Part of Bangladesh

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ABSTRACT

Agriculture employs a significant proportion of Bangladesh's population, with pesticide application serving as a standard practice for pest control and yield enhancement. However, persistent concerns exist regarding the human health and environmental sustainability impacts of excessive and improper pesticide use.

This study evaluates the health consequences of pesticide exposure among farmers, utilizing data from 120 respondents across southwestern part (Khulna, Bagerhat, Satkhira and Jashore districts) of Bangladesh. Findings indicate that most farmers operate within challenging socioeconomic circumstances. Critically, pesticide users incur more than double the healthcare expenditures compared to non-users, with "mixed users"—those applying multiple pesticide types—experiencing disproportionately severe health outcomes.

The analysis reveals a robust positive association between pesticide exposure and adverse health effects, which subsequently drives a significant increase in workdays lost among users. To mitigate these health impacts, the study strongly advocates implementing preventive measures during application, including consistent use of personal protective equipment (PPE) and strict adherence to usage guidelines.

Further large-scale research into the health costs associated with mixed pesticide exposure is recommended to strengthen the evidence base and inform targeted policy reforms.

Keywords: Pesticide Exposure, Insecticide Exposure, Mixed Pesticide Users, Protective Behaviors, Farmer Health, Agricultural Health Costs

BACKGROUND OF THE STUDY

Agriculture remains the primary livelihood for a significant proportion of our nation's population, with pesticides widely employed to enhance crop productivity (Bourguet et al., 2016; Pimentel, 2005). Recognized as the most efficient method for pest control (Abdou and Atta, 2018), over 500 distinct active pesticide compounds are currently utilized in global agricultural production (Douglas et al., 2018). While pesticides demonstrably increase yields, their application poses severe negative consequences for environmental integrity and human health (Mahmood et al., 2016; Bourguet et al., 2016; Pimentel, 2005; Atreya, 2005, 2007).

Health impacts manifest acutely (e.g., headaches, dizziness, eye/skin irritation, muscular twitching) and chronically (e.g., compromised reproductive capacity, cancer) (Atreya, 2007). Global annual pesticide usage exceeds 3 billion kilograms, representing an expenditure of approximately $40 billion. Despite boosting yields, pesticides concurrently account for the destruction of an estimated 37% of potential crop production (Pimentel, 2005). Furthermore, over 2.2 million individuals in developing nations face elevated health risks due to pesticide exposure (Hicks, 2013).

Pesticides—primarily insecticides, fungicides, and herbicides—target organisms detrimental to crops (Sharma and Singhvi, 2017; Atreya, 2007; Daniels et al., 1997; Sharma et al., 2012). Organochlorine insecticides are

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Redefining Service Delivery: Customer Satisfaction and Service Process Simplification at Gopalganj Passport Office in Bangladesh

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Keywords
Bangladesh, Passport Office, Service Process Simplification, Customer's Satisfaction, Technological Innovation.

Abstract
The study explores the relationship between service process simplification and customer satisfaction within the context of a governmental service setting, focusing on the Gopalganj passport office. The study aims to find out the impact of streamlined service processes on customer experiences and satisfaction levels. Using a mixed methods approach data was collected through structured questionnaires administered to customers and semi-structured questionnaires conducted with staff members. Findings revealed that the majority of customers expressed high levels of satisfaction with the simplified service processes, opportunities for further enhancement were identified particularly in technological integration, streamlined procedures and accessibility improvements. Staff perspectives highlighted the positive impact of simplification initiatives on efficiency, yet underscored the need for continuous training and technological updates. The study emphasizes the significance of a customer centric approach, combined with regular training, technological advancement, streamlined processes and effective communication channels as the key drivers for fostering an efficient accessible and customer- friendly passport office environment.

Introduction

Rapid development of information and communication technology helps the extensive opportunities for delivering the public service in an efficient and cost-effective way (Bhuiyan, 2011). Governments everywhere have been trying to simplify the procedures involved in delivering services in order to increase the effectiveness and efficiency of their offerings. The

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Challenges behind Decolonising the English Language Teaching Curriculum of Bangladeshi Universities

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Abstract

This article explores the challenges in decolonising the English language teaching (ELT) curriculum in the context of Bangladeshi universities. It centers on the author's auto-ethnographic experiences of learning and teaching of English language at the tertiary level. Drawing on a qualitative approach, the study involves a critical analysis of current ELT curriculum, as followed by Bangladeshi universities. The paper discusses how the ELT curriculum in post-colonial Bangladesh continues to be characterised by a preference for or bias towards an Anglophile, Eurocentric, Global North, western and white understanding of English language use. The study at first aims to substantiate the urgency of decolonising the tertiary ELT curriculum in Bangladesh. More specifically, it envisions to interrogate the current ELT curriculum and its effects on tertiary English language practices in Bangladesh. It suggests some ways to decolonise the tertiary ELT practiced by Bangladeshi universities and then asks for a pedagogical approach to incorporate southern ways of practicing English as a decolonial option.

Keywords: Tertiary ELT, English Education in Bangladesh, English-only values, Curriculum politics and Decolonisation

Introduction:

The current English Language Teaching (ELT) curriculum including its textbooks practiced by Bangladeshi universities continue to rely on Anglo-centric values and ideologies of English language. The image of English as a global lingua franca and its resultant hegemonic assumptions have usually characterised ELT curriculum of universities in the post-colonial countries like Bangladesh (Hamid, 2021). ELT-induced textbooks are reported to present English as a universal structure rather than as a local and social practice (Alam, 2018; Pennycook, 2010). They also tend to highlight native-like perfection required for English users and learners in their communications with Anglophone users and epistemic activities in English (Nguyen, Marlina and Cao, 2021). Against this English-only backdrop, a basic pedagogical question should be advanced: how can Bangladeshi universities strive to decolonise ELT curriculum through southern perspectives of linguistic appropriation, compatibility, competence and conditioning?

The paper draws on the southern conceptualisations (Connell, 2007) on English including neo-colonial politics of English (Canajagarajah, 1999; Philipson, 1992). It will deconstruct English as a pluriversal, local, individual practice, production and appropriation rather than as a universal structure (Pennycook, 2010; Garcia, 2014; Kachru, 2013). Southern discourses and ideologies of English language that underlie an epistemic ecology and involve context-sensitive non-authoritarian methods

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Research Article

Is Pahela Baishakh a Popular Culture or Capitalist Culture in Bangladesh? A Comparative Study

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Abstract

This paper explores the various forms and styles of Pahela Baishakh celebrations among different socioeconomic classes in both rural and urban areas of Bangladesh, investigating whether it is an expression of popular culture or capitalist culture. Pahela Baishakh, the first day of the Bengali New Year, positions out as the most old-style and protruding cultural carnival in Bangladesh. According to Ahmed (2007a), Pahela Baishakh is the "biggest cultural festival of the Bengalis" and represents a "dynamic manifestation of popular culture in the urban context, and it is a living tradition of great significance" (p. 521). Although it is not a religious festival, it is widely embraced and celebrated by the majority. "To every Bengali, irrespective of age, social

শিল্প-সাহিত্য পত্র
প্রথম বর্ষ ● প্রথম সংখ্যা ● ঢাকা ● জুন ২০২৫
আইএসএসএন : ২৫৪১-৮৬৩২

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বাংলাদেশের নাট্য-আন্দোলন ও রাজনৈতিক আন্দোলন : আন্তঃসম্পর্কের বিশ্লেষণ

ড. সানজিদা হক মিশু

আর্টিকেল হিস্ট্রি : প্রবন্ধ প্রাপ্তির তারিখ: ২১.০২.২০২৫ ।।মূল্যায়নের তারিখ: ০২.০৩.২০২৫ ।। গ্রহণের চূড়ান্ত তারিখ: ১০.০৩.২০২৫

সূচক শব্দ : ঔপনিবেশিক, পরিমণ্ডল, প্রতিরোধ, গণনাট্য, শোষিত প্রভৃতি।

সার-সংক্ষেপ : একটি জাতির ইতিহাস নির্মাণ ও পুনর্গঠনে ঐতিহাসিক অন্যান্য উপাদানের সঙ্গে সাহিত্যের বয়ানও গুরুত্বপূর্ণ হতে পারে। বিশেষ করে, নাটকের মধ্য দিয়ে যেহেতু সমাজ-রাজনীতির প্রকৃত সত্য প্রবাহিত হয়ে চলে, আর নাটকের অঙ্ক-দৃশ্যে ধারিত হয় সময় ও ইতিহাস। রাজনৈতিক বা ঐতিহাসিক নাটকের সঙ্গে ইতিহাস পাঠের পর্যেষণ বা মূল্যায়ন তাই দারুণভাবে আকর্ষণ করতে পারে যে-কোনো গবেষককে। বাংলাদেশের সাংস্কৃতিক পরিচিতির ক্ষেত্রে নাটকের ভূমিকা অগ্রগণ্য। দৃশ্যকাব্য হওয়ায় তা আরও বেশি মান্য। ১৯৪৭-পূর্ববর্তী সময়, ১৯৪৭ থেকে ১৯৭১, কিংবা ১৯৭১-পরবর্তী কালপর্বে বাংলাদেশের রাজনৈতিক-সামাজিক-অর্থনৈতিক প্রেক্ষাপট ছিল সম্পূর্ণ আলাদা। ভাষা-আন্দোলন ও মুক্তিযুদ্ধ আমাদের জাতীয় জীবনের দুটি বড় ঐতিহাসিক ঘটনা। নাট্যকারগণ তাঁদের স্বকীয় চিন্তা ও প্রজ্ঞা থেকে বিভিন্নভাবে এ দুটি গুরুত্বপূর্ণ ঘটনার নানান নাট্যরূপ দিতে প্রয়াসী হয়েছেন। বলা যায়, বাংলা নাটকের বৈচিত্র্যের ধারা তৈরি করার পিছনে, কিংবা নানা প্রান্ত উন্মোচিত হওয়ার কারণ হিসেবে ভাষা-আন্দোলন ও মুক্তিযুদ্ধ তাৎপর্যপূর্ণ ভূমিকা রেখেছে। ১৭৫৭ সালে নবাব সিরাজউদ্দৌলার পতনের মধ্য দিয়ে বাংলার স্বাধীনতা-সূর্য অস্তমিত হয়েছে ধরা হয়। এরপর প্রায় দুইশ বছরের ঔপনিবেশিক শাসন। দ্বিতীয় বিশ্বযুদ্ধকালীন ইংরেজ শাসনের খাদ্যনীতি ও কালোবাজারীদের অর্থলালসার কারণে সৃষ্ট ১৯৪৩ সালের মন্বন্তর ও মানুষের মৃত্যু সমাজজীবনে প্রচণ্ড ধাক্কা দেয়। বিশ্ব রাজনৈতিক প্রেক্ষাপটে সাহিত্যের অন্যান্য আঙ্গিকের মতো বদল ঘটতে থাকে নাটকেরও। মানুষের অস্তিত্বসংকট, আহাজারি, রোধ-প্রতিরোধ অনিবার্যভাবে নাটকের বিষয়বস্তু হয়ে ওঠে।

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রাধারমণ দত্তের গান
অধ্যাত্মবাদ ও লোকজজীবনের শিল্পনন্দন আলেখ্য

ড. সানজিদা হক মিশু*

সারসংক্ষেপ (Abstract)

সিলেটের ভাবান্দোলনের লোকনায়ক রাধারমণ দত্ত (১৮৩৩-১৯১৬)। সহজিয়া বাউলদের প্রতিনিধি হিসেবে রচনা করেছেন বহু গান। নিজের মেধা ও দর্শনকে কাজে লাগিয়ে মানুষের কাছে হয়েছেন পরিচিত। দেহতত্ত্ব, ভক্তিমূলক, অনুরাগ, ভজন, ধামাইলসহ নানা ধরনের গান রচনা করেছেন তিনি। তাঁর গানে অধ্যাত্মবাদ ও লোকজজীবনের দেখা মেলে। স্রষ্টার প্রতি ভক্তি, প্রেম, মানব প্রেম তাঁর গানের মূল উপজীব্য। সাম্প্রতিক সময়েও রাধারমণের গান অনেক বেশি গ্রহণযোগ্য। লোকজবোধ, বিরহ, সৃষ্টিতত্ত্ব, পরমতত্ত্ব প্রভৃতি বিষয় তাঁর গানকে অলংকৃত করেছে। তাঁর গানগুলো অধ্যাত্মবাদের জায়গাতে আলোচিত ও স্বকীয়। সমাজের শোষিত মানুষের বেদনার ভাষাকে সুরে সুরে পৌছে দেওয়ার ব্রত ছিল তাঁর মাঝে। তাঁর গানে অসাম্প্রদায়িকতার সুরও রয়েছে। রাধারমণ তাঁর গানে লোকপ্রিয়তার জায়গা তৈরি করেছেন।

বাউলের কোনো জাত-ধর্ম-সংসার নেই। সম্পূর্ণ জাগতিক মোহমায়া থেকে পৃথক হয়ে ঈশ্বর বা পরমেশ্বরের সঙ্গে আত্মার সন্ধি স্থাপনের ধ্যান জ্ঞানই মুখ্য বিষয় হয়। তবে রাধারমণ দত্ত (১৮৩৩-১৯১৬) সম্পূর্ণ ভিন্ন ঘরানার ছিলেন। লোকসমাজে বাউল হিসেবে পরিচিত থাকলেও তিনি মূলত বাউলের কোনো কার্যবিধিকে তাঁর জীবনে প্রয়োগ করেননি। সংসারের বন্ধনে আবর্ত থেকে গুরুভক্তি সাধনার তপস্যা করেছেন। একদিকে পার্থিব সুখ ভোগ করেছেন অন্যদিকে প্রভুর সঙ্গে মিলনের বাসনায় উন্মাদ হয়ে পথের যাত্রী হয়েছেন। সেখানে শুধুই স্থান পেয়েছে গুরুর প্রতি অপরিসীম ভক্তি ও শ্রদ্ধা। একবার আক্ষেপ

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INTERNATIONAL JOURNAL OF JUDICIAL LAW

A Legal Study on Combating Cyber Slavery in Bangladesh through Prevention and Protection

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Abstract
In Bangladesh, cyber slavery has become a major issue as a result of several residents being victims of human trafficking schemes that use them in Southeast Asian online fraud activities. Victims inside these compounds are subjected to harsh mistreatment, including as incarceration, electric shocks, and beatings, particularly if they don't achieve fraud quotas. One Bangladeshi guy who was trafficked to Cambodia, Mohammad Abdus Salam, for example, spoke of being subjected to torture and forced labour while facing death. In a similar vein, another Bangladeshi, Foysal Hossain, was sold to cybercriminals in Cambodia and tortured until he met with their demands. With many of its inhabitants falling victim to dishonest recruiting practices that result in their exploitation in scam operations overseas, cyber slavery is still a major problem in Bangladesh. The study will explore stronger enforcement of anti-trafficking legislation, increased international collaboration, and extensive victim support networks are all necessary to address this epidemic. Through this study, it is advisable to govern the procedure to prevent cyber slavery in Bangladesh and explore the effective state legal structure, establish international assistance and raise public awareness on cyber slavery.

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Keywords: Cyber Crimes, Cyber Slavery, Human Trafficking, Cyber Safety, Law and Policy

Introduction

The insufficiency of existing frameworks is shown by the lack of clear legal provisions addressing cyber slavery. The convergence of cybercrime and human trafficking is where cyber slavery works, although regulations in both areas sometimes don't work well together. Anti-trafficking laws, for example, do not adequately address the digital aspects of cyber slavery, even while they target physical abuse. Similar to this, rules against cybercrime concentrate on punishing actions taken online but seldom take into account the coercion or exploitation that led to these crimes. Cyber slavery's extraterritorial character makes things much more difficult. Victims of crimes are frequently forced to target people in another jurisdiction after being transported to another country.

While social media has made it possible for there to be previously unheard-of levels of global connectivity and has brought about numerous socioeconomic advantages [1] increased connectivity has also brought about new threats with real-world repercussions. There is growing evidence that social media is used to enable contemporary slavery [2].

[1] Lin, Y & Kant,, 'Using Social Media for Citizen Participation: Contexts, Empowerment, and Inclusion', Sustainability, vol. 13, no. 12,2021 p. 6635.
[2] United Nations Office on Drugs and Crime 2020, Global Report on Trafficking in Persons, United Nations, p. 15. Available at: https://www.unodc.org/documents/data-and-analysis/tip/2021/GLOTiP_2020_15jan_web.pdf. Last accessed on 9 February 2022.

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Legal Analysis of Contractual Liabilities and Remedies for Air Careers: Bangladesh Perspective

Md. Raziur Rahman, *Ph.D*[*]

Abstract: *The study emphasises the responsibilities of air carriers to ensure passenger safety as well as important areas of responsibility, such as damage, delay, and loss of baggage or cargo. The study investigates how culpability is established in situations of accidents or service failures and what compensation methods are available to passengers by examining case law and legislative legislation. This paper attempts to explore and examines how international agreements have been incorporated into domestic legislation and evaluates how well local aviation regulations provide sufficient redress for air carrier contract violations. The function of the Civil Aviation Authority of Bangladesh (CAAB)[1], pertinent national laws such as the Carriage by Air Act, 1934,[2] and how Bangladesh's legal system complies with international norms in offering passengers redress are all critically examined. Given the increasing significance of air travel in the globalised economy, the study ends with suggestions for strengthening the national legal system to better handle contractual obligation and improve passenger protection. The study does a comparative analysis to identify gaps and recommend law adjustments to ensure that Bangladesh's aviation sector conforms to international best practices on liability and remedies.*

Keywords: Contractual Liability, Air Carrier, Aviation Law, International Conventions, Passenger Rights and Remedies.

1. Introduction

Bangladesh relies heavily on air travel to carry both persons and cargo as it links the nation to a number of international locations. Air travel is not risk-free, though, like any other mode of transportation. Air carriers are held accountable when they don't carry out their end of the bargain. A detailed examination of both international agreements and domestic legislation is necessary to comprehend the contractual obligation of air carriers as well as the remedies accessible to passengers or cargo owners in Bangladesh.

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[1] The Civil Aviation Authority of Bangladesh (CAAB) is the national regulatory authority responsible for the development, regulation, and oversight of civil aviation in Bangladesh. One of its main responsibilities is to guarantee the effectiveness, safety, and security of domestic air travel. In Bangladesh, CAAB is in charge of airport operations, air traffic control, aviation safety, and the application of international aviation standards.

[2] Act No. XX of 1934

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Inheritance of Grandchildren in Religious Laws: A Comparative Study

Mansura Khanam*

Abstract: *Inheritance is a systematic procedure by which all property is automatically transferred from one generation to other generation. Rules of inheritance in every community are based on their own religious law. Due to the strict religious rules of inheritance, sometimes specific shareholders especially grandchildren are excluded from their ancestral properties. Inheritance of grandchildren is debatable topic under some religious law. Especially under Muslim law of succession inheritance of grandchildren from pre-deceased son or daughter is one of the most critical areas of Islamic law. The proposed research aims is to examine the inheritance rights of grandchildren within the religious provisions of Bangladesh, considering the context of human rights. In Bangladesh inheritance practices are deeply rooted in religious and customary laws, which often result is discriminatory outcomes for specific groups, particularly grandchildren. This research seeks to explore the complexities surrounding the inheritance rights of grandchildren and assess their compatibility with human rights principles by critically analyzing religious provisions. In this comparative study, we will explore how various religions address the inheritance rights of grandchildren and the implications of these differences.*

Keywords: *Inheritance, Grandchildren, Religious laws, Deceased person, Doctrine of representation.*

1. Introduction

Inheritance bears a great significance in every religious law distribution of property of a deceased person plays a vital role in every community because by inheritance, property is systematically transferred from one person to another person. Inheritance laws play a crucial role in shaping the distribution of assets and wealth within families after the passing of a loved one. These laws are not only a reflection of legal systems but are also deeply intertwined with cultural, social and religious beliefs. One aspect that highlights the complexity of inheritance laws is the treatment of grandchildren's inheritance under different religious laws. Orphaned grandchildren have long been denied the right to inherit a portion of their grandparents' fortune, especially under Islamic inheritance law. Islamic legal treatises from the Middle Ages asserted

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Sexual Harassment of Women in Rajshahi City Area: A Critical Legal Study

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Mansura Khanam**

Abstract: *Sexual harassment is being a social stigma and common phenomena in all over Bangladesh. Despite difference of appearance, age, profession etc. women are not risk-free in the school, college, university, home or workplace. About all the female workers face sexual abuse at the workplace, it may be government or in private sector frequently. Some particular places such as- in the educational institution sexual harassment is being take place by their inferior, superior, teachers, friends or by unknown person and in workplace by their colleagues or by unknown person also. Sexual harassment includes many kinds of violence against women and that may be physical, psychological, sexual or domestic. According to the Human Rights Council Report, it can be considered that, sexual harassment has become a part of the social habit in rural and urban areas of Bangladesh. This paper tries to conduct an in-depth empirical study in order to identify the causes of sexual harassment in Rajshahi City area. It is also trying to attempt to suggest effective and practicable redress mechanism so that sexual harassment can be curbed. In this study, data were collected by quantitative methods. Both primary and secondary data sources were used to explore the study objective. This study found that, despite existing statutory laws, judgments which are provided by our Supreme Court, women of our country are facing sexual harassment and in most of the cases they do not take any legal action.*

Keywords: Social stigma, Sexual harassment, Statutory Laws, Legal Action, Female Workers.

1. Introduction

Bangladesh is entering into the class of middle-income countries. The participation of women in economic sector is crucial for the country as well as for their own economic empowerment and sustainability. However sexual harassment's problems in the workplace discourage women to proceed working. Sexual harassment in the workplaces has emerged as a serious concern in Bangladesh. It can be said that sexual harassment against women is considered a breach of human rights and dignity. Now it has become

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Diversity Analysis of Rice Genotypes Collected from Six Southern Districts of Bangladesh Based on Agro-Morphological Traits

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Abstract: Rice serves as a staple food for millions around the globe, and its productivity is heavily influenced by environmental factors, especially in the southern regions of Bangladesh. This study aimed to assess the agro-morphological diversity of forty local and modern rice genotypes to identify promising cultivars for improved yield and adaptability. The experiment was conducted at the Regional Station of the Bangladesh Rice Research Institute, Gopalganj, using a randomized complete block design (RCBD) with three replications. Significant variations were observed in key traits such as panicle length, filled and unfilled grains per panicle, grain length, grain breadth, 1000-grain weight, and grain yield per hill. Genotypes ASS22, ASS17, and ASS14 exhibited superior agronomic performance, demonstrating longer panicles, higher 1000-grain weight, and greater grain yield per hill. Principal Component Analysis (PCA) and correlation analysis identified grain length, grain breadth, and 1000-grain weight as the major contributors to genetic variability. Cluster analysis grouped the genotypes into three distinct clusters, with six top-performing genotypes (ACC4, ACC8, ACC24, ACC37, ACC6, and ACC16) exhibiting desirable traits for potential breeding programs. These findings highlight the importance of genetic diversity in rice improvement, particularly in southern environments. The identified high-performing genotypes would serve as valuable genetic resources for developing resilient and high-yielding rice genotypes based on their agro-morphological traits.

Keywords: Rice Genotypes; Morphological Traits; Principal Component Analysis; Cluster Analysis.

INTRODUCTION

Rice (*Oryza sativa* L.) is an essential food crop for the global population. It is essential to ensuring global food security both now and in the future. Maize and wheat contribute 19% and 5% of the world's dietary energy, respectively, whereas rice contributes 20% (BBS, 2021). According to this, rice is the most important strategic crop for ensuring the food and nutritional security of the world. The majority of the world's rice is produced in Asian nations, and it is the most important staple food in Bangladesh (Salam *et al.,* 2019). Approximately 75–80% of the land is under cultivation, depending on the season and agro-ecological zone (FAO, 2015). The need for production is rising along with the population, and there is less land available for cultivation. The farmed kinds must be sophisticatedly dragonized for notable improvement in order to meet the consumptive measures and the individuals engaged with the processing, marketing, and distribution with the limited land and resources (Rahayu *et al*., 2020).

All of Bangladesh's rice comes from just three genotypes: *Aus, Aman*, and *Boro*. Broadcast and transplanted Aman are usually cultivated in December and January, *Boro* from March to May, and *Aus* in July and August. The most significant of these new crops, *aman*, took up around 46% of the land used for rice cultivation (Islam *et al*., 2018; Rahman *et al.,* 2024; Howlader *et al*., 2024).

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Review Article

Exploring microplastics as a macro problem for agricultural lands and terrestrial ecosystems: A review focuses on the research insights and challenges

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ABSTRACT

Microplastics (MPs) are persistent pollutants that pose significant environmental challenges globally. The primary reservoir of MPs is soil, which is a thin stratum formed by rock weathering. However, our understanding of MPs' environmental and ecological impacts remains incomplete. The movement, transport, distribution, and ultimate fate of MPs in soil ecosystems, as well as their uptake by plants, are influenced by their physicochemical properties, soil characteristics, agricultural practices, and the heterogeneity of the soil biosphere. MPs have been identified as vectors for various environmental contaminants, and the mechanisms of their adsorption that affect soil properties have been explored. This review also describes how MP-induced stress impairs plant growth and physiological function by altering soil productivity. To scientifically assess MP contamination, methods for isolating and examining soil MPs have been outlined, contrasting the merits and limitations of different techniques and highlighting the potential challenges. Promising technologies for MP removal and degradation have been identified, including physicochemical and biological methods along with their mechanisms and determining factors. Among biological approaches, phytoremediation has emerged as a leading sustainable method, gaining prominence owing to the limitations of conventional techniques, and is briefly discussed here as a future prospect. Drawing on recent research and relevant case studies, a range of practical solutions is suggested. Furthermore, the necessity for cross-sector and cross-jurisdictional collaboration to effectively address this pressing environmental issue is emphasized. The insights from this study contribute to a broader understanding of microplastics and offer valuable information for policymakers, researchers, and stakeholders.

KEYWORDS : Microplastic pollution, Agricultural land, Soil contamination, Soil health, Environmental impacts

Introduction

Plastic materials are extensively used in contemporary society for product packaging, manufacturing, construction, and agricultural mulching. The widespread dependence presents significant ecological challenges and potential health risks owing to increased fossil fuel consumption and inadequate waste management practices. Atmospheric microplastics, which

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ORIGINAL RESEARCH

In silico evaluation and therapeutic targeting of LVDD9B protein for WSSV inhibition: molecular and ecological insights for aquaculture solutions

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Abstract
This study aimed to investigate structural dynamics, binding interactions, stability, pharmacokinetics, ecological risks, and bioactivity of shrimp receptor protein LVDD9B to identify potential therapeutic candidates against White Spot Syndrome Virus (WSSV). LVDD9B protein's 3D structure was predicted using SWISS-MODEL and validated with ProSA and Ramachandran plots. Protein–protein docking between LVDD9B and VP26 (WSSV protein) was performed using HADDOCK 2.4 server. Molecular docking, dynamics simulations, binding-free energy calculations, principal component analysis (PCA), electrostatic, and vibrational frequency analyses evaluated binding affinity, stability and polarity of complexes. The 128-amino-acid LVDD9B protein was predominantly localized in the cytoplasm and extracellular with stable, and hydrophilic, with structural analysis identified key secondary structures and conserved chitin-binding sites. Docking studies revealed strong interactions between LVDD9B and VP26, supported by hydrogen-bonds and salt bridges. Molecular dynamics simulations demonstrated stable complexes with minimum fluctuating RMSF values, and MM/GBSA calculations indicated favourable binding free energies. Pharmacokinetic analysis highlighted promising bioavailability and drug-like properties for Luteolin and Quercetin from *Cuscuta reflexa*, while ecological assessment identified Cosmosiin as least hazardous, with Quercetin and Luteolin showing higher toxicity. PCA revealed stable protein-ligand complexes with flexibility in Apo form. Isorhoifolin exhibited the lowest internal energy (–2099.4722 Hartree) and highest dipole moment (8.1833 Debye). Frontier orbital analysis showed HOMO-LUMO gaps (4.05–4.34 eV) influencing reactivity, while MEP and vibrational frequency analyses supported compound stability and bioactivity. This study explores LVDD9B's structural and interaction dynamics for developing antiviral therapy against WSSV, highlighting therapeutic potential of Cosmosiin, Isorhoifolin and Afzelin based on their pharmacokinetic and ecological profiles.

Keywords Shrimp · WSSV · LVDD9B · VP26 · Density functional theory (DFT) · Molecular dynamics simulation (MDS)

Introduction

Rapid expansion of global shrimp industry, driven by increasing global demand, has led to intensive farming practices following higher stocking densities and more frequent production cycles. These practices have increased stress on shrimp populations, weakened immune responses, and created conditions conducive to the emergence and spread of disease (Millard et al. 2021), including those caused by pathogens such as viruses, bacteria, protozoa, and fungi (Flegel 2006; Walker and Mohan 2009). While improved culture technique, sanitation, and chemical treatments have mitigated bacteria, protozoal, and fungal diseases (Lightner and Redman 2012), viral diseases particularly White Spot Disease (WSD), remain a critical challenge (Millard et al. 2021; Walker and Mohan 2009), causing up to 60% losses

Extended author information available on the last page of the article

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