Indian Journal of Applied Microbiology
ISSN (Online): 2454-289X, ISSN (Print): 2249-8400

Volume 20 Number 2
July - December 2017, pp. 97-100

Marine Natural Products from Marine Microbes

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Abstract: Marine microbes having immense genetic and biochemical diversity look likely to become a rich source of novel effective drugs. Marine bacteria constitute ~10% of the living biomass carbon of the biosphere and they represent dramatically different environment than their terrestrial counterpart. These bacteria originate mainly in sediments but also occur in open oceans and associated with the marine organisms.

Keywords: *Actinomycetes*, Corals, microbes, *Sponges*

Introduction

The natural products are chemical compounds derived from plants, animals and microorganisms. The compounds may be derived from primary and secondary metabolism of the organisms [1]. Due to diverse chemistry and biological activities, the natural products play an important role in pharmaceutical and agricultural research [2]. Research on the natural products started more than 100 years ago. According to the World Health Organization [WHO], 80% of people on the earth depend on traditional medicine for thousands of years, starting from the first record about 2600 BC. Some of these plants are still in use today for the treatments of ailments ranging from coughs and cold to parasitic infection and inflammation [3]. In addition to plants, microorganisms are rich source of natural products.

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Natural products from microbes: In general

Natural products have been the source of most of the active ingredients of medicines. More than 80% of drug substances are derived from natural products [4]. Almost half of the drugs approved since 1994 are based on natural products [5].

Over a hundred natural products are currently undergoing clinical trials and at least 100 similar products are in preclinical development. Most of them are derived from lead compound, isolated from plants and microbial sources. The chemical diversity of natural products is a better match to that of successful drugs than the chemical diversity of synthetic compounds [6]. The interest in applying natural chemicals diversity to drug discovery appears to be increasing [7]. The main sources of natural products derived from microbes are fungi and terrestrial actinomycetes. There is a growing interest in marine actinomycetes and cyanobacteria as the source of bioactive compounds. Over 120 cyanobacterial alkaloids were published between 2001 and 2006 [8].

Terrestrial microorganism are a rich a source of structurally diverse bioactive substance, leading to the discovery of antibacterial agents including *Penicillins, Cephalosporins, Aminoglycosides*, *Tetracyclines* and *Polyketides* [9]. Current therapeutic applications of metabolites from microorganisms have expanded into immunosuppressive agents (*e.g, Cyclosporins* and *Rapamysin*), cholesterol-lowering agents (*eg lovastatin and mevastatin*), antihelmintic agents (*eg Ivermectin*), an antidiabetic agent (acarbose) and anticancer agents (*eg pentostatin, peplomycin* and *Epirubicin*) [10].

Marine natural products from microbes

The marine environment is frequently recognized as the largest potential sources of biodiversity and it is being increasingly searched for novel chemicals with bioactivity. In the year 2004 alone, 76 new marine compounds were described in the literature [11] and a further 812 in 2005 [12].

The lyngbyabellin B is an antifungal depsipeptide derived from the marine cyanobacterium *Lynbya majuscule* and the compound is very active against *Candida albicans* [13]. The ascosalipyrrolidinone-A is a novel polyketide; extracted from the obligate marine fungus *Ascochyta salicorniae* [14]. The ascosalipyrrolidinone-A has antiplasmodial activity against two strains of *Plasmodium falciparum*: (i) strain KI, a strain resistant to chloroquine; and (ii) strain NF 54, susceptible to standard antimalarials. The manzamine A is β-carboline alkaloid, inhibiting the growth of the rodent malaria parasite *P.bergheri*, not only *in vitro* but also *in vivo* [15].

Coral associated bacteria are rich sources of marine products [16], since the coral surface is relatively nutrient rich as compared to seawater or sediments. The norharman is a bate-carboline alkaloid with a wide spectrum of antimicrobial activities, isolated from *Pseudoalteromonas piscida* NJ6-3-1. The cyclo- (L-Pro-L-Phe) isolated from *Alcaligenes faecalis* A72 associated with the sponges *S.tenuis* is moderately inhibitory against *Staphylococcus aureus*.

Marine organism is well known to have specific relationship with numerous microorganisms and sponges are no exception to this. The sponge microbial association is a topic of research since a long time. It is interesting to note that the bacterial density in sponges is attributed to the temporal

variations in the surrounding environment. Some bacteria permanently reside in the sponge mesophyle, pointing to a close interaction between the host and associated bacteria. It has been estimated that in some sponge species as much as 40% of the animal biomass must be attributed to the bacteria, the amount exceeds the population of seawater by two to four orders of magnitude.

The sponges are often associated with symbiotic microbial populations that include *Archaea, Bacteria, Actinomycetes, Fungi, Cyanobacteria* and *Microalgae*. In some cases, it is these microorganisms and not the sponge cells, which are the probable source of the secondary metabolites of interest. The polybrominated biphenyl ether antibiotics isolated from the sponge *Dysidea herbacea* are really produced by the endosymbiotic cyanobacterium *Oscillatoria spongeliae*.

Many pharmacologically interesting marine natural products such as ecteinascidin 743 (ET-743) from the tunicate *Ecteinascidia turbinate*, the halichondrins from *Lissodendoryx* sponges or the bryostatins from the bryozoans *Bugula neritina* can be isolated in minute amounts are presently under clinical trials.

Conclusion

Microbes can sense, adapt and respond to their environment quickly and can compete for defense and survival by production of unique secondary metabolites. These compounds are produced in response to stress and many of them find place in biotechnological or pharmaceutical applications. The ecology of marine natural products actually reveals that many of these compounds are chemical weapons evolved into highly potent inhibitors of physiological process in the prey, predators or competitors of the marine organisms that utilize them for survival.

Conflict of Interest

The authors state no conflict of interest and have not received any payment in preparation of this manuscript

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