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MARINE-DERIVED COMPOUNDS FOR THE TREATMENT OF NEUROLOGICAL DISORDERS

FERUZA AZIZOVA
TASHKENT MEDICAL ACADEMY, UZBEKISTAN, F.AZIZOVA@TMA.UZ
HTTPS://ORCID.ORG/0000-0001-6360-503X

SAIF OBAYD HUSAYN
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.saifobeed.aljanabi@iunajaf.edu.iq

YUSUFJANOV ULUGBEK JAVLON UGLI
FACULTY OF HUMANITIES & PEDAGOGY, CULUGBEKABUYUSUF@GMAIL.COM, HTTPS://ORCID.ORG/0009-0008-0641-2475

S. MURALEEDARAN
DEPARTMENT OF MARINE ENGINEERING, AMET INSTITUTE OF SCIENCE AND TECHNOLOGY, CHENGALPET, TAMIL NADU - 603305, EMAIL: srkmdaran62@amet-ist.in, 0009-0009-6868-246X

MR. CHIRANJEEV SINGH
ASSISTANT PROFESSOR, DEPARTMENT OF PHARMACY, KALINGA UNIVERSITY, RAIPUR, INDIA.

Abstract
The maritime environment has a wealth of highly active chemicals with strong biological activity. Most recently published review publications categorize marine chemical patents according to their evolutionary tree. This review focuses on the possibility of marine natural compounds as a source of new drugs for the treatment of neurological diseases. The current review focuses on two conditions that are successful in the field: neuro-pathic pain and Alzheimer's disease. Here, patents from 1998 to 2004 are included. Neuroinflammation is one of the basic pathogenic characteristics of a widely diverse range of neurological diseases, as observed in conditions such as Parkinson's, multiple sclerosis, Alzheimer's, and Huntington's disease. There is increasing interest in developing novel treatments that target the underlying neuroinflammatory processes, even though the majority of current treatments for these conditions are symptomatic. This review discusses the present status of research on the neuroprotective qualities of compounds found in marine invertebrates and their possible therapeutic use in the treatment of neuroinflammatory diseases. We also discussed the challenges and disadvantages of using marine-derived materials as medicine, such as supply and sustainability concerns, as well as the need for additional preclinical and clinical research to confirm their safety and effectiveness.
Keywords: Alzheimer’s disease, marine natural product, neuroinflammation, neuropathic pain

1. INTRODUCTION

Medicine and natural products have been associated with natural poisons and traditional medicine for thousands of years. More than half of the drugs currently used to treat cancer are thought to be natural compounds or their derivatives. In the century of combinatorial chemistry, microbes, fungi, marine life, and secondary metabolites from plants continue to be rich sources of new drugs [1]. About half of the drugs that have been introduced to the market in the past 20 years come from natural small molecules, either directly or indirectly. In the area of the central nervous system (CNS), natural compounds have also demonstrated promise in treating untreated illnesses like Alzheimer's disease (AD), a neurodegenerative illness. Galanthus nivalis is actually the source of galantamine, one of the recently approved medications. It is now classified as an acetylcholinesterase (AChE) inhibitor for the palliative treatment of AD. The alkaloid is long-acting, reversible, and selective, and it improves patients' cognitive function. The other interesting compounds that have been obtained from natural sources that are

associated with the central nervous system are members of the opioid family. Some of the drugs that are commonly used to treat neuropathic pain include codeine, papaverine, and morphine, which are produced from papaver. [9]. It's important to note that the majority of medications currently derived from natural resources come from terrestrial organisms, but in recent years, it has become more and more clear that the oceans offer a wealth of chemical structures that may have biological activity in tests for antiviral, antitumor, immunomodulation, analgesia, and allergy[2].

The influence of this work on the biomedical sector is growing as more and more of these chemicals are making their way into clinical trials. The literature has recently evaluated the highly effective potential of marine compounds as medicines. Recent evaluations in the literature generally classify patents for marine compounds phylogenetically. This review focuses on the potential of marine natural chemicals as a source of new drugs for the treatment of neurological disorders [10]. Two pathologies were successfully identified in the analysis of patents from 1998 to 2004: The subjects of this review are neuropathic pain and Alzheimer's disease. The nerve system's release of inflammatory factors and immune cell activation make up the complex neuroinflammation mechanism[3]. Neurodegenerative illnesses like Parkinson's, multiple sclerosis, Alzheimer's, and Huntington's can develop as a result of this mechanism, which can also result in neuronal death. Neuroinflammatory diseases have become a serious issue in recent years. Over 50 million people worldwide are infected, and by 2050, that number is expected to rise to three million. Drugs of the sea have been found to be a promising source for the creation of drugs against neuroinflammation.

Because marine species have developed unique defence mechanisms against viruses and predators in their marine environment, researchers are looking into them as a potential source of medications for neuroinflammatory diseases [15]. As a result, they generate many classes of bioactive substances that have therapeutic potential, such as those that have neuroprotective, antioxidant, and anti-inflammatory qualities. Certain chemicals from marine invertebrates have been identified to precisely target key proteins and neuroinflammatory therapeutic mechanisms, such as amyloid β, α-synuclein, and prions, which are known to form plaques, directly activate microglia, and contribute to chronic inflammation[4].

2. REVIEW OF LITERATURE

When it comes to treating neuroinflammation, different substances and marine invertebrates work in different ways. By studying this subject, scientists can determine which drugs and marine invertebrates work best for treating neuroinflammatory diseases. The chemicals that have been effectively extracted from marine invertebrates as anti-inflammatory and anti-neurodegenerative agents are the main topic of this review. The action modes of such compounds are discussed in the context of pathophysiology and principal pathways of neuroinflammation, throwing new light on the development of new natural-product-derived drugs. α-Synuclein aggregates-treated wild-type mice have been shown to cause intracellular spread of α-synuclein in the whole brain. Besides, administration of α-synuclein aggregates causes degeneration of DA neurons in SNc, reduction of levels of dopamine in striatum, and then to the motor dysfunction in PD. Although it is not known how α-synuclein aggregates cause neuronal toxicity, α-synuclein aggregates have been proposed to disrupt protein degradation pathways and mitochondrial function. Therefore, inhibiting the expression and accumulation of α-synuclein or enhancing the clearance rate of aggregated α-synuclein may be a decisive approach for treating PD [14].

Metabolic Pharmaceuticals, along with Elan Corp. and Amrad Corp., is developing components of cone shell venom to treat neuropathic pain. They are claiming the chemical ACV1. An α-conotoxin-like genomic sequence of Conus victorine was used to infer the sequence of this 16-aminoacid peptide. This monopeptide suppresses the neuronal-type nAChR response but not the nAChR response in the mammalian neuromuscular junction, unlike ziconotide and AM-366, which act on the N-type calcium channel. ACV1 showed effectiveness in preventing pain in some experimental animal models of human pain disorders, including neuropathic and post-surgical pain. Numerous peptides that were separated from Conus venom have drawn the attention of small pharmaceutical development companies. Chi-conotoxin peptides, for example, were said by Xenome Ltd. to inhibit the noradrenaline transporter in neurons[5]. The University of Utah (Research Foundation) states that I-Superfamily conotoxins are potassium channel blockers, whereas linear γ-carboxy-glutamate-rich conotoxins are NMDA type glutamate receptor blockers. The University of Queensland also asserts that a 19-amino acid rho-conotoxin polypeptide that was extracted from the fish-eating sea cone snail Conus Tulipa has α1-adrenoceptor antagonist specificity. Subsequent research showed that rho-TIA did not bind to muscle or neuronal subtypes, while having the same molecular weight as α-conotoxins [6].

GM1 ganglioside has been proposed as a disease-modifying therapy for PD. Monosialoganglioside GM1 is possible to produce from a sialidase-producing marine bacterium as a microbial biocatalyst. PD patients on GM1 ganglioside presented early improvement of symptom and gradual progression of symptoms. Imaging study results added more data supporting the potential disease-modifying effect of GM1 in PD. In another clinical trial,

PD patients receiving GM1 ganglioside improved motor scores significantly. GM1 ganglioside is speculated to modulate structure and function of lipid rafts to exert its neuroprotective activities. Still, the mechanisms of neuroprotective effects by GM1 ganglioside are unclear[11].

3. MATERIALS AND METHODS

Neurotrophic factors may support the survival of neurons, and thus can act as potential therapeutic drugs for PD treatment. Additionally, other neurotrophic factors like neurturin may sustain and repair DA neurons. Recent research indicated that SKF38393, a selective D1 receptor agonist, might enhance the development of DA neurons by increasing BDNF expression in the cultures of neurons. In addition, natural compound PYM50028 might induce a dramatic rise in GDNF and BDNF, decreasing MPTP-induced DA neuron loss in mice. These investigations are in favor of the fact that neurotrophic factors are therapeutically valuable by blocking DA neuronal damage during PD progression, and medicines that may raise the level of neurotrophic factors may be applied to the treatment of PD [7]. Up to now, PD is a complicated disease with multiple pathological factors. Thus, the influence of coordination of multiple factors in PD progression cannot be underestimated. Multi-target compounds may simultaneously bind to two or more anti-PD targets, and may exhibit greater therapeutic efficacy than single-target compounds for PD treatment [12].

Above all, the identification of marine chemicals is starting to emerge as a very important field in neurology. Certain marine chemicals have been sold or are undergoing clinical studies to treat Alzheimer's disease, schizophrenia, and neuropathic pain. The production of some of these substances is described in this review; in this instance, the conopeptides, anabaseine, and omega-3 fatty acids are discussed as potential therapies for a range of neurological conditions. Natural products have long been used as a tool for drug development and discovery, and in recent years, the potential of marine natural products as sources of new medications with a wide range of pharmacological activities has become a major concern. In practice, the utility of marine chemicals for the management of neurological diseases seems to be an emerging topic. With an emphasis on marine pharmaceuticals as leads in the discovery of drugs for neuropathic pain and Alzheimer's disease, a few of the more representative cases are included here. HD is only one instance, as are derivatives discovered from sea sponges that demonstrate resistance to the kinase, such as those from the Aelasidae, Axinellidae, and Halichondrid families. But to prevent secondary side effects in a potential pharmaceutical treatment, additional studies are necessary to identify selective proteinkinase inhibitors. Ana-baseine, which is obtained from a sea worm and functions as a powerful nicotine toxin that stimulates all nAChR subtypes, is another such example cited.

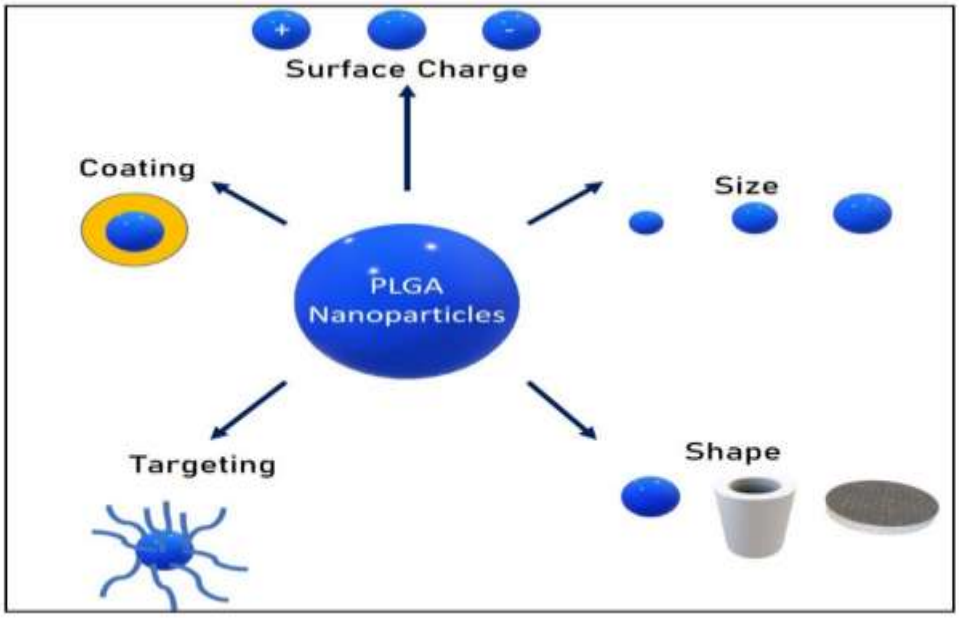

Figure 1: Properties associated

Following the optimization of the basic design, GTS-21 was created with advantageous cytoprotective and memory-boosting characteristics. The drug, which was financed by Taiho, is currently formally in Phase I studies for the palliative treatment of AD in the US and Europe. The variety and specificity of the venom peptides produced by the conus demonstrate its rapid and continuous evolution as a potential target region in neuropathic pain. They have been excellent demonstrations of the great potential of neuropathic pain drug development. Moreover, if delivery systems are optimized for selective peptide distribution, the potential gains are enormous.

To sum up, these results imply that marine products may be used as lead compounds and as possible medications to create active and efficient derivatives for neurodegenerative diseases with favourable ADME profiles.

4. RESULT

The rise in mean life expectancy has led to a high frequency of neurological illnesses such as Parkinson's disease (PD), which in turn has increased the number of old individuals. The second most common neurodegenerative disease, Parkinson's disease (PD), is characterized by a progressive loss of dopaminergic neurons in the substantia nigra pars compacta (SNpc). Numerous distinct and different chemical structures found in the marine environment have been shown to have great therapeutic potential for the treatment of a wide range of ailments, including neurological problems. This review attempts to identify compounds produced from marine life that show neuroprotective properties on in vitro and in vivo models based on their chemical structure, taxonomy, neuroprotective impact, and possible mechanism of action in Parkinson's disease[13].

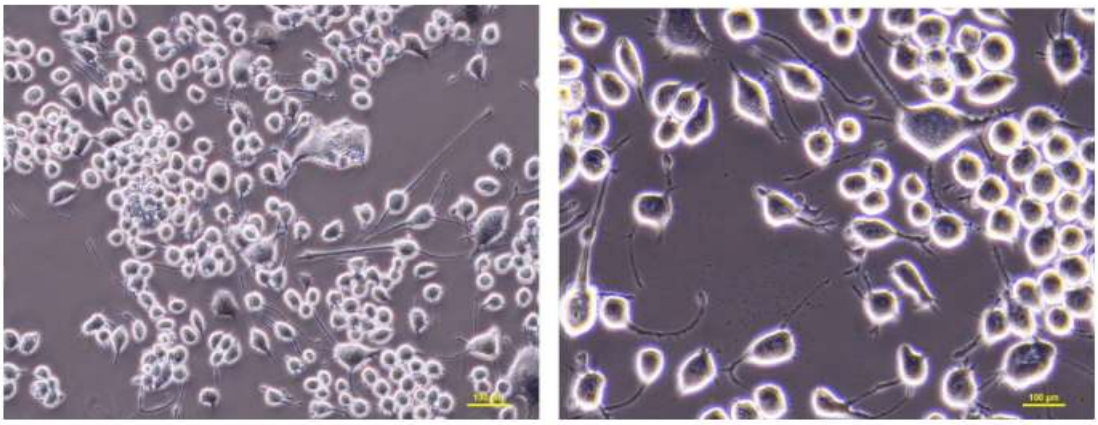

Figure 2: regularly to test

About 60 chemicals with a neuroprotective effect on the treatment of Parkinson's disease have been identified from marine fungi, bacteria, mollusks, sea cucumbers, seaweed, soft coral, sponges, and starfish[8]. The iron level of the cells, the ability of neurons and mitochondria to recover from calcium, and melanin deposition will all be affected. Consequently, subsequent insults such as impairments in mitochondrial Complex I and IV and α-synuclein aggregation lead to the degeneration of susceptible neurons, which in turn results in the emergence of Parkinson's disease symptoms. As people age, a build-up of cellular dysfunctions makes SNpc neurons susceptible. Therefore, as part of the illness process, aging may contribute to the substantia nigra pars compacta's cascade of stressor events, impairing the neurons' ability to react to new insults.

5. CONCLUSION

Globally, neurological disorders like Parkinson's disease are becoming more prevalent as a result of population aging. Existing medications only treat the disease's symptoms; therefore, it is imperative to find new medications that can cure the condition and enhance older people's quality of life. Chemicals with special structural characteristics that have significant therapeutic potential against a variety of neurodegenerative illnesses can be biosynthesised by marine organisms. Additionally, some marine species suppressed Caspase-3 activation, inhibited phosphorylation of JNK and p38 MAPK, down-regulated Bax expression, inhibited MAO, and normalized total GSH levels. Of the 60 marine natural products discussed in this research, ten compounds have demonstrated the ability to cross the BBB. For this neurodegenerative disease, it is imperative to develop stronger therapeutic agents that can cross the blood-brain barrier and have fewer side effects than the drugs now available. As an alternative, the creation of novel delivery mechanisms, like nanoparticles, can make up for some medications' inability to cross the blood-brain barrier. Therefore, scientists have a window of opportunity to assess the potential of chemicals originating from marine sources as novel medications.

REFERENCES

1 Choi, Dong-Young, and Hyukjae Choi. "Natural products from marine organisms with neuroprotective activity in the experimental models of Alzheimer’s disease, Parkinson’s disease and ischemic brain stroke: Their molecular targets and action mechanisms." *Archives of pharmacal research* 38 (2015): 139-170.

2 Muhammed Jaseel, E. K., & Kokila, R. (2024). Application Designed to Revolutionize the Way People Discover and Book Sports Grounds Effortlessly (Game Snap). International Academic Journal of Innovative Research, 11(2), 01–12. https://doi.org/10.9756/IAJIR/V11I2/IAJIR1108
3 Mohankumar, M., Balamurugan, K., Singaravel, G., & Menaka, S. R. (2024). A Dynamic Workflow Scheduling Method based on MCDM Optimization that Manages Priority Tasks for Fault Tolerance. International Academic Journal of Science and Engineering, 11(1), 09–14. https://doi.org/10.9756/IAJSE/V11I1/IAJSE1102
4 Sharmila, M., Divya, R., Saniya, A., & Prakash, C. (2025). Study On Natural Dyeing of Silk Yarns Using Fermented Turmeric Rhizomes with Theobroma Cacao Fragrance. Archives for Technical Sciences, 1(32), 93–102. https://doi.org/10.70102/afts.2025.1732.093
5 Kale, M. R., Sundar, I. S., Jayabalan, B., Desai, B., Bhagat, A. K., & Pund, S. S. (2025). Revolutionizing Mobile Banking System: Novel ML-Based Approach for Securing Cloud Data. Journal of Internet Services and Information Security, 15(1), 170-181. https://doi.org/10.58346/JISIS.2025.I1.011.
6 Hafez Ghoran, Salar, and Anake Kijjoa. "Marine-derived compounds with anti-Alzheimer's disease activities." Marine Drugs 19, no. 8 (2021): 410.
7 Nassar, M. O., & Al-Mashagba, F. F. (2025). Optimal Ensemble Learning with Meta-heuristics for Multiclass Classification of Syscall-Binder Interactions in Mobile Applications. Journal of Wireless Mobile Networks, Ubiquitous Computing, and Dependable Applications, 16(1), 26-48. https://doi.org/10.58346/JOWUA.2025.I1.002.
8 Hannah Jessie Rani, R., Verma, V. V., Guntaj, J., & Jadhav, Y. (2025). The Role of Turmeric Extract in Promoting Fish Health and Stress Resilience in Goldfish (Carassius auratus L.). Natural and Engineering Sciences, 10(1), 206-218. https://doi.org/10.28978/nesciences.1643503
9 Khotimchenko, Yuri S., Denis N. Silachev, and Vladimir L. Katanaev. "Marine natural products from the Russian Pacific as sources of drugs for neurodegenerative diseases." Marine Drugs 20, no. 11 (2022): 708.
10 Arora, Rashmi, Ritchu Babbar, Abhishek Dabra, Bhawna Chopra, Geeta Deswal, and Ajmer S. Grewal. "Marine-derived Compounds: A Powerful Platform for the Treatment of Alzheimer's Disease." Central Nervous System Agents in Medicinal ChemistryChemistry-Central Nervous System Agents) 24, no. 2 (2024): 166-181.
11 Barik, S., Mohanty, L., Sahoo, S., Mohanty, S., & Swain, S. C. (2025). Impact of Personal Income on Usage of FMCG Product of Rural Consumer. Indian Journal of Information Sources and Services, 15(1), 55–59. https://doi.org/10.51983/ijiss-2025.IJISS.15.1.09
12 Silva, Joana, Celso Alves, Francisca Soledade, Alice Martins, Susete Pinteus, Helena Gaspar, Amparo Alfonso, and Rui Pedrosa. "Marine-derived components: can they be a potential therapeutic approach to Parkinson's disease?." Marine Drugs 21, no. 8 (2023): 451.
13 Hong, Yirui, Xinyu Zhang, Wenni Rong, Chenwei Hu, Yujie Jiang, Jiayi Xu, Huimin Wen et al. "Uncovering the therapeutic potentials of marine-derived natural compounds with small amounts for neurological disorders." Gene 957 (2025): 149465.
14 Alonso, Diana, Ana Castro, and Ana Martinez. "Marine compounds for the therapeutic treatment of neurological disorders." Expert Opinion on Therapeutic Patents 15, no. 10 (2005): 1377-1386.
15 Martinez, Ana. "Marine-derived drugs in neurology." Current Opinion in Investigational Drugs 8, no. 7 (2007): 525.
16 Zakaria, R., & Zaki, F. M. (2024). Vehicular ad-hoc networks (VANETs) for enhancing road safety and efficiency. Progress in Electronics and Communication Engineering, 2(1), 27–38. https://doi.org/10.31838/PECE/02.01.03
17 Orozco, L., & Ttofis, H. (2025). Energy harvesting techniques for sustainable embedded systems: Design and applications. SCCTS Journal of Embedded Systems Design and Applications, 2(1), 67–78.
18 Prasath, C. A. (2024). Energy-efficient routing protocols for IoT-enabled wireless sensor networks. Journal of Wireless Sensor Networks and IoT, 1(1), 1-7. https://doi.org/10.31838/WSNIOT/01.01.01
19 Kozlova, E. I., & Smirnov, N. V. (2025). Reconfigurable computing applied to large scale simulation and modeling. SCCTS Transactions on Reconfigurable Computing, 2(3), 18–26. https://doi.org/10.31838/RCC/02.03.03
20 Peng, G., Leung, N., & Lechowicz, R. (2025). Applications of artificial intelligence for telecom signal processing. Innovative Reviews in Engineering and Science, 3(1), 26–31. https://doi.org/10.31838/INES/03.01.04
21 Pallavi, C. H., & Sreenivasulu, G. (2024). A Hybrid Optical-Acoustic Modem Based on MIMO-OFDM for Reliable Data Transmission in Green Underwater Wireless Communication. Journal of VLSI Circuits and Systems, 6(1), 36–42. https://doi.org/10.31838/jvcs/06.01.06
22 Prabhakar, C. P. (2024). Scalable edge-based architecture for real-time video analytics in smart transportation systems. Electronics, Communications, and Computing Summit, 2(4), 80–85.