**Drug Properties of Marine Microorganisms**

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**Earth’s oceans cover the majority of the planet’s surface. The oceans are vast and are mostly unexplored due to their sheer size and depth as well as other technological challenges that are faced during exploration. Due to this, we have faced the consequences of not fully interpreting the potential that is present when further analyzing the importance of marine-derived drugs. Thus, we are highly unfamiliar with macro-, and microorganisms found within this region. However, when research is done properly, we discover the potentiality of natural products from organisms such as macroalgae and symbiotic microbes. Moreover, there has been some research done on natural products found in marine environments before, and some have even been approved for medical treatment. Additionally, macroalgae related to phylum Bacillota has been occasionally known to produce a special compound that protects the hosts from detrimental predators. In this study, the natural products and drug properties made by macroalgae-associated Bacillota were summarized. It was revealed that the Bacillota are indeed efficient when it comes to producing biologically active molecules. Yet, it is to be noted that only antibacterial properties were tested for most of these compounds. Additional testing should be executed to fully grasp the idea of expanding potential pharmaceutical leads from the marine environment.**

**Introduction**

The volume of Earth’s oceans is substantial compared to the total surface area of the planet, they have an expansive biodiversity and cover around 70% of Earth’s surface. Thus, due to challenging conditions a large proportion of it remains out of reach and unexplored. Some of the abiotic conditions that cause issues to deep-sea exploration would include temperature, depth, and sample collection. Layers such as the thermocline layer, pycnocline layer, and the halocline layer are other factors that influence the difficulties of exploring our oceans to a greater extent. For instance, the halocline layer involves a rapid change in salinity that is either caused by high or low latitude regions, the thermocline layer involves a temperature decrease which is followed by a temperature increase as the depth of the ocean expands and lastly, the pycnocline layer involves the rapid change of density (Therman & Trujillo, 2019). Due to these circumstances, the challenging conditions of marine habitats make it strenuous work to research marine microbes. Nevertheless, these difficulties are what help marine organisms integrate atypical chemical compounds that allow them to fully adapt to their ecosystem. Altogether, the natural products produced by organisms in terrestrial environments have been more intensively studied compared to those of marine environments due to the facility of sampling and culturing in laboratories. Regardless of the difficulties marine environments cause to researchers, many studies have been conducted and a few marine natural products (MNPs) have already been produced. Investigating marine microorganisms is essential for discovering new drug properties. According to Uche et al., symbiotic marine microorganisms have a rather wide variety of novel secondary metabolites compared to their free-living counterparts, and most of these marine microorganisms can be found settling in hosts such as marine macroalgae which are known to be a common host for a diverse number of bacterial species (Uche et al., 2023). In addition to having a great variety of metabolites, Bacillota found in marine organisms are known to create antifouling agents and antimicrobial agents (Li et al., 2020). These agents can be relevant for development of new antibiotics, considering that they are great sources and contain a variety of properties that may be used in creating new marine drugs. There is plenty of potential found in the research of (MNPs) since they have so much to offer to the industry of medicine.

**Recent Progress**

The emergence of antibiotic resistance has led discoverers to seek new antibiotics since resistance makes infections difficult to treat. Expanding treatment options and creating a new diversity of antibiotics could potentially allow healthcare providers to prevent future health threats by combating antibiotic resistance and by supporting antimicrobial stewardship (ASPs). For these reasons, it is vital to research our marine environments to enhance our pharmaceutical potentials by exploring the rich biodiversity marine microorganisms have to offer us. Additionally, many of these species (such as Bacillota) found in marine habitats tend to have unique chemical structures that are not commonly found in terrestrial environments. These compounds with unique structures found within marine symbiotic microorganisms are promising in the development of new drug discovery. Furthermore, according to a survey done by Uche et al., “compounds isolated from the macroalgae Bacillota showed varied levels of effects against human bacterial pathogens.” (Uche et al., 2023). These findings were mostly in vitro antibacterial properties. The compounds also showed antibacterial activities against a wide variety of pathogenic bacteria, some of those including methicillin resistant bacteria and vancomycin-resistant bacteria (Uche et al., 2023). Moreover, other properties from Bacillota were documented. These included cytotoxicity, anti-inflammatory, antioxidant, antidiabetic, anti-hypercholesterolemic and antihyperglycemic extracts from the macroalgae Bacillota (Uche et al.) With a wide range of properties available, it is rather easy to note that with such a variety of properties come great benefits. Some examples would include cost-effectiveness and versatility within clinical applications. Not to mention the drug resistance situation mentioned earlier. Nevertheless, while it may be simple to explain all the benefits that Bacillota possesses, we must first further analyze symbiotic Bacillota since there are thousands of species available and only a few have been thoroughly and properly researched.

**Discussion**

I believe facing the challenges that come with deep sea exploration would benefit us by furthering our scientific discoveries/ knowledge and by also allowing us to advance in the research of symbiotic microorganisms such as Bacillota. There are many more species of bacteria with plenty of potential that have not been fully examined regarding the drug properties they may possess. Moreover, the ocean is highly diverse and thus, exploring it would help us gain more insight over this topic. In addition to the investigation of the symbiotic bacteria, we must also emphasize the importance that the host plays as well. Different factors affect different species of macroalgae. Like I mentioned earlier, salinity, depth, and density all play a role in the development of the symbiotic bacteria found within different hosts. In conclusion, promoting research in marine environments would help us to diversify and expand our understanding of marine microbes.

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