TPM Vol. 32, No. S6, 2025
ISSN: 1972-6325
https://www.tpmap.org/

Open Access

MARINE SPONGES AS A SOURCE OF NOVEL PHARMACEUTICALS

TURDIKUL BOBOMURATOV
TASHKENT MEDICAL ACADEMY, UZBEKISTAN, t.bobomurotov@tma.uz
https://orcid.org/0000-0002-9021-4576

HAASSAN MOHMEDMHDI
DEPARTMENT OF COMPUTERS TECHNIQUES ENGINEERING, COLLEGE OF TECHNICAL ENGINEERING, ISLAMIC UNIVERSITY IN NAJAF, NAJAF, IRAQ
DEPARTMENT OF COMPUTERS TECHNIQUES ENGINEERING, COLLEGE OF TECHNICAL ENGINEERING, ISLAMIC UNIVERSITY IN NAJAF OF AL DIWANIYAH, AL DIWANIYAH, IRAQ EMAIL: iu.tech.eng.iu.hassanaljawahry@gmail.com

ABDUMUTALLIEV ABDULAKHAD ABDUSAMAD UGLI
FACULTY OF BUSINESS ADMINSTRATION, TURAN INTERNATIONAL UNIVERSITY, NAMANGAN, EMAIL: Uzbekistan.aabdulaxadturan@gmail.com, ORCID ID: https://orcid.org/0009-0006-1675-0756

RAJENDRAN PALANIVELU
DEPARTMENT OF NAUTICAL SCIENCE, AMET UNIVERSITY, KANATHUR, TAMILNADU -603112, EMAIL: rajendran.p@ametuniv.ac.in, 0000-0001-5016-9742

MRS. POOJA TIWARI
ASSISTANT PROFESSOR, DEPARTMENT OF MICROBIOLOGY, KALINGA UNIVERSITY, RAIPUR, INDIA.

Abstract
Oceans are an important source of biological and chemical diversity and account for over 70 % of the surface of the earth and holding over 200,000 known species. They consist of various specific habitats featuring a broad range of pH, temperature, hydrostatic pressure, and salinity concentrations. Marine microorganisms have evolved a number of adaptations to live in such distinctive ecosystems, some of which include the synthesis of specific biomolecules. Therefore, the marine biological diversity possesses significant potential to yield bioactive compounds that do not exist in terrestrial ecosystems. Over the last few decades, the urgency to discover safe and effective drugs from nature becomes paramount, and it is imperative that new drug leads from under-exploited ecosystems should be investigated as sources of new therapeutic agents. Marine microorganisms are a treasure house of natural products of high bioactive activities. The extreme physical and chemical conditions of the marine environment and the hard competition for resources and predatory pressure have led to an increased production of a vast array of compounds in marine organisms, which are distinct from those found in terrestrial plants and are a reservoir of novel bioactive compounds with high pharmaceutical potential. Most of the studies indicated the promise of marine organisms in offering greater bioactive natural products than terrestrial organisms.
Keywords: Marine, Sponges, Pharmaceuticals, medicine.

1. INTRODUCTION

The most valuable chemicals that can be obtained from nature are those employed to cure disease. Most commonly prescribed drugs are naturally occurring chemicals, or natural products, which are obtained from terrestrial plants or microorganisms that can be cultivated on a large scale and synthetic analogues of these compounds. The development of these materials has made a big contribution to progress in the field of medicine, and the quest for new and improved medicine has not only been pursued but intensified. Nowadays it is evident that the majority of infectious diseases can be brought under control through natural or synthetic drug products but as human lifespan has increased later on, new medical issues in degenerative disease control have become of key significance [1]. We are still in desperate need of beneficial drugs that can suppress viral infections and neoplastic growth, stimulate regeneration, assist in the treatment of cardio vascular degenerative process and lead to the restoration of normal function in the aging nervous system [2]. Thus, it is essential to search for effective and safe drugs from alternative sources. The long-standing misconception that the sea is an element against man was certainly one explanation why marine pharmacology and chemistry followed later than terrestrial natural products chemistry [9]. The other explanation for the belatedness of work in these sciences, is that there is no marine. study

discipline corresponding to ethnobotany, which has been a boon has is to research pharmaceutically active such stances. But attempts to find marine-derived, pharmacologically normal natural products have become more and more common and have included research on marine natural products across much of the globe [3]. Some programmes have been driven by isolating a compound, then screening it for a variety of bioactivities, but the most successful have been biology-driven screening for a particular bioactivity, then isolating the compound [4]. Marine sponges carry a dense reserve of fungal diversity, and fungi have been an extremely fruitful source of novel compounds relative to other microbial sources retrieved from the ocean. On the basis of their capability to develop in marine environments, marine fungi are broadly categorized as obligate or facultative marine fungi; the former develop quickly and sporulate under a marine condition only, while the latter typically originate from the terrestrial environment and are tolerant of the marine environment [10]. As it is challenging to distinguish the obligate or facultative nature of marine fungi, the term "marine-derived fungi" with a broader context is being used. Most of the marine fungi are represented by the phylum Ascomycota, while the phylum Basidiomycota is represented inadequately [18]. The extreme physical and chemical conditions of the sea environment are accountable for the establishment of special metabolic pathways in marine fungi that do not exist in their terrestrial counterparts. The metabolites of fungi in association with marine sponges are the outcome of fungus-sponge chemical communication, which is of mutual advantage, further leading to the establishment of entirely novel metabolites [13].

2. REVIEW OF LITERATURE

Oceanic resources from both the nonliving and living entities have served the society's need since time immemorial. Nevertheless, marine organisms have come to the centre stage in the recent past owing to their unique adaptability in the marine environment and having structurally distinct compounds of biomedical interest. These marine compounds have opened up vast research opportunities in studying their likely bioactive capabilities, their structural characterizations and describing it as a candidate drug for future use in the marine pharmaceutical industries [17]. Natural products in the simplest form are known as the chemical compound, generated by living organism as primary or secondary metabolites. The main metabolites are proteins, carbohydrates, and lipids etc., which the organisms need as a source of energy. Conversely, the secondary metabolites comprise terpenes, alkaloids, flavonoids etc., which have no direct function to play in various functions of the organisms but have vital role to play in an ecological niche [5]. It has been observed that the natural products have been in use for a long time as a food source, perfumes, insecticides, drugs etc. Of these, predominantly the land plants have been a source of medicinally valuable products, particularly in traditional or folk medicine since times immemorial [7]. This terrestrial product acceptability as medicine could be due to their low toxicity, in contrast to synthetic chemicals, biodegradability, availability from renewable resources and being inexpensive [6]. As is known, natural compounds either target other systems of animals such as human or target through interfering with the metabolism of microbes infecting them. Therefore in either sense, naturally occurring medicinal plant bioactive compounds are a deciding factor in controlling host-microbe interaction in the host's interest. Joffe et al. (1989) also mentioned that nearly 25% of all active compounds are from natural plant products and a further 12% are rooted on related microbial origin. Traditionally, there were plenty of research that established terrestrial organisms as the richest source of natural medicines whereas research in marine natural products is relatively new since most of them had not yet been studied. It is also discovered that most of the bioactive compounds that are of marine origin are secondary metabolites, i.e., species-specific chemical agents that may be classified into different categories. [11].

3. MATERIALS AND METHODS

Eight various sponge species have been explored here for their symbiotic bacterial association and the bioactive compounds from such symbiotic bacterial extracts were screened for activity against human pathogens. Further, bacterial extracts were also screened against Leptospira inntregonns, one of the causative agents of leptospirosis, popularly referred to as Andaman Haemorrhagic Fever (AHF), which is prevalent in Andaman Islands.

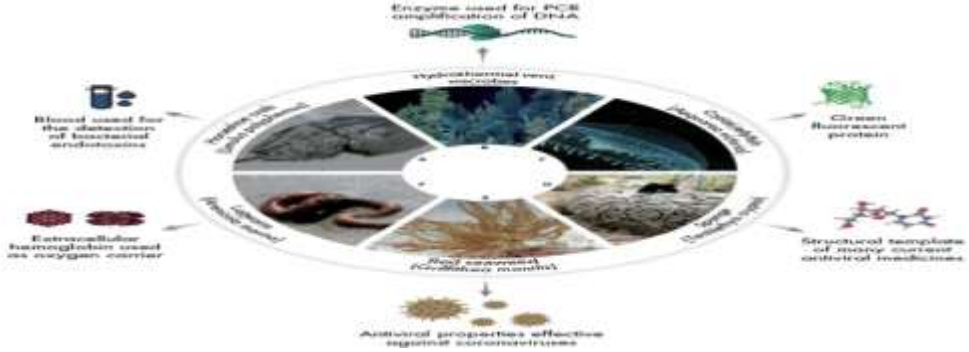


Figure 1: Illustration of biomedical application

Antimicrobial activity against leptospirosis (Leptospira inntregonns) exhibited strong inhibiting activity. GC-MS analysis of extracts of symbiotic bacteria was identified based on retention factors in the spectrum were compared to the library and approximately 155 compounds were identified, which needs to be studied in detail. There is a need to find new classes of antibiotics because drug resistances have increased among the pathogenic microorganisms [7]. Andaman Sea blessed with high marine biodiversity and every single marine entity is known to play a highly interesting role to produce some kind of toxic product (bioactive) to save themselves in the dynamic oceanic environment [12]. Sponges were the subject of this research, owing to two principal reasons: (i) they are in close association with a large number of microorganisms and (ii) they are a rich source of biologically active secondary metabolites [8]. Yet still there is no distinct image of microbial diversity—and the factors that control it—in these hosts [16].

From this, modest amount of sea plants, animals and microbe of marine origins already provided countless new chemicals compound with high bioactive potential and use in biomedical sciences. A fact is that the significance of sea organisms as a source of new substances of bioactive potential to treat diseases in humans increases and there are plenty of microbial-derived compounds also. Once more, with marine animals making up roughly half of all global biodiversity and these marine organisms provides a tremendous resource for new compounds with potential for tapping into this largest reservoir left of natural molecules for new drug activity. Their discovery from marine natural products can focus on in-depth understanding related to the marine ecosystem with a perspective to discover novel chemical entities, which are mostly highly complex in nature [14].

4. RESULT AND DISCUSSION

Newly emerging structures possessing novel pharmacological activities were still discovered and described from every category of natural product source. Most of these compounds show one or more bioactivities that may deliver value to be employed as medicine for human being.

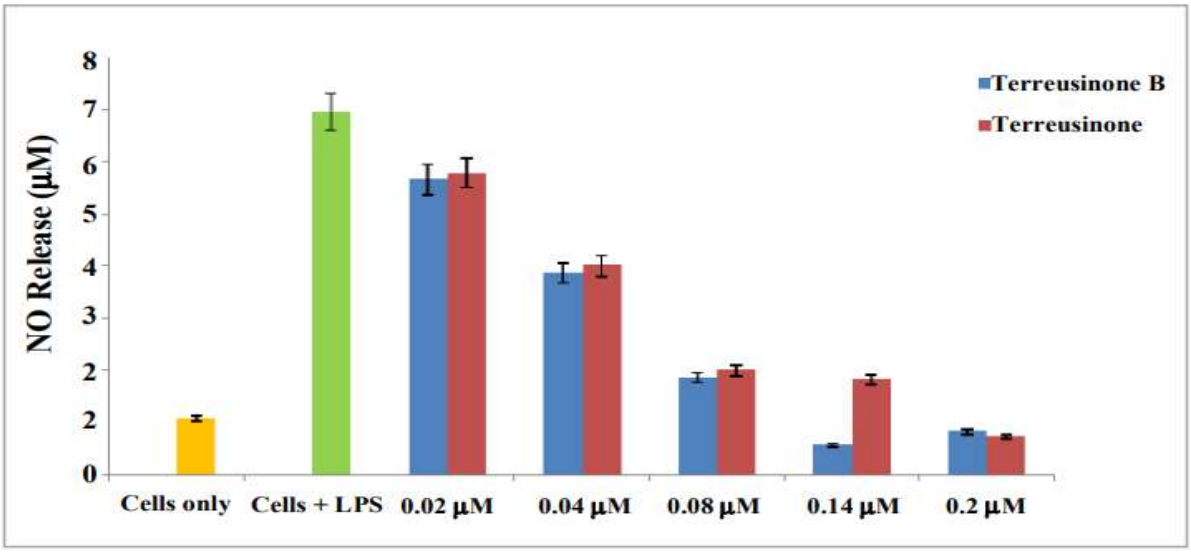
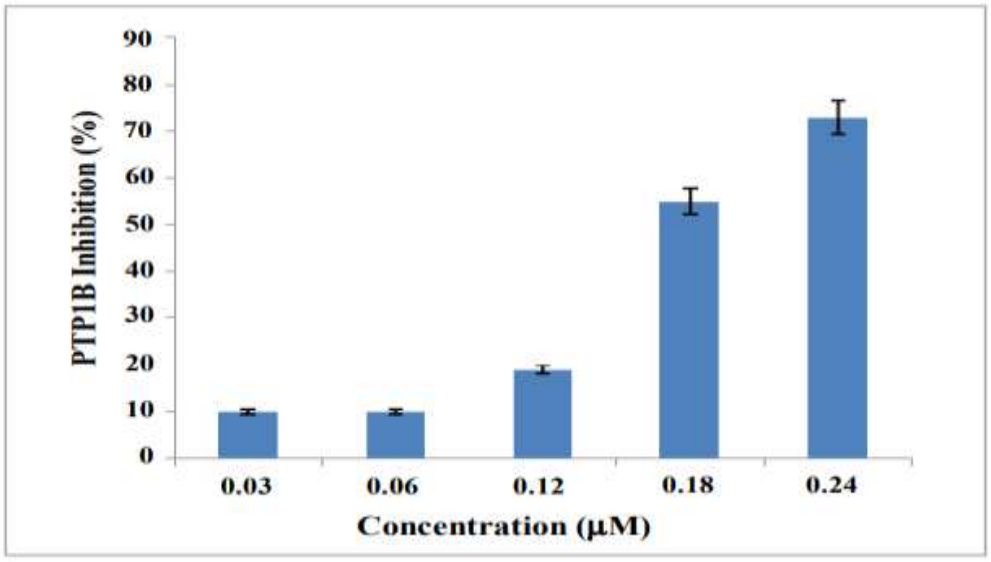
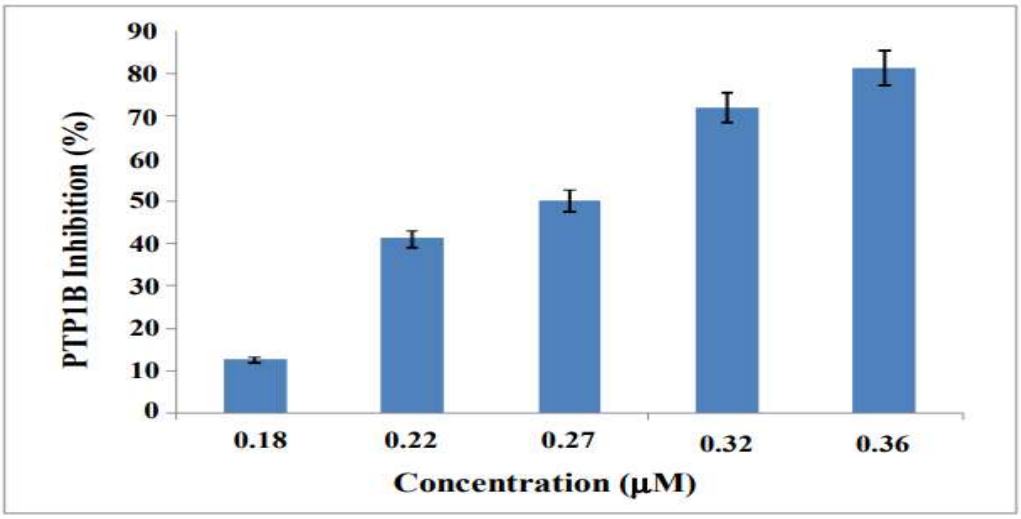


Figure 2: different concentrations of compounds test

Of late there is great interest in marine natural products of therapeutic interest, as these natural products tend to provide novel chemical structures of great bioactivity. As is usual, marine invertebrates such as sea cucumbers, sponges and sea squirts contain a treasure trove of novel and biologically active metabolites [15].



(a)



(b)

Figure 3: enzymatic inhibitory activity

As reported, active peptides isolated from marine sponges tend to be cyclic or linear peptides with unusual amino acids that are either rare in terrestrial or microbial systems or even completely novel peptide like Polydiscamide A and its derivatives, which were suggested as antibacterial and antitumor agents. Marine organisms provide a rich pool of structurally novel and biologically active metabolites. Recent studies on screening of marine organism led to the characterization of a broad spectrum of antiviral compounds.

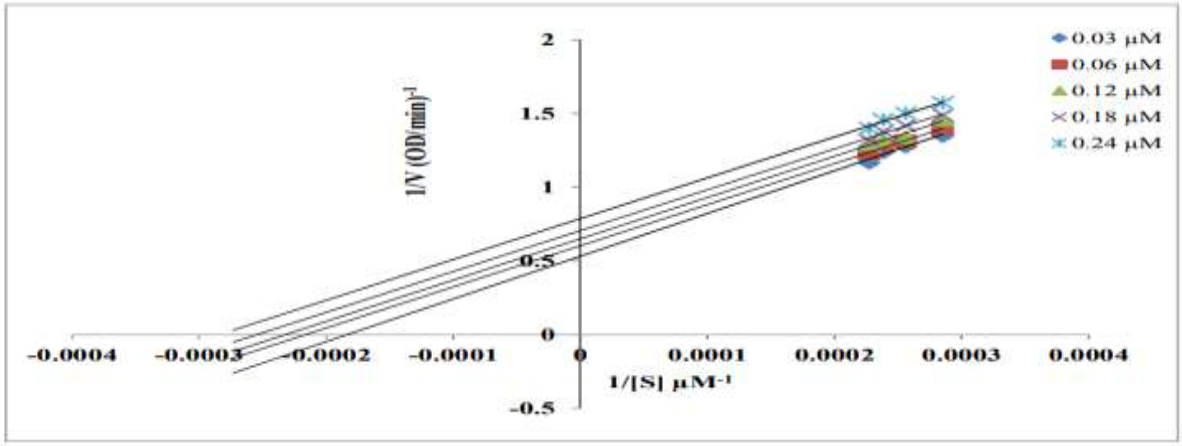


Figure 4: Kinetic Assay

Since it has been reported that the compounds are a significant source for new lead in the treatment of numerous diseases like cancer, AIDS, inflammations, arthritis, malaria and large. It is at times challenging to identify a

prospective bioactive molecule from marine sources. But these molecules can play an important role in the creation of modern biotechnology since they tend to produce novel chemical structures with surprising outcome.

5. CONCLUSION

Several bioactive compounds have been isolated from different marine animals such as tunicates, sponges, soft corals, sea hares, nudibranchs, bryozoans, sea slugs and other marine species in recent years. The quest for new metabolites from marine species has yielded lots of metabolites, most of which possess pharmacodynamic activity. The mechanism by which marine species synthesize bioactive molecules to sustain themselves is intriguing. It is noted that the marine environment offers varying biosynthetic conditions to the organisms dwelling there. Overall, marine organisms are seen to exist in association with symbiotic bacteria and the mode of transfer of nutrients among symbiotic partners is a way for actual origin of bioactive metabolites formed due to such associations. Attention is therefore paid to comprehend the current trend in marine natural products chemistry by learning the symbiotic pattern and the coexistence pattern of marine organism.

REFERENCES

1 Thomas, Tresa Remya A., Devanand P. Kavlekar, and Ponnapakkam A. LokaBharathi. "Marine drugs from sponge-microbe association—A review." Marine drugs 8, no. 4 (2010): 1417-1468.
2 Iyer, S., & Trivedi, N. (2023). Cloud-powered Governance: Enhancing Transparency and Decision-making through Data-driven Public Policy. In Cloud-Driven Policy Systems (pp. 13-18). Periodic Series in Multidisciplinary Studies.
3 Prasath, C. A. (2024). Optimization of FPGA architectures for real-time signal processing in medical devices. Journal of Integrated VLSI, Embedded and Computing Technologies, 1(1), 11-15. https://doi.org/10.31838/JIVCT/01.01.03
4 Belarbi, El Hassan, Antonio Contreras Gómez, Yusuf Chisti, Francisco García Camacho, and Emilio Molina Grima. "Producing drugs from marine sponges." Biotechnology advances 21, no. 7 (2003): 585-598.
5 Rao, N., & Tiwari, M. (2023). Nature-Based Solutions for Coastal Resilience: Case Studies from Southeast Asia. International Journal of SDG's Prospects and Breakthroughs, 1(1), 8-10.
6 Sathish Kumar, T. M. (2023). Wearable sensors for flexible health monitoring and IoT. National Journal of RF Engineering and Wireless Communication, 1(1), 10-22. https://doi.org/10.31838/RFMW/01.01.02
7 Anjum, Komal, Syed Qamar Abbas, Sayed Asmat Ali Shah, Najeeb Akhter, Sundas Batool, and Syed Shams ul Hassan. "Marine sponges as a drug treasure." Biomolecules & Therapeutics 24, no. 4 (2016): 347.
8 Poornima, K., Manish, J., Abarna, C., & Dharunkumar, M. (2024). Advanced Facial Recognition for Mask Compliance and Precision Temperature Screening using IoT. International Journal of Advances in Engineering and Emerging Technology, 15(1), 06–12.
9 Perdicaris, Stamatios, Thomais Vlachogianni, and Athanasios Valavanidis. "Bioactive natural substances from marine sponges: new developments and prospects for future pharmaceuticals." Nat. Prod. Chem. Res 1, no. 3 (2013): 2329-6836.
10 Sadulla, S. (2024). Next-generation semiconductor devices: Breakthroughs in materials and applications. Progress in Electronics and Communication Engineering, 1(1), 13–18. https://doi.org/10.31838/PECE/01.01.03
11 Shinde, Pravin, Paromita Banerjee, and Anita Mandhare. "Marine natural products as source of new drugs: A patent review (2015–2018)." Expert opinion on therapeutic patents 29, no. 4 (2019): 283-309.
12 Carvalho, F. M., & Perscheid, T. (2025). Fault-tolerant embedded systems: Reliable operation in harsh environments approaches. SCCTS Journal of Embedded Systems Design and Applications, 2(2), 1–8.
13 Sipkema, Detmer, Maurice CR Franssen, Ronald Osinga, Johannes Tramper, and René H. Wijffels. "Marine sponges as pharmacy." Marine biotechnology 7 (2005): 142-162.
14 Fatma, A., & Ayşe, M. (2025). Secure data transmission advances for wireless sensor networks in IoT applications. Journal of Wireless Sensor Networks and IoT, 2(1), 20-30.
15 Javed, Faraza, M. Imran Qadir, Khalid Hussain Janbaz, and Muhammad Ali. "Novel drugs from marine microorganisms." Critical reviews in microbiology 37, no. 3 (2011): 245-249.
16 Alaswad, H., & Hooman, K. (2025). Thermal management in electronics using advanced technologies for heat transfer. Innovative Reviews in Engineering and Science, 3(1), 19–25. https://doi.org/10.31838/INES/03.01.03
17 Bibi, Fehmida, Muhammad Faheem, Esam I Azhar, Muhammad Yasir, Sana A Alvi, Mohammad A Kamal, Ikram Ullah, and Muhammad I Naseer. "Bacteria from marine sponges: a source of new drugs." Current Drug Metabolism 18, no. 1 (2017): 11-15..
18 Sadulla, S. (2024). Techniques and applications for adaptive resource management in reconfigurable computing. SCCTS Transactions on Reconfigurable Computing, 1(1), 6-10. https://doi.org/10.31838/RCC/01.01.02

19 GHAZO, M. M. (2025). Evolution and Integration: Navigating the Path to Business Excellence through the European Foundation for Quality Management Model and Circular Economy Principles. Quality-Access to Success, 26(206).
20 Veerappan, S. (2025). Integration of Hydrogen Storage with PV Systems for Off-Grid Power Supply. Transactions on Energy Storage Systems and Innovation, 1(1), 41-49.
21 Vishnupriya, T. (2025). Grid-Connected Inverter Topologies for High-Penetration Solar PV Systems: A Comparative Study. Transactions on Power Electronics and Renewable Energy Systems, 44-50.
22 Poornimadarshini, S. (2025). Topology Optimization of Brushless DC Machines for Low-Noise and High-Torque Applications. National Journal of Electrical Machines & Power Conversion, 45-51.
23 Karthika, J. (2025). Wireless Control Of Industrial Servo Drives Using Industrial IOT And 5g Technologies. National Journal of Electric Drives and Control Systems, 49-58.
24 Sadulla, S. (2025). Next-Generation Perovskite Solar Cells: Stability Challenges and Scalable Manufacturing. National Journal of Renewable Energy Systems and Innovation, 47-60.
25 Madhanraj.(2025). Blockchain-Assisted Peer-to-Peer EV Energy Trading in Vehicle-to-Grid Networks.National Journal of Intelligent Power Systems and Technology, 1(1), 48-56.
26