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MARINE-DERIVED COMPOUNDS FOR THE TREATMENT OF INFECTIOUS DISEASES

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Abstract
Many active crude aqueous and organic solvent extracts have been obtained from screening natural compounds from marine organisms for antiviral activity. There are currently around 40 substances on the pharmaceutical market, either as potential antiviral medications being studied or as alternative antiviral medications. Many more are being studied as preclinical and clinical candidate antiviral medications. The continued search for compounds with significant pharmacological applications in the marine environment will be accelerated by the growing demand for antiviral compounds derived from marine sources as well as new developments in marine culture and extraction techniques. For contemporary medicine, this will remain a promising approach and cutting-edge technology.
Keywords: Marine microorganisms, Marine compounds, Antiviral activities

1. INTRODUCTION

The oceans are a special resource that yield a wide variety of natural goods, primarily from invertebrates like sponges, tunicates, bryozoans, and mollusks, as well as marine bacteria and cyanobacteria. When infectious diseases develop and grow resistant to current treatments, the maritime environment offers new insights into bacterial, viral, parasitic, and fungal infections. Drug resistance, emerging infectious diseases, and the potential for bioterrorism have all spurred interest in evaluating natural ocean products in the treatment of infectious organisms, even though the majority of clinical trials using marine products are centred on cancer treatments. This study highlights the pharmacologically investigated marine leads that have shown potent in-vitro activity or in-vivo efficacy against parasitic and viral illnesses. [1].

All oceanic regions—polar, temperate, and tropical—have seen the adaptation of macroscopic animals and plants. The Indo-Pacific Ocean is home to the highest tropical marine biodiversity in the world, and coral reefs can have up to 1000 species per inch in some places. There are many useful products in the seas that are just waiting to be found to treat infectious disorders. Environmental stressors include competition for space, surface fouling, predation, and the capacity for successful reproduction have necessitated the development of secondary metabolites with a range of biological functions. The significance of these secondary metabolites in managing parasitic and pathogenic organisms was underestimated for a long time. Over the past 30 to 40 years, marine plants and animals have been the focus of a global research effort to characterize the natural products of the marine world [9]. A few marine species, plants, and bacteria have already produced over 12,000 novel

chemicals, and hundreds more are found each year. The pharmaceutical industry has effectively created a number of bioactive metabolites as a result of these search efforts[2].
These marine-product discovery programs have already produced a number of pharmacological compounds, therapeutically useful medications, and medicinal candidates under development. Here, we highlight the marine leads that have been tested pharmacologically and shown significant in-vitro or in-vivo action against bacterial, fungal, and viral illnesses as well as parasitic and infectious diseases such as trypanosomiasis, malaria, and toxoplasmosis. Our goal was to identify the most promising compounds with the highest potential for developing clinically useful medications [3]. While specific infectious disease treatments were not discussed, there are a number of useful reviews for antiparasitic drugs, antinematode drugs, antituberculosis drugs, antiviral leads, and antifungal agents.

2. REVIEW OF LITERATURE

Many previously unheard-of natural items have been characterized in terms of their chemical composition and antifungal activity thanks to antifungal screening of marine materials. As the number of immunocompromised people, such as HIV-positive patients, receiving cancer chemotherapy, immunosuppressive medicine, or broad-spectrum antibiotic treatment has grown, so too has the incidence of invasive fungal infection. There is mounting evidence that the creation of new secondary metabolites is one of the extremely unique adaptations that fungi display in the maritime environment. The majority of marine-derived antifungal substances are cytotoxic [14].
Although we compiled a list of marine natural compounds with potent antifungal activity, not all of them showed signs of cytotoxicity. To improve the therapeutic index for these medicines, it is usually required to first determine whether antifungal efficacy exceeds cytotoxic consequences, then make logical modifications. Anthelmintics are medications that kill the host organisms of helminth parasites[4]. The unsegmented worms that make up the phylum Nematoda, or nematode parasitism, are a serious problem in the commercial livestock sector and a major cause of hunger and illness in humans. The giant gut worm Ascaris lumbricoides, which causes malnutrition and obstructive bowel disease, and the soil-transmitted blood-sucking hookworms Ancylostomiasis duodenale and Necator americanus, which cause severe blood loss and iron-deficient anemia, decreased food consumption, impaired digestion, malabsorption, and poor growth rate, are particularly challenging to eradicate. The quest for new bioactive chemicals is required because of the increasing resistance to the main structural classes (benzimidazoles and macrolides), even if there are good commercial anthelmintics available [5].
Nevertheless, knowledge of these substances' in vitro method of action may still result in the discovery of novel, more potent anthelmintics. An obligate intracellular parasite from the genus Leishmania causes the disease known as leishmaniasis. The disease comes in a variety of forms, such as self-curing ulcers (cutaneous leishmaniasis), spreading nasopharyngeal sickness (mucocutaneous leishmaniasis), and propagating visceral leishmaniasis, which is usually fatal if ignored[10]. In Mediterranean nations, adult visceral leishmaniasis is recognized as an opportunistic infection linked to AIDS because immunosuppression triggers the reactivation of latent infections. The most widely used drugs for treating leishmaniasis are pentavalent antimonies, which means that alternative therapies are desperately needed.

3. MATERIALS AND METHODS

Cats infected with the parasite Toxoplasma gondii can infect humans with toxoplasmosis. The course may vary widely, ranging from a self-limited adenopathy to deadly encephalitis. Immunocompromised individuals and pregnant women are more vulnerable; congenital infections in infants are usually lethal. The other class of drugs used to treat toxoplasmosis, the macrolides, only work against the tachyzoite and not the cysts. Manzamine A and several of the selected compounds demonstrated quick action due to their enhanced bioavailability and long-lasting antiparasitic efficacy without any clearly noticeable side effects. Manzamine A has a therapeutic index comparable to that of chloroquine, with a toxic dose of 500 mol/kg, ten times greater than the quantity required to eradicate the parasite if given three times with two-day intervals between doses. Understanding the structure-activity relationship of this special class of alkaloids will surely result in antimalarial drug leads related to manzamine that are less toxic and more effective. Because of their effectiveness against malaria, manzamine and several of its analogues are among the most promising anti-infective leads to be extracted from the ocean. Given the hitherto unheard-of diversity of marine natural products and the increasing awareness of the need for innovative anti-infective medications worldwide, there will surely be greater incentive to introduce sea products into the clinic [11].
Terrestrial drug leads have led us to make blunders that make continuous and thorough extraction from nature unreliable and puts the corresponding species in danger of going extinct. Therefore, it is difficult to produce marine natural product metabolites on a big scale for therapeutic use, and it is clearly necessary to find alternate ways to provide supplies that are both inexpensive and environmentally friendly. Chemical synthesis is

traditionally one of the first options to be taken into consideration in the supply of tiny molecules from the sea[12].

Due to the structural complexity of marine chemicals, which suggests unique mechanisms of action and remarkable selectivity, there are very few commercially viable methods for comprehensive chemical synthesis[6]. Ziconotide is a successful example of a marine product drug that can be produced indefinitely since it is a peptide. A second, albeit still somewhat labor-intensive, approach is to study the biological activities of marine natural product pharmacophores with a well-defined structural moiety and try to ascertain whether the essential pharmacophore can lead to more useful drugs from a marine model through synthesis, chemical degradation, modification, or a combination of these. The biomass currently generated is usually still substantially less than what would be needed should a sea-based treatment finally reach the market, despite significant advancements in the aquaculture of source species, such as sponges, tunicates, and bryozoans, for cancer applications [7].

Furthermore, a number of variables, like as disease or storm destruction, affect the growth of invertebrates in their native habitat. Several studies have shown that bacteria have a role in the synthesis of natural chemicals from invertebrates. Among the primary developments in the characterisation of the microbial communities present in sponges are molecular techniques such fluorescence in-situ hybridization with group-specific 16 S rRNA-targeted oligonucleotide probes. This tactic has made it easier to identify the bacterial species that live in a variety of marine invertebrates.

4. RESULT AND DISCUSSION

Large-scale fermentation would benefit from the careful creation of specialized culture medium if bacteria or other related microbes did manufacture these chemicals of interest. Only around 5% or fewer of the bacteria that can now be cultured under normal conditions are found in marine samples using microscopic techniques. By putting biosynthetic gene clusters into a vector appropriate for high-volume fermentation, molecular approaches provide especially intriguing options to culturing problems for symbiotic bacteria. It seems obvious that the oceans will have a significant impact on reducing the prevalence of infectious diseases in the future. Finding novel treatment options from marine resources has advanced significantly, but much more work is required to translate these findings into clinical applications. Bioactive chemicals essential to drug discovery can be found in natural products produced from plants and marine life [13]. The substances' pharmacological actions are influenced by their diverse combinations of metabolites.

Figure 1: DPPH assay of ascorbicoaid and EAF

Yet, because of their intricate chemistry and uncommon presence in natural extracts, it is challenging to isolate individual bioactive chemicals. Despite these restrictions, a large number of substances originating from plants and marine life have received regulatory approval, particularly[8]. The therapeutic potential of marine and plant sources, as well as innovative extraction and separation methods that support sustainable drug development, are covered in this review. The significance of machine learning, artificial intelligence, and responsible innovation to accelerating drug discovery will be highlighted in the future[15].

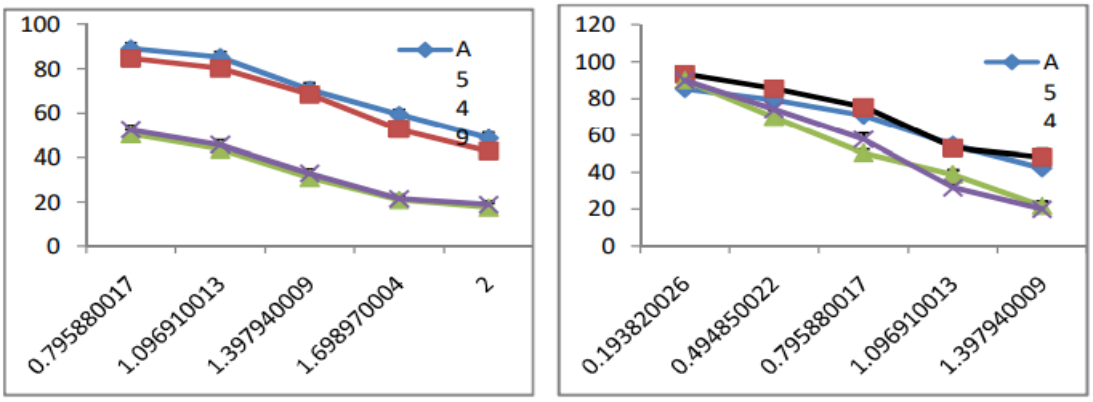

Figure 2: MTT assay

Additionally, ongoing research to meet global health needs will be highlighted. The remarkable chemical diversity of sponge-derived compounds of interest.

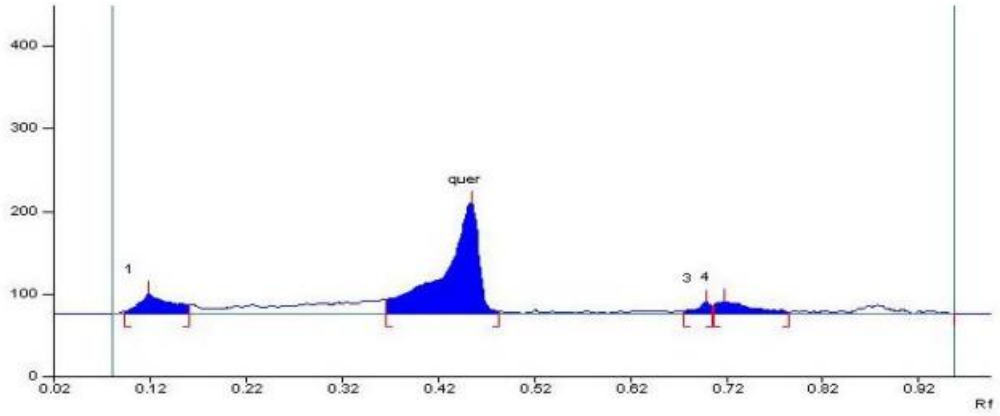

Figure 3: HPTLC Chromatogram of Quercetin in Acanthophora spicifera

In addition to the rare nucleosides, sponges have been shown to contain bioactive terpenes, sterols, cyclic peptides, alkaloids, fatty acids, peroxides, and derivatives of amino acids (typically halogenated). They have had plenty of time to develop a sophisticated chemical defense mechanism because of their early evolutionary appearance. It is important to note that the conditions the sponge encounters regulate the formation of secondary metabolites.

5. CONCLUSION

Pharmaceutical companies have not pursued the commercialization of bioactive compounds produced from marine creatures due to a lack of knowledge on the precise circumstances and parameters required for the growth and cultivation of marine micro- or macro-organisms. Research was initially limited to near-shore, surface-accessible species, which were acquired using traditional methods like scuba diving, due to difficulties in the marine environment. The eventual solution to the commercial manufacturing of these substances is anticipated to involve some combinational genetic and metabolic engineering. Combinatorial biochemistry, post-genomic technology, and computer-based molecular modelling designs may be used to produce metabolites in a sustainable manner. As with all antiviral medications, the development of virus resistance is a major problem. Nonetheless, it is reasonable to believe that a growing number of novel drugs that viruses have not yet learned to resist will be found, considering the vast number of unidentified marine organisms and their distinct metabolites. It should be mentioned that most organisms from various species manufacture similar types of molecules, each specific to their particular environment and composition.

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