

GOLDEN JUBILEE CELEBRATIONS

Souvenir

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Bio Active Compounds from Gulf of Mannar Resources

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Introduction

Man has been venturing the oceans for his livelihood since ancient time. i.e. One century B.C. as recorded by Pliny the Elder. Of the wealth of oceans viz. fish, algae, mangroves, corals, minerals, natural gas and petroleum, fish by-catches, shells, etc., fishes substitute the major animal protein demand of the increasing world population. About 60% of the population of the developing countries derive 40% or more of their total animal protein from fishes. As the population is increasing alarmingly mainly in developing countries, controlled and sustainable sea resources exploitation are to be kept in mind. As the terrestrial exploitation to some extent has lead to non-sustainable state now, alarm has started from different parts of the world to control the global destabilization like green house effect, global warming, etc. To overcome these, oceans have been the point of attraction for sustenance and as a result oceans uncover many new things of nature hitherto unknown.

Noted among them are the potential value added products like drugs, toxins, pharmaceuticals and novel organic compounds. Reason on for this exploitation, it is needless to say, is the existence of folklore medical practices among aborigins and the modern human beings, dependant on marine resources. With the advent of modern chemical methods and sophisticated instruments, systematic exploration and investigation of marine sector for its resources have been triggered to unravel the hither to 'untapped marine products.

Seas of Mandapam

Gulf of Mannar and Palk Bay being the natural gift to the Indian coast have been in a strategic position to house myriads of oceanic resources. This is unique in marine resource diversity with 21 islands starting from Rameswaram to Tuticorin. Echinoderms, gorgonids, sponges, molluses, crustaceans and marine algae apart from fin fishes are extensively available in this region.



Sea horse

Some traditional medical practices with marine food are followed by the local people to cure some diseases. It is interesting to note that the dry power of sea horse is mixed with honey and consumed to cure asthma. Now sea horse is mainly exported to Singapore from the coastal town of Kilakkarai. Sea cow, *Dugong dugon* and sea turtles, *Chelonia mydas*, *Lepidochelys olivacea* are consumed to cure piles. Of course, sea cow is now an endangered one and banned from poaching.

Exploration of Marine Resources

Exploration of marine natural products started only 30 years back and it took new turn with the development of taxonomical work for species identification of marine flora and fauna. The emergence of new field of biotechnology paves the way for new techniques for isolation and purification methods of active components of the marine organisms. In this way nearly 7000 natural products have been isolated so far and their bioactivity studied. The chemical compounds include organic acids, carbohydrates, proteins, amino acids, steroids, lipids, enzymes, etc. The bioactivity studies include the properties of antibiotic, antitumor, anticoagulant, antiviral, antiulcer, haemolytic, analgesic, antilipemic, cardioinhibitory, stimulating, depressants, fungicides, insecticides, pharmaceutical adjuvants, stabilizers, etc. The research on marine organisms for newer products is the timely one as the ocean appears to be a good alternative source of unique materials. The organisms found in the seas of Mandapam area are fascinating as the source of many bioactive compounds.

Invoking the general quality of sea foods, dietary fat of fish is a good source of essential fatty acids. Fish meat is rich in vitamin B complex. Fish liver oil is rich in vitamins A and D. Oysters are good source of iron and copper. Micronutrients like Ca, P, Na, Fe and easily accessible from sea foods. Sperm whale fat is the source of series of fatty acids. Perfumary

compounds are synthesized from some of these constituent fatty acids.

As the accessibility of marine specimens is not readily possible unlike the one on land, this work limits to various skilled tactics like modern underwater exploration techniques with specialized vessels, SCUBA diving, skin diving and employing professional divers.

Echinoderms

Gulf of Mannar and Palk Bay are rich in echinoderms like sea cucumber, star fishes and sea urchins. Sea cucumbers, *Holothuria atra*, *H. scabra* and *H. spinifera* have overseas market for delicious dishes prepared from their deviscerated and cured products. Their body wall contains saponins (glycosidic steroids) and holothurin compounds which are ichthyotoxic in nature. This property was studied on fish fingerlings, mice and erythrocytes (haemolytic activity).

Bech-de-mer, a processed form of sea cucumber has the curative power for ailments like high blood pressure and muscular disorders. In the Philippines, the cuverian tubules are used as a crude plaster for minor wounds. Star fishes also contain saponins called asterosaponins. Toxins of echinoderms are soluble in water and alcohol. They possess antifungal, antiviral properties as revealed from the test on influenza virus B in the chicken embryo. The saponins of star fishes *Asterias forbesi*, *Acanthaster Planci* and *Asterina Pectinifera* structurally contain cholestane type aglycone, sulphate group and sugar moieties.

Sea hares, *Aplysia* spp. excrete irritating substances which have toxic neuromuscular effects when tested on mice resulting in paralysis. Cray fish, *Jasus islandi* contains oxygenated cholestanes like crustecdysone which plays an important role in insect metamorphosis including moulting in crustaceans.

Gorgonids

They are corals of the order *Gorgonacea* having flexible branched skeleton of horny material. These plant like organisms are extensively seen in the seas of Mandapam. They contain compounds having significant bioactivity. Gorgonian, *Juncella juncea* on methylene chloride extraction yields a compound which has been found to inhibit the settlement of barnacle of *Balanus amphitrite*. It was identified as diterpenoid compound and thus have an immense value as an antifouling agent. Another gorgonian coral, *Plexaura homomalla* contains significant quantity of prostaglandins (PGs). These compounds are medicinally important used for cellular level biochemical actions, in birth control measures, in renal pathology and in the treatment of intestinal ulcers. Di- and sesquiterpenes are obtained from *Eunicea mammosa* and they inhibit the growth of *S. aureus* and *Clostridium* spp.

Sponges

They are calcareous or siliceous spicules having porous skeleton. A toxic sponge, *Sigmadocia fibulata* contains antiviral compound. It is found in Hare Island of Gulf of Mannar. The extract of another sponge *Placospongia carinata* exhibits antimicrobial activity against *Bacillus* and *Pseudomonas* spp. Sponge like *Spongia officinalis* contains bioactive peptides (adrenergic) and furanoterpenes like furospingin and isofurospingin. They inhibit the growth of *S. aureus* and *B. subtilis*. Unusual nucleosides like spongouridine and spongothymidine are obtained from sponges like *Cryptotethya crypta*. They provide models for antitumor nucleic acid antagonists. The resistance of sponges to bacterial decomposition has obviously attracted investigators for any causative agents to be present. On investigation it was found out that they contained antibiotic compounds which protect them from harmful microbes. These organisms have an efficient canal system by which they extract chemical substances from the seawater. A few hundred sponge species have

been studied and many extracts have showed wide spectrum of antibiotic activity against gram +ve and gram -ve organisms. Sponges, *Verongia acrophoba* yielded aerophysinin-I and it showed resistance to *S. alba*, *B. cercus* and *B. subtilis*. Bromo phenol and brominated pyrrole compounds having antibiotic activity were isolated from sponges, *Dysidea herbacea* and *Phakellia flabellata*.

Gastropods

Opisthobranches and other gastropods are the source of variety of bioactive compounds. A pulmonate gastropod (shell is absent), *Onchidium verruculatum* available near Tuticorin, has toxic compounds. The MeOH-CH₂Cl₂ extract of this animal is toxic to *Artemia salina* and inhibited the growth of *Isochrysis galbana*. It also repels fishes and crabs.

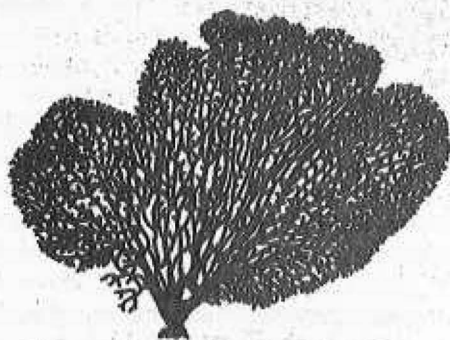
Other organism

Colonial zoanthid of the genus *Zoanthus* contains novel alkaloids that possess anti-inflammatory and analgesic properties. Sea anemone, *Actinia equina* contains a quaternary ammonium compounds (QAC), tetramethyl ammonium hydroxide which has paralytic activity. Another QAC, hormarine isolated from sea anemone has the effect of decreasing heart beat and cause cardiac arrest at high concentrations. Bioactive peptides are isolated from these animals and they are cardiotoxic.

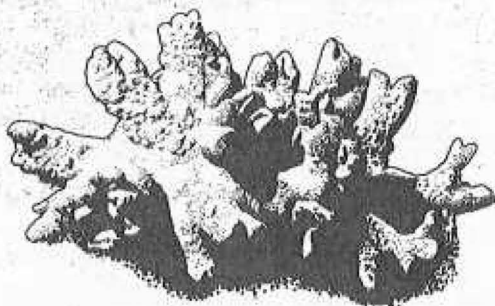
Microbial flora, *Cephalosporium acremonium* (a sea water fungi) contains cephalosporin C which has broad spectrum activity against gram +ve and gram -ve bacteria. They arrest the proliferation of infectious microbes of sea water to provide hygienic environment.

Marine alga (Sea weeds) and Mangrove

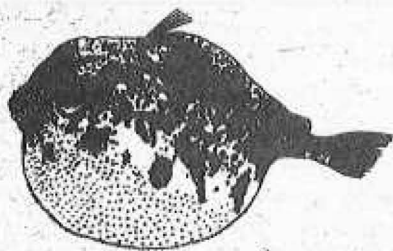
Marine algae contribute the major source of variety of bioactive compounds. Gulf of Mannar and Palk Bay coasts are abundant with many varieties of seaweeds. Agar is a valuable



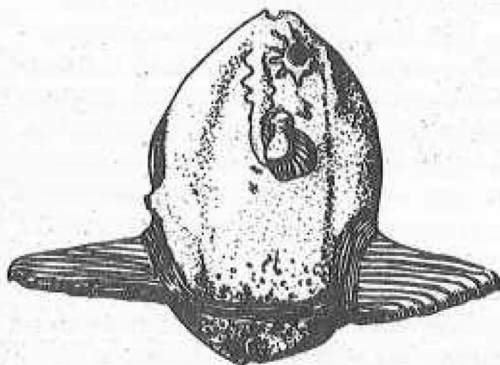
Sea fan



Sponge



Puffer Fish



Sun Fish

product of red seaweeds, *Gelidium* and *Gracilaria* spp. Agar contains agarose (neutral polysaccharide) and agaropection (acidic polysaccharide). It is widely used as emulsifying agent in pharmaceutical formulations. Various grades of agar are prepared by chemical treatments. The refined form is used in microbiological work as bacterial culture media. Carrageenan, another important product of red algae *Gigartina* spp. is used as antiviral compound for certain influenza viruses and also as anti-ulcer agent. Alginic acid and alginates are extracted from brown algae, eg. *Laminaria* spp. It is anticoagulant in absorbable haemostatic materials for the control of surface bleeding. Lipids of *Hypnea muciformis* shows inhibition against *Sarcina lutea* and *E.coli.*; of *Enteromorpha* spp. (*intestinalis*) against *S. lutea*, *B. subtilis*, *E.coli*, and *C.albicans*.

Extracts of *Padina teterastromatica*, *Gelidiella acerosa* and *Acanthophora spicifera* show antifertility activity thus having promise in birth control measures. These extracts contain fatty acids, novel steroids and dipeptides. A diterpene isolated from *Dyctyota* spp. (*dichotoma*) has anti bacterial, antiviral and ichthyotoxic properties. A sphingosine derivative of palmitic acid isolated from green algae *Ulya faciatia* is a potential antiviral compound.

Mangroves like *Acanthus ilicifolius*, *Avicennia marina* and *Excoecaria agallocha* contain active compounds in their root, leaf and flower and they have analgesic activity.

Marine Toxins

Though the delicious marine food animals are enjoyed during consumption sometimes they turnout to be dangerous due to toxins accumulated in them resulting in sea food poisoning. Of the total estimated 2500 species of fishes, 700 are designated as poisonous. Marine toxins form an important part among the marine natural products as it poses an environmental problem on its incidence and draw immediate attention to cure the affected persons.

They are of extensive pharmacological interest, as they are used in treating many dreadful diseases at controlled doses. Characterization, of these toxins leads to the discovery of their antidotes. They form an important models in developing new drugs as neuromuscular relaxant, local anaesthetics, etc.

Tetrodotoxin, present in puffer fish (*Tetrodon* spp) is chemically a polyhydroxylated perhydromethyl quinazoline compound. At lower dose, it is useful as muscle relaxant and pain killer in neurogenic leprosy and terminal cancer. Toxins of porcupine fish, *Diodontidae* and sunfish, *Molidae* also come in this group. Ciguatoxin is primarily derived from dinoflagellate, *Gambierdiscus toxicus* and percolates to fishes through food chain. About 400 species of marine fishes have been implicated with ciguatoxicity. It was first reported on injection of marine snails of Caribbean areas. Saxitoxin and gonyaulax toxins are derived from dinoflagellate, *Gonyaulax catenella* and reaches clams and crabs by the food cycle.

Pahutoxin is excreted by box fish, *Ostracion lentiginosus*, as a defensive substance to upset other fishes. It is 3-ace toxyhexadecanoyl choline. It has surfactant and haemolytic properties. A peptide toxin is secreted by mucus producing glands of soap fish, *Rypticus Saponaccus*. They produce haemolytic effect and disturbance on predators.

Conclusion

The potential use of many of these marine bioactive compounds thus depends on proper isolation and characterisation.

Oceans are provided with immense treasure, thus throwing open many areas of multidisciplinary work. The novelty of many marine derived compounds and their wide spectrum of applications may find way in getting solution to many dreadful diseases like AIDS, Cancer, Alzheimer's disease and arthritis which are difficult to be cured even today.