

## An Eminent Role of Marine in Pharmacology and Nutraceuticals

**Received:** 14 February 2023, **Revised:** 16 March 2023, **Accepted:** 20 April 2023

**A. Vijayalakshmi<sup>1</sup>, A. Parvathi Priya<sup>2</sup>, V. Nirmala<sup>3</sup>, M. Meena<sup>4</sup>**

1,2,4Chemistry dept, R.M.K. Engineering College, Tamil Nadu, India

3Mathematics dept, R.M.K. Engineering College, Tamil Nadu, India

Mail id: avl.sh@rmkec.ac.in

app.sh@rmkec.ac.in

vna.sh@rmkec.ac.in

mm.sh@rmkec.ac.in

### Abstract:

Marine bio-diversity is the wide and large variability of life in the ocean/marine and this one plays a vital characteristic of all the three pillars of sustainable development (SD) of economic (viable), social (equity) and environmental (protection) supporting the well-being running of the earth planet and providing heap and vast services that reinforce the health, as well as the prosperity of the humankind. The ocean/Marine is one kind of the foremost sources of the universe/globe bio-diversity. It constitutes approx. 90% of the inhabitable place on the earth's planet. It contains nearly 250,000 well - known species (flora and fauna), with many of the remaining to be discovered at least two - third of the globe's ocean species are still unidentified. The ocean, and the life in there, are perilous to the good healthy functioning of the planet, supplying ½ of the oxygen we inhale breath and absorbing about 26 % of the anthropogenic carbon dioxide per annum discharged into the atmosphere. The fishing and aqua-culture industrial sectors are a main source of income for many people (hundreds of millions), particularly in low salaried families, and pay both directly and indirectly to their food safety and security. Marine/sea ecosystems provide heap of facilities for coastal/marine communities around the world. For example, an ecosystems of mangrove are most important resource of food for more than 210 million of population but they also provide other services, such as livings or livelihood, pure water, valuable forest product goods and protect them against destruction and risky weather events. In this article, the eminent role of pharmacology and nutraceuticals are discussed in detail.

### 1. Introduction:

Most of the drugs used today have mostly come from nature. For example, Aspirin was first identified from the willow tree. Penicillin was first invented from common bread mould, So, majority of the medicinal drugs were derived from natural resources. It come from land-dwelling organisms [1]. However, as demand increases for the invention of novel industry oriented enzymes and new medicines, Scientific researchers are looking towards the ocean[2].

Systematic finding for new drugs have shown that marine based invertebrates produce more anti-biotic property, anti-cancer activity and anti-inflammatory [1] substances than any other group of terrestrial (land based) organisms. The promising invertebrate groups mainly include sponges, ascidians, tunicates [2], annelids, and echinoderms.

Some important chemicals produced by oceanic animals that may be useful in treatment of human diseases include:

Name of the chemical	Name of the marine animal	Cure diseases
Ecteinascidin	Tunicate variety	Ovarian and Breast cancers and tumors.
Discodermalide	Sponges in deep sea related to the genus Discodermia	Anti - tumor material
Bryostatin	Bugula and neritina bryozoan	Melanoma and Leukemia
Pseudopterosins	Sea whip (octocoral)	Analgesic and Anti-inflammatory. It reduce skin irritation and
w-conotoxin MVIIA	Conus magnus and cone snail,	Pain reliever

## 2. Ocean pharmacology in India:

India has more than 8000 kilo metre of sea shore coastline area with more marine habitats. The potential of Indian marine habitats has largely identified for their potential of new novel drugs and biotechnological programs. Some selected institutes like the National Institute of Oceanology (NIO), Goa, Central Drug Research Institute (CDRI) Lucknow [3] are currently working on the new exploration of vital lifesaving medicines from oceanic sources.

## 3. Classification of Marine Pharmacology:

Marine/Ocean pharmacology can be classified [4] on the basis of sources of the candidate drug

- Genetically engineered ocean organisms
- marine origin - based pharmaceuticals and nutraceuticals
- Chemicals in marine organisms

Marine therapeutic drugs can be classified based on their various actions as follows:

### **Anti-bacterial drugs:**

Polyunsaturated fatty acid Eicosapentaenoic acid is isolated from the marine origin of [5] *Phaeodactylum tricornutum*. This shows an activity against Gram-positive and negative bacteria viruses. This includes also a variety of *Staphylococcus aureus* multidrug-resistant.

### **Anti-inflammatory drugs:**

The anti-inflammatory properties of *Spongia officinalis* extracts and other parts were investigated in an in vivo model of rat carrageenan-induced paw edoema.

### **Neuroprotective drugs:**

The extracts of South Indian green seaweed (*Ulva reticulata*) has shown neuroprotection by inhibiting acetyl- and butyryl-cholinesterases [7], with efficacy comparable to the agents currently approved for Alzheimer's disease treatment.

### **Anti-parasitic drugs:**

By exhibiting the related morphological changes in promastigotes of *Leishmania major*, Tunisian sponge extracts, also known as *Sarcotragus* sp. have exhibited in-vitro anti-leishmanial efficacy [8].

### **Anti-viral drugs:**

Exo-polysaccharides (High molecular weight material) derived from the French oceanic sponge (*Celtodoryx girardae*) and the symbiotic bacteria it harbours have been shown to have anti-herpes simplex virus-1 (HSV) action [9].

### **Anti-cancer drugs:**

The sorbicillactone A and its 2', 3'-dihydro analogue sorbicillactone-B, which are produced from sorbicillin, have demonstrated action against leukaemia cells without exhibiting any significant cytotoxicity. The bacterial strain *Penicillium chrysogenum*, which was isolated from the Mediterranean sponge specimen *Ircinia fasciculata*, was used to make sorbicillactone-B in a salt-water culture [10].

### **Analgesic drugs:**

In 2004 the United states Food and medicine Administration (USFDA) granted the first medicine of marine origin, ziconotide, approved for the relief of pain. It was initially arised from the marine snail, often known as Prialt. Results from experiments on animals pointed it has a critical role in blocking calcium channels (N-type) on the spinal cord's major nociceptive nerves [11].

### **Anti-microbial drugs:**

A well-known anti-microbial agent [4] cephalosporins with a marine source of origin. Cephalosporin-C [5] was extracted and purified from a marine fungus called *Cephalosporium acremonium*.

### **Anti-malarial activity drugs:**

Iso-nitrile having antimalarial properties have been extracted from the Japanese sponge (*Acanthella*). The present molecule belongs to a class of kalihinane diterpenoids. It also contains antifouling, antifungal and anthelmintic compounds [12].

## **Marine-Based Nutraceuticals:**

The basic notion of “nutraceutical” was familiarized by Stephen De Felice (1989). The term combining both nutrition and pharmaceutical. The word refers to the raw foods, stimulated improved food / dietary food supplements possess active biological substance. It also called as bio-active molecules [13] which give the benefits of well-being[14]. These bio-active compounds additionally include vitamins, poly saccharides, fats, peptides and phytochemicals, which are available naturally in foods. It can be added to foods producing functional foods /fortified. It can be articulated into dietary enhancements. These bio-active molecules got by either extraction of natural sources or by both synthesis of chemical and biotechnology [15].

Recently marine/ocean sources has received a great attention. The research on bio molecules derived from marine possess crucial properties. This improves their applicability in food as nutraceuticals. Marine invertebrates and its constituents proved the improvement of human well being health [16]. Ocean species of invertebrates account for approx. 40% of universal fisheries and ocean food received from these resources are widely recognized for health benefits. It contains huge amounts of poly unsaturated fatty acids, minerals (Fe, Se and I<sub>2</sub>) and some other bio-active substances like carotenoids [17] and taurine. Plenty of molecules with bio-medical activity are used as pharmaceutical substance.

## **Nutraceuticals in the global market:**

The Universal market of nutraceutical covered of foods, dietary supplements and beverages was valued approx. \$250 billion in the year 2014. Consumer based demand expected to reach about \$385 billion by 2020 [18] and expecting \$650.5 billion in the year 2030 [19]. Marine/ocean nutraceuticals play a vital huge portion in the universal market. The products are derived from a wide range bio active molecules. The origin source, as well as the bio - active molecules components, are given below.

### **Collagen:**

Fish is the major marine source (silver line grunt, albacore tuna, brown -backed toad fish, cat fish, lingcod hake, mackerel *etc.*). It is used in edible coating in meat (e.g., sausages) industry. Its main health benefit

is anti - oxidant, anti-hypertensive and anti-skin aging activities [20,21].

### **Gelatin :**

The ultimate marine source is fish, (Cod, Pollock, haddock, cusk and hake). It is used as texturizer, stabilizer or thickener in ice cream, jam , cream cheese, yogurt, confectionaries , margarine utilized in less fat foods and clarifiers . The main use is to prevent and treat chronic atrophic gastritis [22].

### **Albumin:**

Crustaceans , mollusks, low-fat fish is the main source of albumin. It is used in suspending, whipping or stabilizing agent. It possess anti-coagulant and anti-oxidant properties [23].

### **Agar agar:**

Red Algae is a main source of agar agar like *Gracilaria*, *Gelidium* , *Hypnea* and *Gigartina* [24]. It is mainly used in *food gums and gel formation*.

### **Chitin, chitosan and derivatives:**

The Lobster, shrimp, krill, crab and prawn are the main marine sources for chitin and chitosan derivatives. It's application is gelling materials, edible protective films, de-acidification and clarification of fruits[25]. It is mainly used to reduce lipid absorption, increase dietary fiber, anti-tumor, bacterial and fungal activities.

### **Omega -3 fatty acids :**

Omega-3 fatty acids are present almost in all marine sources. Its major application is in Nutraceuticals industry (fish oil and capsules ), livestock fortification , infant feed formula. It has plentiful health benefits [26] (e.g., neuro and visual development, reduce the risk of cardiovascular (heart) problems , hypertension and arthritis).

### **Carotenoids: $\beta$ -carotene, and lutein:**

The major marine source is *Sarcina maxima* , *Dunaliella salina*, *Chlorella protothecoides* . The major use is nutraceutical agents, natural food colorings, salmon pigmentation [27]. The health benefits is antioxidants, vitamin A precursors, anti-inflammatory, anti-carcinogenic..

# Journal of Coastal Life Medicine

## Chlorophylls :

The major marine source is *A. flos-aquae* and *S. platensis*. It is mainly used as natural colorant for food and beverage [28]. Its health use is anti-cancer activity, natural source of pigmentation

## Vitamins and Minerals :

Almost all marine sources are rich in vitamins and minerals. It performs huge essential needy functions in the body. For ex., they act as cofactors during metabolic processes and provide transport inside of the cells. [29].

## Phlorotannins:

Marine brown algae is the most abundant polyphenols found in the ocean. In nutraceuticals industry, It is the active ingredient. It is used as anti-oxidant agent [30].

## 4. Conclusion:

In the present scenario, Marine environment is a promising and assure source of natural products. Its nutraceuticals and pharmaceutical values are countess. This will give assurance for the new arrival of novel drugs in future.

## References:

- [1] <https://oceanexplorer.noaa.gov/facts/medicinesfromsea.html#:~:text=Most%20drugs%20in%20use%20today,discovered%20from%20common%20bread%20mold.>
- [2] Donia M, Hamann MT. Marine natural products and their potential applications as anti-infective agents. *Lancet Infect Dis*. 2003;3:338–48.
- [3] Thakur NL, Thakur AN, Muller WEG. Marine natural products in drug discovery. *Natural Product Radiance*. 2005;4:471–7.
- [4] Murti Y, Agarwal T. Marine derived pharmaceuticals-development of natural health products from marine biodiversity. *Int J ChemTech Res*. 2010;2:2198–217.
- [5] Desbois AP, Mearns-Spragg A, Smith VJ. A fatty acid from the diatom *Phaeodactylum tricorutum* is antibacterial against diverse bacteria including multi-resistant *Staphylococcus aureus* (MRSA) *Mar Biotechnol* (NY) 2009;11:45–52.
- [6] Dellai A, Laroche-Clary A, Mhadhebi L, Robert J, Bouraoui A. Anti-inflammatory and antiproliferative activities of crude extract and its fractions of the defensive secretion from the mediterranean sponge. *Spongia officinalis*. *Drug Dev Res*. 2010;71:412–8.
- [7] Suganthy N, Karutha Pandian S, Pandima Devi K. Neuroprotective effect of seaweeds inhabiting South Indian coastal area (Hare Island, Gulf of Mannar Marine Biosphere Reserve): Cholinesterase inhibitory effect of *Hypnea valentiae* and *Ulva reticulata*. *Neurosci Lett*. 2010;468:216–9.
- [8] Ben Kahla-Nakbi A, Haouas N, El Ouaer A, Guerbej H, Ben Mustapha K, Babba H. Screening of antileishmanial activity from marine sponge extracts collected off the Tunisian coast. *Parasitol Res*. 2010;106:1281–6.
- [9] Rashid ZM, Lahaye E, Defer D, Douzenel P, Perrin B, Bourgougnon N, et al. Isolation of a sulphated polysaccharide from a recently discovered sponge species (*Celtodoryx girardae*) and determination of its anti-herpetic activity. *Int J Biol Macromol*. 2009;44:286–93.
- [10] Bringmann G, Gulder TA, Lang G, Schmitt S, Stöhr R, Wiese J, et al. Large-scale biotechnological production of the antileukemic marine natural product sorbicillactone A. *Mar Drugs*. 2007;5:23–30.
- [11] Skov MJ, Beck JC, de Kater AW, Shopp GM. Nonclinical safety of ziconotide: An intrathecal analgesic of a new pharmaceutical class. *Int J Toxicol*. 2007;26:411–21.
- [12] Miyaoka H, Shimomura M, Kimura H, Yamada Y, Kim HS, Yusuke W. Antimalarial activity of kalihinol A and new relative diterpenoids from the Okinawan sponge, *Acanthella* sp. *Tetrahedron*. 1998;54:134 67–74.
- [13] Palthur M.P., Sajala Palthur S.S., Chitta S.K. Nutraceuticals: Concept and Regulatory Scenario. *Int. J. Pharm. Pharm. Sci*. 2010;2:14–20.
- [14] Liu R.H. Health benefits of fruit and vegetables are from additive and synergistic combinations of phytochemicals. *Am. J. Clin. Nutr*. 2003;78:517S–520S.
- [15] Keith W.G. *Functional Foods and Nutraceuticals Series*. CRC Press Taylor and Francis Group; Boca Raton, FL, USA: 2009. Marine Products for

# Journal of Coastal Life Medicine

- Healthcare: Functional and Bioactive Nutraceutical Compounds from the Ocean, Vazhiyil Venugopal.
- [16] Voultziadou E. Therapeutic properties and uses of marine invertebrates in the ancient Greek world and early Byzantium. *J. Ethnopharmacol.* 2010;**130**:237–247. doi: 10.1016/j.jep.2010.04.041.
- [17] Borresen T. Seafood for improved health and wellbeing. *Food Technol.* 2009;**63**:88.
- [18] Mordor Intelligence Global Nutraceuticals Market—Growth, Trends and Forecasts (2015–2020)
- [19] <https://www.alliedmarketresearch.com/nutraceuticals-market>
- [20] Lai G., Yang L., Guoying L. Effect of concentration and temperature on the rheological behavior of collagen solution. *Int. J. Biol. Macromol.* 2008;**42**:285–291. doi: 10.1016/j.ijbiomac.2007.12.010.
- [21] Noitup P., Garnjanagoonchorn W., Morrissey M.T. Fish Skin Type I Collagen. *J. Aquat. Food Prod. Technol.* 2005;**14**:17–28. doi: 10.1300/J030v14n01\_03.
- [22] Gómez-Guillén M.C., Turnay J., Fernández-Díaz M.D., Olmo N., Lizarbe M.A., Montero P. Structural and physical properties of gelatin extracted from different marine species: A comparative study. *Food Hydrocoll.* 2002;**16**:25–34. doi: 10.1016/S0268-005X(01)00035-2.
- [23] Nicholson J.P., Wolmarans M.R., Park G.R. The role of albumin in critical illness. *Br. J. Anaesth.* 2000;**85**:599–610. doi: 10.1093/bja/85.4.599.
- [24] Freile-Pelegrín Y., Murano E. Agars from three species of *Gracilaria* (Rhodophyta) from Yucatán Peninsula. *Bioresour. Technol.* 2005;**96**:295–302. doi: 10.1016/j.biortech.2004.04.010.
- [25] Shahidi F., Abuzaytoun R. Chitin, chitosan, and co-products: Chemistry, production, applications, and health effects. *Adv. Food Nutr. Res.* 2005;**49**:93–135.
- [26] Sijtsma L., de Swaaf M.E. Biotechnological production and applications of the omega-3 polyunsaturated fatty acid docosahexaenoic acid. *Appl. Microbiol. Biotechnol.* 2004;**64**:146–153. doi: 10.1007/s00253-003-1525-y.
- [27] Maeda H., Sakuragi Y., Bryant D.A., Dellapenna D. Tocopherols protect *Synechocystis* sp. strain PCC 6803 from lipid peroxidation. *Plant Physiol.* 2005;**138**:1422–1435. doi: 10.1104/pp.105.061135.
- [28] Bhattacharya S., Shivaprakash M.K. Evaluation of three *Spirulina* species grown under similar conditions for their growth and biochemicals. *J. Sci. Food Agric.* 2005;**85**:333–336. doi: 10.1002/jsfa.1998.
- [29] Parr R.M., Aras N.K., Iyengar G.V. Dietary intakes of essential trace elements: Results from total diet studies supported by the IAEA. *J. Radioanal. Nucl. Chem.* 2006;**270**:155–161. doi: 10.1007/s10967-006-0323-2.
- [30] Arct J., Pytkowska K. Flavonoids as components of biologically active cosmeceuticals. *Clin. Dermatol.* 2008;**26**:347–357. doi: 10.1016/j.clindermatol.2008.01.004.