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Marine Pharmacognosy and its Biological Diversity in Marine Environment

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Opinion Article

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Description

Marine Pharmacognosy is the study and identification of medicinally important plants and animals found in the sea. It is a sub-discipline of terrestrial Pharmacognosy. Generally, drugs are derived from marine bacteria, viruses, algae, fungi and sponges. Oceans cover more than 70% of the earth's surface and contain 95% of the planet's biosphere. They have evolved many different mechanisms over time to survive the various harsh environments which include extreme temperatures, salinity, pressure, various levels of aeration and radiation, overcoming mutation effects and combating infection, fouling and overgrowth by other organisms. Physical or chemical adaptations to survive in different environments are possible. Organisms that lack obvious physical defences, such as sessile organisms, are thought to have evolved chemical defences to protect themselves. Due to the dilution effect of seawater, the compounds are also thought to be extremely potent.

This has been described as analogues to pheromones but with the aim of repelling rather than attracting. Predators have also evolved chemical weapons to paralyses or kill prey. *Conus magus* is a cone snail with a poisoned harpoon-like projectile that it uses to paralyze prey such as small fish. Some organisms, such as the Viperfish are thought to use their photophore to attract small fish or prey. Many different marine organisms have been studied in search of bioactive compounds. Fish, sharks and snakes are examples of vertebrate animals. Sponge, coelenterates, tunicates, echinoderms, corals, algae, mollusks and bryozoans are examples of invertebrates. Bacteria, fungi and cyanobacteria are examples of microorganisms.

Marine environments are thought to have greater biological diversity than terrestrial environments. The oceans of the 33 recognized phyla contain thirty-two different animal phyla. Only one phylum is exclusively represented in terrestrial environments, while fifteen are exclusively represented in marine environments. There are also functionally unique organisms in the marine phyla, such as filter feeders and sessile organisms that have no terrestrial counterpart. Furthermore, marine autotrophs are more diverse than terrestrial autotrophs. Marine autotrophs are thought to be descended from at least eight ancient clades, whereas terrestrial organisms are thought to be descended from a single clade, *Embyrophyta*. More than 80% of the world's plant and animal species may be found in marine environments. Coral reef diversity can be extraordinary, with species diversity reaching 1000 species per meter squared.

Several steps must be completed in order to isolate biologically active compounds from organisms. Extraction, chromatographic purification, de-replication, structure elucidation and bioassay testing are the various steps required to obtain a biologically active compound. The steps do not have to be completed in that order and several steps may be completed concurrently. The sample may be triturated and extracted with a suitable solvent or macerated in the first step. Methanol: chloroform, ethanol, acetonitrile and other solvents may be used. The goal is to remove organic compounds with a medium polarity that is more "drug-like." Polar compounds such as salts, peptides and sugars, as well as very non-polar compounds such as lipids are ideally left behind to simplify chromatography because they are not generally considered "drug-like." To remove any excess water and thus limit the amount of highly polar compounds extracted, the sample could be dried before lyophilisation. The next step is determined by the methodology of each laboratory. Bioassay-guided fractionation is a popular technique for identifying biologically active compounds. This entails testing the crude extract or preliminary fractions from chromatography in an assay or multiple assays, determining which fractions or crude extracts show activity in the specific assays and fractionating the active fractions or extracts further. This step is then repeated, with the new fractions tested and the active fractions fractionated further. This process is repeated until the fraction contains only one compound. De-replication should be performed as soon as possible to determine if the active compound has already been reported in order to avoid "rediscovering" a compound. This can be done by comparing the information obtained in the biological assay-guided process to that found in databases of previously reported compounds using Liquid Chromatography-Mass Spectrometry (LC-MS) data or Nuclear Magnetic Resonance (NMR) data.