

# Medicinal Foods from Marine Animals: Current Status and Prospects

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Contents	I. Introduction	2
	II. Fish	3
	III. Crustaceans	6
	IV. Mollusks and Echinoderms	7
	V. Other Marine Animals of Medicinal Value	7
	VI. Conclusion	8
	References	8

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## Abstract

The lifestyle of human being is changing day by day toward the simplified and more convenient way of living. Human wellbeing is majorly dependent on the daily food habits that are in accordance with the habits of individual community and the surrounding environments. Although the food habits are simplified and fashioned according to the current lifestyle, many of the Asians are still showing much importance to the naturally derived and traditional foods. One such medicinally important natural source is the foods from marine organisms, which are an important growing notion for the development of marine nutraceuticals and functional foods. In this context, we have already brought the recent trends and applications of marine algal (macro and micro) foods in my previous volume. The current preliminary chapter of this book volume on marine animals and microbes describes about the prospects of

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various marine animals and their derived substances/materials as medicinal foods. In addition, this chapter encourages the new researchers as well as various health communities to implement the marine animal-based medicinal foods and their applications.

## I. INTRODUCTION

Oceans are the Earth's most valuable natural resources, which provide majority of the food in the form of fish and shellfish (about 200 billion pounds are caught each year). Oceans are the richest resource for numerous biomedically important chemical as well as the protein molecules, which are ranging from the general medication purposes to the specific therapeutic applications (Jimeno, 2002; Vo and Kim, 2010). While the use of floristic resources in traditional medicine has been widely explored, there is a paucity of information regarding the utilization of faunistic resources (Alves and Rosa, 2006), and as such, the medical value of animal species has not been included in the calculations of economic value of biodiversity by the World Conservation Union (IUCN) (Alves *et al.*, 2009; Pearce and Moran, 1994).

Science is being useful to humans day by day to cure the latest ailments, and the development of medicine from sea becoming the best nowadays because of the conventional belief that "life originated from sea." Asians supplement their regular diet with sea food, which provides them more proteinaceous and medicinally valuable ingredients. Healthy and nutritious life of human beings depend on the food and agricultural products they use, and *in lieu* to this, search of medicinal foods from marine sources is effective and continuous. The present day importance of focusing on marine medicinal substances has been procured from past experiences of use and applications of marine resources, for example, old Chinese medicinal records mentioned more than 200 species of marine organisms that are extensively been used in previous decades, whereas very few species have been under the medicinal usage. In general, until recently, very few researchers were cognizant of the value of marine animals in studying fundamental processes of relevance to human beings. However, as the thirst of exploring marine animal foods is increasing, there have been a number of articles describing the special attributes of these marine animals and forecasting noteworthy benefits from their increased use in medically oriented research.

The impact of marine food is directly proportional to the rate of consuming each level of marine food chain. For example, the phytoplanktons, seaweeds/grasses are consumed by the next level of ecological pyramid, the herbivores, which consists of zooplanktons, parrot fish, oyster, shrimp, clams, crabs scallops, tilapia, lobster, etc. Oceans carnivores

(squids, sardines, snappers, catfish, herming, lobster, pollock, sablefish, soles, striped bass, etc.) are the next level occupiers in the food chain, which dependent on other carnivores and herbivores like zooplankton; however, they ultimately serve for the nourishment of bigger and faster animals that are presented on the next level of the food chain, the top predators. The top level predators along with the subsequent food levels are well explored by humans from past decades, but the medicinal significance has not been put forward toward the sustainable and renewable way of ocean's exploration and exploitation. [Table 1.1](#) represents few of the medicinally valuable marine species along with the ones reported earlier by [Alves et al. \(2009\)](#).

Hence, the value of the marine animals in terms of medicinal and nutraceutical applications has to be brought in such a manner that the consumption of frequently available marine animals can be directed for best human diet practices. In the current chapter, the role of various marine animals as medicinal foods has been covered and in addition, the possible recommendation of utilizing these marine animals in regular diet has been advised toward the health benefits of human kind.

## II. FISH

The oceans have been explored for thousands of years and became the integral part of human society. Especially, fish have been very important to the world economy for many years occupying the bigger position in marine animal consumption, starting with the Viking trade of cod till the diverse fisheries found in many countries like Lofoten, Europe, Italy, Portugal, Spain, and India. Fisheries of today provide more than 16% of the total world's protein in many developing nations [Marine Bio](#). Fisheries are still enormously important to the economy and wellbeing of communities. The most common species making up the global fisheries are herring, cod, tuna, salmon, anchovy, mullet, flounder along with other organisms like shrimp, squid, crab, lobster, scallops, and oyster. Among them, especially cod is used for consumption in fresh as well as frozen forms. Atlantic herring is used for canning, fishmeal, and fish oil. The Atlantic menhaden is used for fishmeal and fish oil, and Alaska pollock is not only consumed, but also used for fish paste to simulate crab. The Pacific cod has recently been used as a substitute for Atlantic cod which has been overfished. Another important medicinally valuable fish is tuna (*Thunnus obesus*), one of the largest commercially canned fishery products in the world, and annually, more than 4million metric tons of tuna are harvested worldwide and approximately 3 million tons of canned tuna are produced ([Choi et al., 2011](#)). Even shark fin soup is traditionally regarded as beneficial for health in East Asia, and its status as an "elite"

**TABLE 1.1** Few marine species that are consumed and proposed as medicinal food

Name of the species	Consuming part	Remedy for diseases
<i>Electrophorus electricus</i> (Linnaeus, 1766)—electric eel	Fat	96 Headache, acne, skin spots, wounds, rheumatism, and pain
<i>Hippocampus reidi</i> (Ginsburg, 1933)—longsnout seahorse	Whole animal	Asthma, epilepsy, and alcoholism
<i>Thunnus obesus</i> (Lowe, 1839)—bigeye tuna	Whole animal	Blood pressure, stroke and cardiovascular disease, Alzheimer's disease, arthritis, cancer, macular degeneration
<i>Gadus macrocephalus</i> (Tilesius, 1810)—cod fish	Liver fats	Cardiovascular disease, heart muscle function, skin diseases
<i>Theragra chalcogramma</i> —Alaska pollock (close cousin of cod fish)	Liver fats and meat	Blood pressure, stroke, and other heart disease
<i>Rhincodon Typus</i> (Smith, 1828)—shark	Liver, cartilage, fins, meat	Immunity disorders, cancer, arthritis, psoriasis, and other allergic reactions
<i>Thaleichthys pacificus</i> (Richardson, 1836)—ooligan fish	Fat	Skin complications
Several species of Coregonidae and also squid and crab	Fish paste/jelly	Nutritional disorders
<i>Arraia</i> —unidentified species of ray	Flesh	Weakness
<i>Echinaster brasiliensis</i> (Müller and Troschel, 1842)—starfish	Whole animal	Asthma and alcoholism
<i>Echinaster echinophorus</i> (Lamarck, 1816)—starfish	Whole animal	Asthma and alcoholism
<i>Luidia senegalensis</i> (Lamarck, 1916)—starfish	Whole animal	Asthma and alcoholism
<i>Mellita quinquiesperforata</i> (Leske, 1778)—starfish	Whole animal	Asthma
<i>Oreaster reticulatus</i> (Linnaeus, 1758)—starfish	Whole animal	Asthma and alcoholism

**TABLE 1.1** (continued)

Name of the species	Consuming part	Remedy for diseases
<i>Echinometra lucunter</i> (Linnaeus, 1758)—malvaric	Whole animal	Asthma
<i>Caiman crocodilus</i> (Linnaeus, 1758) LR/II—common cayman	Skin	Asthma, allergies, and epilepsy
<i>Pteriomorpha</i> sp. (Beurlen, 1944)—mussel	Whole animal	Hypertension and stroke
<i>Haliotis asinina</i> (Linnaeus, 1758)—abalone	Whole animal	Cough and immune disorders

dish has led to huge demand with the increase of affluence in China. Naturally fermented fish and their derived peptides after enzyme treatment gain much importance in healing various diseases like Alzheimer's disease, hypertension, cancer, viral infections, bone disorders, etc. (Kim and Mendis, 2006; Vo and Kim, 2010; Wijesekara and Kim, 2010).

Additionally, fish have so many medicinal values in their composed forms viz., oils, fats, proteins/peptides, carbohydrates, etc. Marine collagen, especially fish collagen, is evaluated for its potential application as an alternative to the immunogenic mammalian collagen. In addition, the employment and the further development of sophisticated fish and marine mammal hunting techniques allowed intensive gathering, preservation, and subsequent use during times of food scarcity (Mos *et al.*, 2004). Similarly, the oils from fish gained tremendous value in the medicine for centuries. Middle age records show that cod liver oil was prescribed for rickets. Stored surplus resources also served in trade, which flourished among several coastal regions, for example, ooligan grease, a fat rendered from ooligan fish (*Thaleichthys pacificus*), was used by some coastal First Nations as an ingredient in the preparation of food items, in the preservation of fruits, wood, and leather, and as a medicinal ointment for skin rashes.

Other types of fish products are essentially the minced fish flesh. A steamed and molded fish paste called "Kamaboko" (fish jelly) is famous in Japan since sixteenth century. Further, the mechanization for flesh preparation and mincing is advanced, and several fish meat analogues have been developed to use as traditional medicine (Whittle, 1998).

### III. CRUSTACEANS

Shell fish has been contributing a lot among the marine resources to provide significant medicinal prospects to humans. Crustaceans, by possessing a vast diversity in their species, play a major role in the development of food and nutritional industries worldwide. The medicinal impact of these sources from crustaceans is the basis for many of the novel nutraceuticals and functional foods. For example, shells of shrimp and crab are majorly used for the derivation of chitin, chitosan, chitooligosaccharides (COS), and further derivatives, which have been used for various biomedical significances (Kim, 2010). Chitin and chitosan are natural biopolymers found in many natural organisms. In fact, chitin is the most important natural polysaccharide (second after cellulose), whereas chitosan is a derivative, which can be extracted from external skeleton of an octopus or some sea fishes with the chemical name 2-acetamido-2-deoxy-D-glucose-N-acetyl-D-glucosamine. It has many biological applications in pharmaceutical, nutraceutical, and cosmeceutical industries and even in food and agriculture sectors. Hypocholesterolemic effects of the chitosan and COS have attracted much attention as this property can be applied widely in the biomedical field (Vidanarachchi *et al.*, 2010). However, according to an early study, chitosan oligomers have not shown a cholesterol-lowering activity (Sugano *et al.*, 1988). However, Kim *et al.* (1998) have carried out an experiment for the investigation of the effects of hydrophilic COS on the liver functions of mice. They have found that the COS can partially reduce the elevated serum cholesterol levels after a diet containing cholesterol. After the 6-week experimental period, the serum cholesterol level has been reduced by 23% in the group of mice fed with a diet containing 1% COS and 3% cholesterol than the group fed with 3% cholesterol alone (Kim *et al.*, 1998). This reflects the involvement of the orally administered COS in the partial reduction of elevated serum cholesterol levels.

The rich proteins from shrimp and crab are a positive notion nowadays for the supplementing of high ranked nutrition for many of the patients of nutrition depletion. The collagen and other protein disorders can be overcome by the intake of these crustaceans regularly. However, the financial limitations and the inadequacy of fishing profound disturbances due to the human population and pollution; many of the developing nations are underutilize these animals. In addition, chitin and its derivatives are vastly known for their biomedical importance; however, the utilization of the crustacean foods is restricted mostly to Asian countries, and many of the developed, developing, and underdeveloped countries are henceforth advised well for the proper implementation of these medicinally valuable resources.

#### IV. MOLLUSKS AND ECHINODERMS

Mollusks along with the crustaceans are also widely sought to participate in the world's consumption of marine food. Fermented marine food sauces such as blue mussel sauce and oyster sauce possess bioactive peptides which play a major role as Angiotensin I converting enzyme inhibitors that indirectly suppress hypertension (Wijesekara and Kim, 2010). Hence, the mollusk-derived proteins and other macromolecules are highly valuable to indicate these organisms as medicinally valuable food sources.

Abalones are other important marine animals which have significant medical importance. Besides the use of soft body of the animal in food markets, dried abalone is sold among herbs and other items in medicine shops in Hong Kong, Singapore, and elsewhere in Southeast Asia. Ground and processed abalone shells are used as a calcium supplements both for humans and animals. In China, where food and medicine have long been considered more or less the same thing, abalone is highly valued for its healing powers. It is considered especially well for treating eye disease, particularly the powder made by grinding up the shells. Paolin, a drug made from abalone juice, is an effective inhibitor of penicillin-resistant strains of bacteria. The flat shell of the abalone, with its iridescent inside, is powdered and taken orally to improve vision, to remove keratoses (cataracts), and to improve such conditions as hemeralopia (Man and mollusk).

More importantly, oyster juice has been found to have antiviral properties, which might be directing a way to develop drugs. In Vietnam, traditional medicine has a wide variety of uses for shells: powdered oyster shell is taken to treat acid indigestion, fatigue, and to stop hemorrhage. It is also sprinkled over open wounds and boils. Powdered pearls from oysters are used as a topical eye medicine, and it has been scientifically proven to have some anti-inflammatory effects on a painful condition called conjunctivitis, where the surface of the eye becomes red and sore. Cuttlefish bones are used as a remedy for rickets, as a healing agent in the treatment of gastrointestinal troubles, as a local antihemorrhagic, and as an antiseptic in the cases of inflammation of the middle ear.

Octopuses, squid, cuttlefish, and nautiloids are also other common food source for many of the Asians because of their importance of potentiality in medical applications. More specifically, octopus and squids are well explored in Asian countries due to their traditional medical values.

#### V. OTHER MARINE ANIMALS OF MEDICINAL VALUE

As mentioned earlier, marine animals are the richest source of various biologically and biomedically important compounds/materials/substances. One such traditional and ancient medicinally important chordate

is seahorse, which plays a fundamental role as an ingredient in various therapies for a variety of disorders including asthma, arteriosclerosis, incontinence, impotence, thyroid disorders, skin ailments, broken bones, heart disease, as well as to facilitate childbirth and even as an aphrodisiac. The seahorse *Syngnathus acus* L. is a very important traditional Chinese medicine from sea, which possesses amino acids, proteins, trace elements, poly-carbon non-saturation fat acids, etc. (Li *et al.*, 2001). In addition, *S. acus* has sexual hormones, anticancer, and fatigue-resisting effects. It can also improve the immunity and enhances the systolic strength of heart muscle. It can be widely used in many fields such as food science, medicine, and aquatic industries.

There are several other species of marine origin, which have significant medical uses. This featured chapter, however, depicts very limited information to recommend the readers for the sustainable exploration and exploitation of the marine animals toward medicinal benefits.

## VI. CONCLUSION

The ocean plays a critical role in removing carbon from the atmosphere and providing oxygen. It regulates Earth's climate and is an increasingly important source of biomedical organisms with enormous potential for fighting disease. Seafood consumption makes tremendous impact on the ocean and its interdependents. However, today's health, safety, and sustainability considerations direct to determine the best seafood choices for human survival at the best. This interactive guide compiles all the information you need to continue to eat healthfully while lowering your seafood footprint. It is very important to explore not only the sea plants but also the marine animals to find out whether the consumed favorite food represents the high rank of sustainability, biocompatibility, with medicinal values, as well its place in the food chain. Hence, the exploration and exploitation of the marine animals toward their medical use is a greater deal to understand why we must keep the ocean healthy for future generations.

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