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Marine Bioprospecting – An Approach to Discover Drugs

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Abstract

Large quantities of material are being collected from the bush or the Oceans for screening of novel products which acts as a good drug to cure many severe diseases and also used for the initial stages of the drug discovery process. Marine bioprospecting has significantly increased over the last decades and leads to discover new molecules. This article mainly focus on prospecting marine resources, approaches and techniques, medicinal value of prospected materials from the different type of organisms.

Introduction

Our Ocean is bestowed with an amazing variety of life forms. Genetic resources in the world's oceans are of actual and potential interest for commercial uses. Drugs currently available in market are simple, semi-synthetic modifications of naturally occurring substances. Approximately 25% of the world's pharmaceutical products find a significant degree of origin in indigenous communities, which represent more than a 2000-billion-dollar share in global market. The ratio of natural compound is higher in marine than terrestrial organisms. Now-a-days there are more chemical substances derived from marine resources that are considered to be important drugs. Several of these medicinal products were discovered in one way or the other way by the phenomenon of bioprospecting.

Bioprospecting

Bioprospecting is mainly the exploration, extraction and screening of biological diversity and indigenous knowledge for commercially valuable genetic and biochemical resources. The systematic search for genes, natural compounds from the natural resources in the marine environment without disrupting the nature. Bioprospecting for new marine natural products has increased significantly over the last decades and leads to an unprecedented discovery of new molecules.

Marine bioprospecting can be described as a systematic search in marine organisms from the sea, along the coast and from the fjords, seabed etc., It includes all kinds of organisms, microorganisms like bacteria, fungi and viruses and larger organisms such as sea plants, shellfish and fish (Bowler *et al.,* 2009). This bioprospecting technique is carried out by a wide variety of industries mainly by the pharmaceutical firm, but also by the variety of branches of agriculture, manufacturing, engineering, construction and many others. The methods of bioprospecting are mainly in four different forms. They are chemicals, gene, microbial and enzyme.

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Methods used in Bioprospecting

Basically three methods are used in bioprospecting. They are,

• **Traditional Approach:** Based on natural products

• **Empirical Approach:** Based on rational design

• **Molecular Approach:** Based on the better understanding of the molecular target

Extraction Techniques

Totally there are five phase for getting the prospected compounds or materials.

• **Phase – I:** Determination of environmental characteristics and formation of hypothesis related to where to search for organisms.

• **Phase – II:** Onsite collection of samples in the hypothesized areas and select the target organisms.

• **Phase – III:** Culturing, Isolation and identification of target organisms.

• **Phase – IV:** Screening of target organisms for their ability to produce the needed compounds.

• **Phase – V:** Development and industrial production of the acquired compounds.

Marine Resources

Bioprospecting using the marine resources is not now, as evidenced by the fact more than 10,000 molecules have already been reported from marine resources and very few of them have been put on the market. Marine bioprospecting has tended to target macro – organisms such as corals and sponges because of their evolutionary diversity and they have assumed to be rich in defense molecules with efficient potencies adapted for marine environment (Heni Abida *et al.*, 2013). The largely untapped biodiversity and unknown adaptations presents in the extreme conditions in the environment like hydrothermal vents and the deep sea resources were targeted particularly nowadays (Table 1).

Merits of Bioprospecting

• It is very effective for pharmaceutical firms to conduct research through bioprospecting by using the advancement in molecular biology and the sophisticated tools for screening the compounds.

• Invention of several lifesaving drugs from the marine resources has renewed the interest in bioprospecting.

Table 1: List of some common drugs derived using marine resources

Sl. No.	Name of the compound	Type of producer organism	Name of the producer organism	Clinical uses
1.	Jaspamide	Marine Sponges	*Hemiastrella minor*	Anti–neoplastic
2.	Cembranoid diterpens	Corals	*Sinularia polydactyla*	Anti tumour
3.	Variolin	Marine sponges	*Krikpatrika variosa*	Anti–cancer
4.	Discodermolide	Marine sponges	*Discodermia dissoluta*	Immune suppressive & Antimitotic
5.	Contignasterol	Marine sponges	*Petrosia contignata*	Anti–asthma
6.	Venuceane	Deep sea microbes	*Thermus thermophilus*	Anti–aging
7.	Cryphtophycin	Marine Cyanobacteria	*Lyngbya majuscula*	Chemotherapy
8.	Tolytoxin	Marine Cyanobacteria	*Tolypothrix distorta*	Anti–fungal
9.	Aequorin	Jelly fish	*Aequorea victoria*	Bone repair
10.	Trabectedin	Mangrove tunicata	*Ecteinascidia turbinata*	Anti–ovarian cancer
11.	Prialt	Cone snails	*Conus magus*	Neuropathetic pain
12.	Eribulin	Marine sponges	*Halichondria okadai*	Anti–microtubule
13.	Plinabulin	Marine Fungi	*Aspergillus* sp	Anti–cancer
14.	Pseudopterosins	Soft coral	*Pseudopterogorgia elisabethae*	Anti–inflammatory
15.	Salinisporamide	Marine Actinomycetes	*Salinispora tropica*	Anti–cancer
16.	Violaxanthin	Green Algae	*Dunaliella tertiolecta*	Anti–breast cancer
17.	Fucoidan	Brown Seaweeds	*Fucus visiculosus*	Neuro protective
18.	Cephalosporin P	Marine Fungi	*Acremonium chrysogenumi*	Anti–bacterial
19.	Phlorotannins	Marine Kelp	*Ascophyllum nodosum*	Anti–diabetic

• The collaboration between many pharmaceuticals companies and countries supplying the medicinal raw material and knowledge offer the revenue source.

• It also offers various opportunities to the society for employment and education avenues.

• The terms and conditions of bioprospecting agreements under which indigenous people might benefit financially and free from ambiguity.

• Technology and knowledge transfer among countries is promoted through bioprospecting.

• Traditional culture and habitats are preserved by rediscovering ancient native practices.

Limitations of Bioprospecting

• It is a time consuming process and there is no certainty of returns.

• Unsustainable harvesting of resources and other negative environmental impacts may damage the biodiversity and environment.

• Imbalance in ecosystem due to excessive exploitation of material resources, which constitute more than 50% of medicinal plants. It is mainly due to multitude of commercial interests including bioprospecting.

• Capital intensive is very high and the methods of deriving compounds are somewhat risky.

Conclusion

It is speculated that in the coming decade, Marine Bioprospecting based sector will evolve to a well developed and also have strong market presence with many novel and unique drugs. The systematic analysis of overall trends exhibited in bioprospecting may allow researchers to redirect their efforts towards different taxonomical groups or geographic regions in order to improve the efficiency of their studies and maximize the number of new products being discovered. It will be possible to merge bioprospecting interests and conversations efforts, along with social, ecological and financial sustainability by fully recognizing the importance of marine biodiversity for many applications in near future.

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