REVIEW ARTICLE

A review on marine natural products and their application in modern medicine

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Abstract

In recent years, drugs from natural sources are becoming important owing to their potency and less toxicity. Natural products from marine microorganisms and marine algae are one of the highly explored areas in natural product research. Plenty of marine natural product being isolated and is showing a wide array of biological activity. The present review focuses on pharmaceutically important marine natural products isolated from different microorganisms, marine invertebrates, variety of algae, and their application in modern medicine.

Key words: Marine, natural products, bacteria, fungi

INTRODUCTION

More than 30,000 species of variety of algae alongside with variety of microorganisms including several fungi and bacteria are abundantly found in the sea. Marine algae have attracted attention due to their beneficial support to the biosphere. They act as the major source of oxygen supply to the biosphere and also are the major part of food for fishes. They are used in the manufacture of medicines and fertilizers. Majority of red algae as well as brown algae excluding *Bondanella, Pleurocladia,* and *Heribaudiella* occur in salt water. Shallow waters are the perfect environment for the growth of algae such as *Codium, Caulerpa, Ulva,* and *Enteromorpha*. *Prasiola, Enteromorpha,* and *Cladophora* and related species are able to grow both in fresh water and sea water. Many algae such as dinoflagellates and certain blue-green algae grow abundantly in sea water. Fungi and bacteria are a major source of antagonistic substances in the terrestrial environment. A similar kind of action is expected from these organisms in oceans too. It has been found true because the antibacterial, antiviral, and antifungal activities of these organisms had been reported in the literature[1] along with a few growth stimulant properties that may be of use in studies on wound healing and carcinogenic properties. The present review elaborates on the natural products obtained from marine algae as well as marine microorganisms with their role in modern medicine.

IMPORTANT BIOACTIVE COMPOUNDS FROM ALGAE, BACTERIA, AND FUNGI

Brominated phenols, sulfur and nitrogen bearing heterocyclics, peptides and proteins, oxygen bearing heterocyclics, terpenes, terpenoids, polysaccharides, and steroidal-containing moieties are some of the major bioactive metabolites of marine flora. The chemistry and applications have been briefly reviewed.

Brominated Phenols

The red, brown, and green algae have been extensively examined for antibacterial and antifungal activities. Various biologically active metabolites were isolated from *Symphyocladia gracilis, Rhodomela larix,* and *Polysiphonia lanosa* were 2,3-dibromobenzylalcohol, 4,5-disulfate dipotassium salt (A), 2,3-dibromo-4,5-dihydroxybenzaldehyde (B), 2,3-dibromo-4,5-dihydroxybenzyl alcohol (C), 3,5-dibromo-p-hydroxybenzyl

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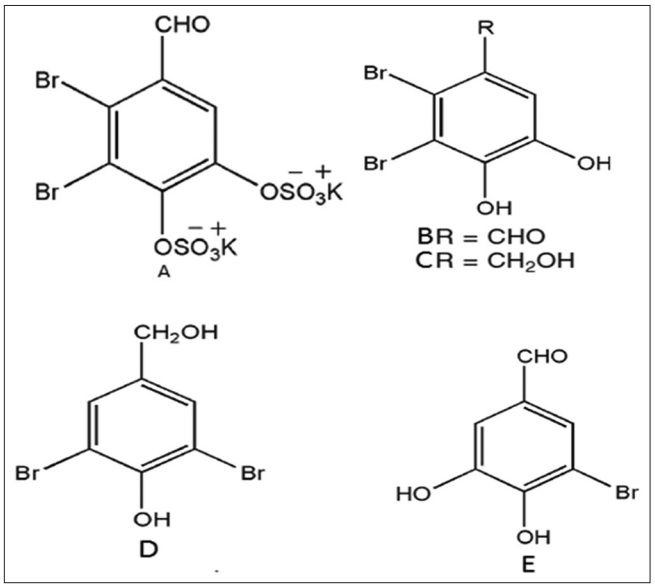
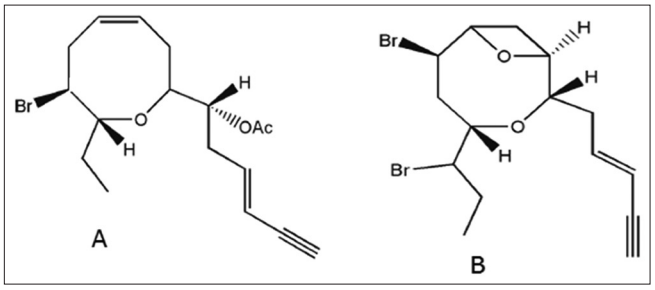
alcohol (D), and the 5-bromo-3,4-dihydroxybenzaldehyde (E). Literature data are not available regarding the biological activity and biosynthetic pathways of the bromo phenols. Their antialgal activity suggests that they may play a role in the regulation of epiphytes and endophytes. The bromo phenols may be biosynthesized through the shikimic acid pathway, and bromination may occur through the presence of suitable peroxides.



Bromine Containing Oxygenated Heterocycles

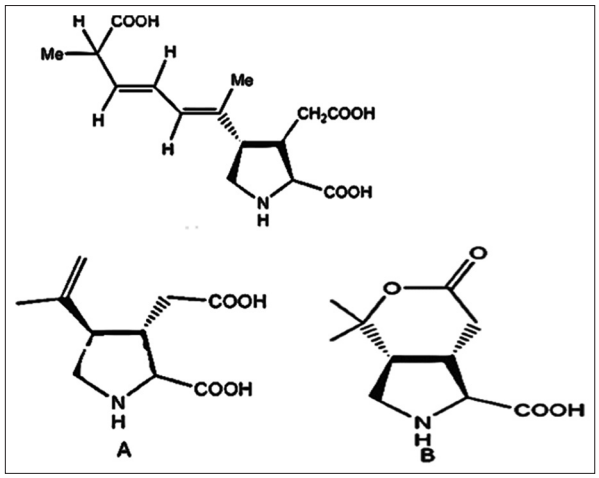
The red algae *Laurencia* sp. consists of a diverse class of natural products[2-5] *Laurencia glandulifera* and *Laurencia nipponica* containing two brominated oxygen heterocyclic compounds, laurencin (6)[6] and laureatin (7), respectively. Their toxic nature limits the usage in medicine.



Nitrogen Heterocycles

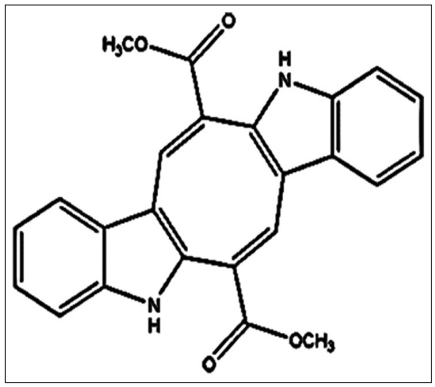
A large number of marine algae with nitrogen containing heterocyclic compounds were found. Domoic acid (8) and the kainic acid are important derivatives.

Domoic acid found to possess excellent anthelmintic activity and was found effective in expelling ascaris and pinworms. People in the Mediterranean region use the extract of alga *Corallina officinalis* for the same purpose. Kainic acids are the active principles found in these algae. Of the kainic acids, α-kainic acid was the most potent. α-Kainic acid is effective in the treatment of ascariasis.



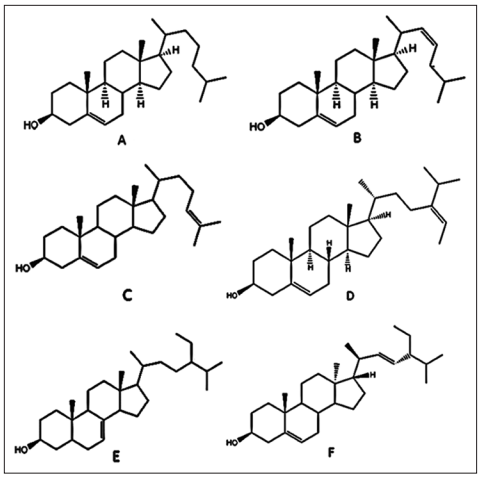
Phenazine Derivatives

The marine alga *Caulerpa lamourouxii* is extensively found in the islands of Phillippines. The chemical constituents of the alga had been fractioned and were found to contain caulerpicine, caulerpin,they are correct terms and we have reviewed it.[7,8] Caulerpin was found to produce local anesthetic action. In certain groups, it produced toxic effects.



Sterols

The sterols in algae were first identified by Heilbron *et al*.,[9] and Tsuda *et al*.[10] and Gibbons *et al*.[11] which confirmed the existence of 22-dehydrocholesterol and desmosterol in red algae. Idler et al.[12] found three species of algae, which contained C27, 28, and 29 sterols, respectively. Extensive review reports the presence of sterols in algae. Red algae mainly contained cholesterol (A), also desmosterol (B), and one species contained primarily 22-dehydrocholesterol. Fucosterol (C) was brown algae. Most phaeophyta contained traces of cholesterol and biosynthetic precursors of fucosterol (D and E). The sterols from marine algae are reported to reduce the blood cholesterol level and also reduce the tendency to form a fatty liver and excessive fat accumulation in the cardiac region.[13]

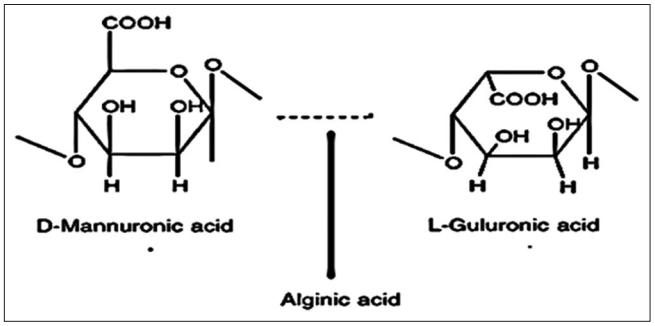


Sulfated Polysaccharides

The sulfated polysaccharides are economically most important products owing to their use in food and medicine. The application seaweed extracts in food and medicine are extensively reviewed.[14] Carrageenan is produced by species of *Chondrus, Eucheuma, Gigartina,* and *Iridea.* Carrageenan was also found to be anticoagulant and anti-clotting agent. The carrageenan was found to be a good anti-ulcer agent.[15,16]

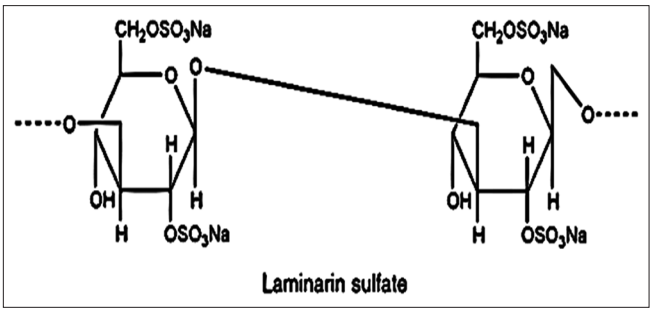
Alginic Acid

Alginic acid is a polysaccharide, which is obtained from the brown seaweeds. Alginic acid consists of two monomers, the D-mannuronic acid and L-guluronic acid.[17] Calcium alginate is a good hemostatic agent used as a coagulant.[18] Sodium alginate is used as adjuvant in the viral vaccines. Sodium alginate effectively chelates strontium 85 and strontium 87 to clear them from the system without seriously affecting the availability of Ca, Na, or K in the body.[19] The selective action of sodium alginate finds application in the clearance of Sr-90 contamination during atomic explosions.



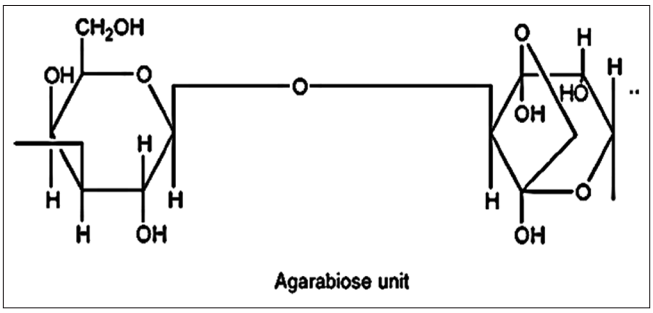
Laminarin

It is essentially a linear polymer of β-1,3-glucan, with branching points at carbon 6 and with a variable proportion of the glucose chains. Two lower sulfated laminarins are extensively reported for their anticoagulant activity such as natural heparin.[20,21]



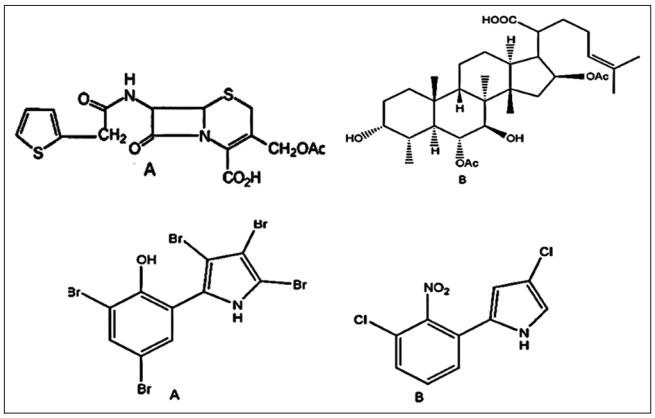
Agar and Agarose

The red algae are the main sources of agar and agarose. Although these polysaccharides have no direct medicinal use, their use in biomedical research is well documented.



MARINE PRODUCTS FROM BACTERIA AND FUNGI

Among the many bacteria isolated from sea, a variant of the ichthyotoxic *Pseudomonas piscicida*[22] showed better antimicrobial activity. A red-colored bacterium obtained from Puerto Rico was found to release Vitamin B and antimicrobial compounds into the marine water.[23] The bacteria and fungi from sea are also reported to produce substances which affect central nervous system, respiratory system, etc.[24,25] A penicillinase sensitive antibiotic named antibiotic N, which was active against Gram-negative bacteria, had been isolated from the similar source. This material was reported to be cephalosporin C (A),[26-28] and it was different from cephalosporin N. Many bacteria, producing antibiotic substances, had been isolated from the shallow marine water. A bromo substituted pyrrole antibiotic has been isolated from *Pseudomonas bromoutilis*.[29]



CONCLUSION

Marine algae have through the years been a large source for a variety of biologically active chemical entities, many of which have medicinal properties. Bacteria from marine sources are among the producers of most potent toxins. Seaweeds form the source of sulfated polysaccharides which are extensively used in food and medicine. Agar and agarose are obtained from red algae. Sodium alginate has an application used in the ice cream industries. The most applied property of sodium alginate is its medicinal value. It is used in the elimination of strontium 85 and strontium 87 from the biological system. Treatment of gastric and duodenal ulcers by carrageenan enjoys considerable popularity. Microalgae represent a vast unexplored resource of genetic perspective for the production of an array of biologically active agents. Only a few of microalgae from an estimated 50,000 different species have been characterized till date. Exploring and analyzing them in a better way may furnish potent drugs to treat viral infections including AIDS in the near future.

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