Prospects and Problems of **Beche-de-mer** Industry in Andaman and Nicobar Islands

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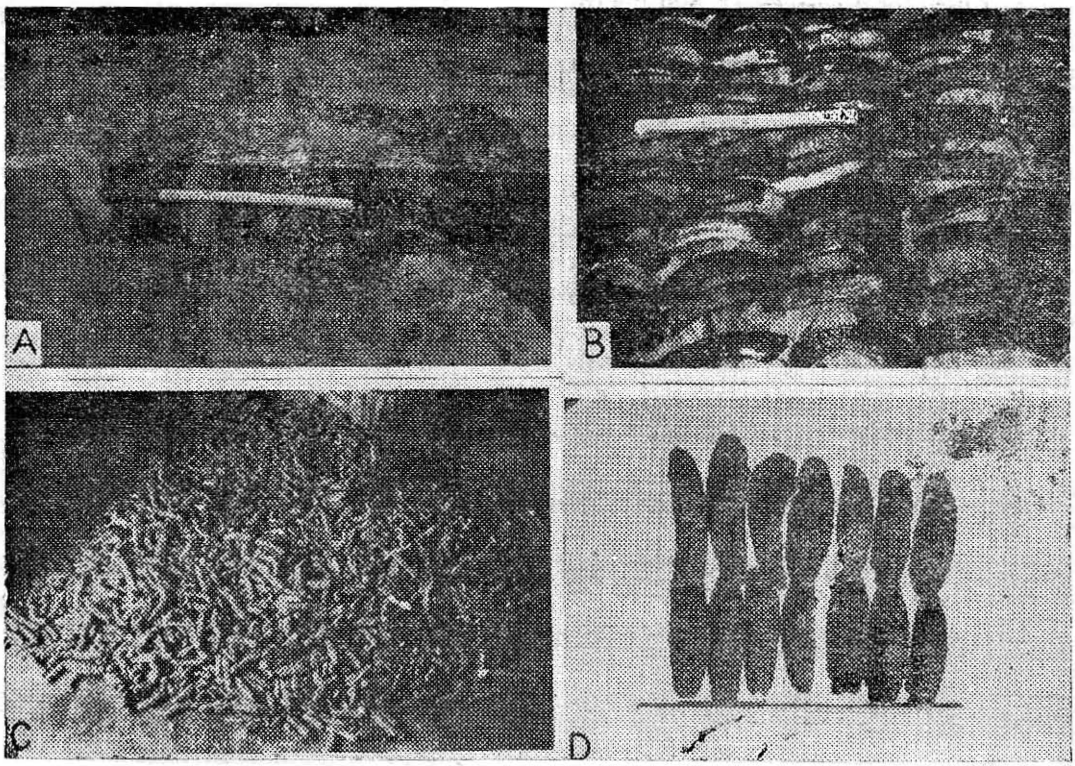
ABSTRACT

The Andaman and Necobar Islands have a rich potential of sea cucumbers and offer excellent opportunities for *beche-de-mer* industry, The availability of the holothurian resources, their distribution, farming, processing, problems and solutions pertaining to the industry in the islands, are presented in the paper.

Andaman and Nicobar Islands are very rich in sea cucumbers having excellent possibilities for *beche-de-mer* industry (James 1973, 1986a). Soota *et al.* (1983) listed 11 species useful for *beche-de-mer* in the Andamans. *Beche-de-mer* is the commercial name given to processed sea cucumbers which are considered a delicacy in South East Asian countries. India is earning a foreign exchange of 20 lakh rupees annually from their export. Earlier, this industry was restricted to the south east coast of India along the Palk Bay and the Gulf of Mannar. Many sea cucumbers which produce high quality *beche-de-mer* occur in the Andaman and Nicobar Islands.

Resources

James (1983) has listed 52 species of holothurians from Andaman and Nicobar Islands. Of these only half a dozen species are of commercial value *Holothuria scabra* is the most important species because of its numerica abundance. It occurs in muddy flats, [confined to shallow waters, prefering low saline and brackish waters. *Actinopyga echinites* is an important species for *beche-de-mer*. *Actinopyga miliaris* which is completely balck is found in good numbers at Wandoor. *Actinopyga mauritiana* is yet another important species found near the low water mark on the reefs. The *beche-de-mer* prepared out of this species is said to be of high quality Another large sea cucumber which can be used is *Bohadschia vitiensis*. It is found in good numbers around Port Blair. The processing has to be modified to remove the excess clacareous matter Another sea cucumber which gives hopes for the industry is *Stichopus* sp. This has to be processed immediately after it is collected since the body wall is not very stiff. *Holothuria pyxis* which is common in some places can also be processed. *Actinopyga locanora* sparsely



A. *Holothuria scabra* in a heap after collection
B. Large size *beche-de-mer* of *H. scabra*
C. Small size *beche-de-mer* of *H. scabra*
D. *Beche-de-mer* of *Actinopyga echinites*

distributed in the islands is very useful for the industry.

Distribution

The Andaman group of Islands are more productive than the Nicobar group for the sea cucumbers used for *beche-de-mer*. Starting from North Andamans *Holothuria scabra* is found in large numbers at Diglipur and Mayabunder. The other important species in North Andamans is *Bohadschia vitiensis*. In Middle Andamans, *Actinopyga* spp. occur in good numbers and *H. scabra* to some extent. In South Andamans, especially around Port Blair, the most important sea cucumber is again *Holothuria scabra*. Other quality species are *Actinopyga mauritiana*, *A. miliaris*, *B. vitiensis*, *Stichopus* sp. and *Holothuria atra*. In Hut Bay, Little Andamans *Holothuria leucospilota* is found in large numbers but it is not of much value because of its small size and thin body wall. At Car Nocobar no sea cucumbers were encountered. At Nancowry species like *Actinopyga mauritiana*, and *A. echinites* were found in small numbers. At Campbell Bay *Stiehopus chloronotus*, *A muaritina* and *A. echinites* were found on the reefs.

Farming

Since sea cucumbers are harmless and defenceless creatures with no powers to escape at the time of collection, there is the danger of getting the beds depleted by over-exploitation. Therefore in 1982, Government of India imposed a ban on the export of material below3" in length as a conservation measure. *Beche-de-mer* of the larger *H. scabra* (pl. I, B) has a very good market. Processing of smaller froms (pl. I, C) should be immediately stopped. The beche-de-mer of *A. echinites* (pl. I, D) commands better price than the beche-de-mer of *H. scabra*. No processing is done in Andaman and Nicobar Islands during the prolonged monsoon period. This gives the sea cucumbers sufficient time to grow and breed.

The possibilities to farm these animals around these islands are excellent. Lowlying muddy flats should be selected and stocked with small sea cucumbers which are plenty around these islands. Since they are burrowing in habit during low tide when water receds, there is no donger of their getting back into the sea. Artificial feeding does not arise as they live on organic matter present in the mud or sand. Small sea cucumbers could be added to the farm throughout the year and large forms removed as and when required. James (1983) presented results of his experiments on farming of *H. scabra* at Port Blair.

Processing

Processing the sea bucumbers for *beche-de-mer* is very simple. There are three methods of processing depending on the species used. Suitable sea cucumbers are collected either by hand picking during the low tide or by diving in shallow waters. After collection they are kept in a heap (pl. I, A). Crowding them at one place will make them to throw out their internal organs. Those which fail to do so are cut at the cloaca on the dorsal side. On making a small slit of 30 mm length, the internal organs would flow out. The sea cucumbers are also squeezed to remove the internal organs. After the internal organs are removed, they are put in iron drums and boiled for one or two hours depending on the size of the sea cucumbers. While boiling, the material should be constantly stirred to make the product uniformly cylindrical. After a distinct cooked odour is emitted, they are removed and burried in a pit near the shore. After 12 hours they are removed from the pit and put in a basket to clean them. Some sand is put over them to facilitate good abrasion. This is trampled by one person while another pours water over the material to remove all chalky deposits sticking to them. The quality of *beche-de-mer* is rated high if it is completely free from chalky deposits. If the processing is imperfect this is deposited as a white substance on the surface especially on the underside. After a thorough clearing, the material is once again put in clean sea water and boiled for a few minutes. The material is then removed and completely dried in sun for 3-4 days. The material could be smoke dried during rainy season, but the material does not command good price. The above method of processing is suitable for *H. scabra* which is by far the most important species in the Andamans. There are minor modifications in processing depending on the species of sea cucumber used. The processing thus does not call for any costly equipment. Fuel is not a problem due to good supply of coconut husk. This is a cottage industry ideally suited for rural areas, James (1986b) has suggested many ways to improve the quality of *beche-de-mer*.

Problems and solutions

The problems for any industry of this type which is yet to establish firmly are varied and many. The first and foremost problem is that they cannot be processed round the year due to rains for about eight months in a year in these islands. This problem can be solved by using artificial driers. Problems in transport may also arise as the processed material should quickly reach Port Blair from remote areas and then to mainland for export. Instead iron boilers get easily rusted on coming in contact with sea water. Hindalium vessels are preferred since the product would be clean and hygenic. The practice of drying them on the ground should be given up since sand and other dirt will stick to the material. Since the dried product is hygroscopic and gets spoiled quickly, it is essential to pack them in polythene paper.

By adopting above methods, exploiting the resources in a rational manner and supplementing the same by farming the animals, the *beche-de-mer* industry of these islands has a bright future in our national economy.

Acknowledgement

I thank Dr. P. S. B. R. James, Director, Central Marine Fisheries Research Institute, Cochin for his kind interest and encouragement in the work.

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Chemicals from Sea Weeds of Indian Waters with Reference to the Andamans

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ABSTRACT

The seaweeds are rich in a wide variety of important chemicals, minerals, vitāmins, essential amino acids, lipids, etc., besides the economically important polysaccharides like agar, carregenan and algin. The magnitude of seaweed resources along the Indian coast, method of processing seaweeds for extraction and purification of agar, carrageenan, alginate and alginic acid, mannitol, laminarian, fucoidin, iodine and other few polysaccharides, the status of seaweed based industries in India and the export utility of seaweeds and their products are described.

The Andaman group of islands offer congenial environment for the growth of seaweeds. There is a need to undertake a detailed survey of this resource to assess their potentiality for establishing seaweed industries in these islands.

Seaweeds are macroscopic algae, generally attached in the intertidal and shallow subtidal water of an ocean. Their vertical distribution is generally restricted by light and economically important species are found to occur in waters shallower than 40m. The importance of seaweeds to man has been recognized since 3,000 BC (Chase, 1941). Seaweeds were initially used as food, particularly in condiments, fertilizers, medicines and animal fodder. The industrial use of seaweeds began during the seventeenth century in Western Europe with the production of soda and potash from the ash of burnt brown seaweeds (kelp). The ash was also employed for the manufacture of glass soap. In 1812, Courtois found the presence of iodine in kelp ash.

Indian seaweed resources are limited to rocky or coral formations in Gujarat and Tamil Nadu states, in Karwar, Ratnagiri, Goa, Varkala, Vishakhapatnam, Chilka and Pullicat lakes and the islands of Laccadives, Andaman and Nicobar (Rao, 1969; Chauhan *et al*, 1982). The seaweeds are reported to be a vast storehouse of a wide array of important chemicals, minerals, vitamins, essential amino acids (proteins), lipids, etc. Marine algae also contain a wide variety of polysaccharides which constitute an important group of industrially important phycocolloids, which are mucilaginous and constitute 10-65% of the dry weight of harvested seaweeds. The polysaccharides of considerable economic importance are agar and carrageenan from red algae and algin from brown algae. The chemicals from seaweeds of Indian waters with reference to Andamans are dealt in this paper.

Commercial seaweeds : The carbohydrates in the plant tissues provide energy and structural strength to cell wells and matrix polysaccharides. Besides the above functions sulphated polysaccharides which are absent in higher plants are found in marine algae. Several functions like ability of charged polysaccharides to imbibe water, which provides cushion against physical buffeting which seaweeds undergo by wave action and protects the weeds from desiccation. Their anionic character serves a sort of ion exchange material and may sequester certain ions. The seaweeds of commercial value like agarophytes, alginophytes and carrageenophytes and their yields are presented in Table 1,

Table 1. Commercial seaweeds and their yield

Seaweeds	Commercial product	% yield
	Agrophytes	
Gelidiella acerosa	Agar	45
Gracilaria edulis	Agar	43
G. crassa	Agar	25
G. corticata	Agar	30
G. verrucosa	Agar	43
	Carragenophytes	
Hypnea musciformis	Carrangeenan	32
Hypnea valentiae	Carrangeenan	30
Halymenia venusta	Carrangeenan	43
Sarconema filiforme	Carrangeenan	22
Sebdenia sq.	Carrangeenan	32
Laurencia sq.	Carrangeenan	22
	Alginophytes	
Dictyota sp.	Algin	5.50
Padina sp.	Algin	10.35
Cystophyllum muricatum	Algin	15.63
Hormophyea triquetra	Algin	18.22
Sargassum johnstonii	Algin	22.34
S. myriocystum	Algin	24.70
S. teherrimum	Algin	14.77
S. wightii	Algin	31.70
S. swartzii	Algin	15.30
S. chinerium	Algin	16.60
Turbinaria conoides	Algin	35.60
T. ornata	Algin	32.18

Chemicals from seaweeds of the Andaman coast : The coast line of Andaman and Nicobar islands is about 2000 km long and the average tidal amplitude range in 0.14 to 2.35 meters. Most islands of the Andaman group have open coral reafs around them and an extensive low lying protected area. These conditions are congenial for good growth of seaweeds. But very little is known about the quantity of seaweeds available from the area. According to a recent report (Jagtap, 1985) and available literature the Andaman coasts have a number of economically important seaweeds. Among them *Sargassum*, *Turbinaria*, *Gracilaria* and *Gelidiella* are most common. The species of *Sargassum* and *Turbinaria* are important source of alginate and iodine, *Gracilaria*, *Gelidiella* and *Pterodadia* sp. provide agar while carrageenan is extracted out of *Hypnea* and *Gigartina* sp. Thus an industry for the extraction of alginate, agar and Carrageenan from the locally available seaweeds can come up in the Andamans. However a quantitative assessment of the raw materials on the basis of a

Raw material
(2.5 kg pulverised seaweeds)
↓
Washing in freshwater
↓
Soaking overnight in freshwater
↓
Wet grinding for 30 minutes
in edge runner or pestle-mortar type grinder
↓ ←Washing with soft water
Seaweed pump
↓
Extraction with 100 litres of water for 2 hours
in a double jackated open-pan evaporator
circulated with steam;
adjusting the pH to 6 with
400-500 ml of N Sulphuric acid
↓
Filtering
(in a double jacketed vacuum filter)
↓
Cooling the filtrate at room temperature
Shredding the agar gel chopper
↓
Freezing the agar for 24 hours
(in ice plant)
↓
Thawing
(at room temperature)
↓
Drying
(in air or in an oven with hot air circulation)
↓
AGAR-AGAR
(1.0 kg yield)

Fig. 1. **Mathod for agar manufacture on a commercial scale**

detailed survey of seaweeds of the Andaman coast must be made prior to any commercial exploitation. Based on the quantitative assessment of the economic seaweed resources, manufacture of the industrial phycocolloids can be considered.

The annual demand for the raw materials by seaweeds based industries in the country is 2,000 tonnes agarophytes and 13,000 tonnes of alginophytes, respectively. The annual production of both these agar and alginate is 56 and 736 tonnes against the current demand of 80 and 800 tonnes. The anticipated demand for both the polysaccharides is to the tune of 100 and 3,000 tonnes/year, respectively. Despite plantful marine algal resources the seaweed industries in India are unable to cope up with the ever increasing demand of agar and sodium alginate. Thus such an industry in Andaman and Nicobar islands can usefully exploit seaweed resources of the islands.

Polysaccharides from red seaweeds : The red algae synthesize mainly galactan sulphates containing 1.3-linked galactose together with certain proportions of 3.6-anhydrogalactosa residues and sulphate ester groups. The most familiar polysaccharides of the group are agar-agar and carrageenan.

Agar : Agar is a complex linear polysaccharides present in the cell walls of certain red algae. It is normally extracted with hot water followed by a series of purification steps (Fig. 1). Another approach for the extraction of agar is the treatment/washing of seaweeds with alkali and acid alternately below 25°C, prior to extraction with hot water. The agar is a mixture of two polysaccharides, agarose and agaropectin, a composition quite similar to starch which comprises amylose and amylopectin. The empirical composition of agarose can be represented as $(C_{12}H_{14}O_5(OH)_4)_n$. Agaropection is a more complex polysaccharide having the same backbone, but comprising ester sulphates, glucuronic and pyruvic acids.

Agar gel has the unique properties of being inert and stable over the incubation range of temperatures required for incubating most of the microorganisms. Agar being nontoxic finds a wide use in food industry for canning meat, fish, certain foods and cereals. It is also used in cosmetics, leather and textile industries.

Krishnamurthy *et al.* (1979) have reported the following data on yield and physical properties of agar-agar from some agarophytes :

Seaweed	Maximum yield of agar-agar %	Gel strength g/cm²	Gelation temp. C°	Melting temp. C°
Gelidiella acerosa	50 (Dec.-Jan.)	325	38-52	61-86
Gracilaria edulis	45-51 (Dec-Jan)	139	37.5-51	48-75
G. foliifera	40.4 (Jnne)	56	37.5-51	48-70
G. corticata	50.4 (June)	22	40-49	50-60

Carrageenan : Carrageenan is extracted most economically from red alga *Chondrus crispus*, generally termed as Irish moss and from species of *Gigartina, Euchuma, Hypnea*, etc., these algae may contain upto 59% carrageenan on the basis of their dry weight. It comprises mainly kappa carrageenan and lambda carrageenan. The extraction procedure for these polysaccharides is almost similar to that for agar. Carrageenan is used chiefly in food preparations and one of its unique applications is in the presentation of blancmagne. It is an important stiffening and binding component of certain textiles and is also used in leather softening. A process for the production of K-carrageenan (10 kg/day) from Hypnea musciformis has been developed by the Central Marine and Chemical Research Institute, Bhavnagar.

Polysaccharide from Brown Seaweeds

Alginates : Brown seaweeds upon treatment (Fig. 2) produce alginic acid, a reserve product of cellular metabolism. Alginic acid is a complex polyuronide (glycuronan), highly stable to hydrolysis. It comprises B-1, 4-linked D-mannuronic and L-guluronic acid units and is considered to be a linear structural polymer. It is present in the weed as an insoluble complex of potassium, sodium, calcium and megnesium alginates. It is used widely in foods and

Seaweed powder (100 g)
↓
Treatment with N hydrochloric acid
(330 ml) at pH 2-3 for overnight
↓ ←Washing with water
Extraction at room temperature
with 3% Sodium carbonate solution (500 ml)
for overnight
↓
Filterlng
↓
Bleaching
both 2.5% sodium hypochlorite

10% solution of calcium chloride (110 ml) Drying at 60°C ⟶ **CALCIUM ALGINATE**

↓ **Evaporation** at 60°C In hot air oven ⟶ **SODIUM ALGINATE**

Treatment with N hydrochloric acid at 2-3 (200 ml) ⟶ **ALGINIC ACID**

CALCIUM ALGINATE ⟶ Treatment with N hydrochloric acid at 2-3 pH ⟶ **ALCINIG ACID**

Fig.2. **Methods for extraction of Sodium alginate Calcium alginate and Alginic acid**

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