NATIONAL SEMINAR ON

SEAWEEDS

A Source of Nutraceutical Health Care Products and New Materials

FUTURE PERSPECTIVES

9th FEBRUARY 2017

SOCIETY OF FISHERIES TECHNOLOGIST S (INDIA)
KOCHI

ICAR-CENTRAL INSTITUTE OF FISHERIES TECHNOLOGY
KOCHI

SPONSORS

Seaweeds: A Source of Nutraceutical Healthcare Products and New Materials - Future Perspectives

Edited by

Suseela Mathew, K.K. Asha, C.S. Tejpal,
Lekshmi R.G. Kumar and A.R.S. Menon

ICAR-Central Institute of Fisheries Technology
Matsyapuri P.O., Cochin – 682 029, India

2017

Seaweeds: A Source of Nutraceutical Healthcare Products and New Materials - Future Perspectives

Edited by:

Suseela Mathew, K.K. Asha, C.S. Tejpal,
Lekshmi R.G. Kumar and A.R.S. Menon

Printed and Published by:

Dr. C.N. Ravishankar, President, SOFTI & Director,
ICAR-CIFT, Cochin - 682 029, India

Cover credits

Shri Pradip Kumar Mahato

February, 2017

Citation

Siddhanta, A.K. (2017) - Marine derived healthcare products and new materials, In: Seaweeds: A Source of Nutraceutical Healthcare Products and New Materials - Future perspectives (Eds.) Suseela Mathew, K.K. Asha, C.S. Tejpal, Lekshmi R.G. Kumar and A.R.S. Menon, ICAR-CIFT, Cochin , P. 88.

Large scale Mariculture of Seaweeds - Need of the Hour

P. Kaladharan

ICAR-Central Marine Fisheries Research Institute, Cochin - 682 018

Seaweeds are marine macroalgae consisting of taxonomically distinguished groups of Chlorophyta (Green seaweeds), Phaeophyta (Brown seaweeds) and Rhodophyta (Red seaweeds). They are generally found attached to rocks, pebbles or other aquatic plants in the intertidal or subtidal regions of the sea. Seaweeds are the natural source of phycocolloids such as agar-agar, algin and carrageenan. A number of tropical seaweeds including green algae (*Ulva, Enteromorpha, Monostroma, Caulerpa*) brown seaweeds (*Dictyota, Laminaria, Cladosiphon, Padina*) and red seaweed (*Gracilaria, Porphyra, Eucheuma*) are eaten directly (sea vegetables) for their minerals, vitamins, proteins, essential amino acids and low fat content.

Mariculture of seaweeds is well recommended because; A) It increases seaweed production, B) Desirable varieties can be selectively cultivated on a large scale, C) Natural beds can be protected against over exploitation, D) Exotic varieties can be cultivated after introduction and careful acclimatization, E) Can support seaweed industries by constant supply of raw materials of same quality and maturity stage unadulterated with non-commercial species, F) Harvest is easy and hence supply of raw material is assured, and G) Green technology, since seaweed mariculture does not require application of either fertilizers or pesticides.

Seaweeds are cultivated for their commercial importance of phycocolloids such as agar, algin and carrageenan, besides, their use as food, source of enzymes, dyes, drugs, antibiotics etc. World seaweed production through mariculture is expected an increase to 9.8 million tons by the year 2025. ICAR-Central Marine Fisheries Research Institute (ICAR-CMFRI) at its Regional Centre at Mandapam Camp since 1970s ventured to contribute its might towards

cultivation technology of seaweeds like *Gracilaria edulis* and *Acanthophora spicifera*. The cultivation of agar-yielding seaweeds *Gelidiella acerosa, Gracilaria edulis,* carrageenophyte *Hypnea* sp., alginophyte *Sargassum* sp., and edible seaweeds *Ulv afasciata* and *Enteromorpha compressa* at different locations in Northwest and Southeast coast of India by the CSMCRI, Bhavnagar using various culture techniques were noteworthy. These experiments revealed that *Gelidiella acerosa* could be successfully cultivated on dead corals and hollow cylindrical cement blocks and *Gracilaria edulis* and *Hypnea musciformis* on long line ropes and *Ulva fasciata* and *Enteromorpha compressa* on nets. Among these different seaweed species, the economically viable commercial cultivation has been proved only for *Kappaphycus alvarezii*. *K. alvarezii* alone had been introduced in 26 countries. Its commercial cultivation was going on successfully.

Seaweed mariculture in India remained in experimental trials until recently although started in 1964. Large scale sefarming of *Kappaphycus alvarezii,* a carrageenan-yielding seaweed started in 2000 with a back up by M/S Pepsico India Holdings Pvt. Ltd., Gurgaon in the coastal waters of Tamil Nadu, Odhisha and Gujarat including Daman & Diu with technical support from CSMCRI, Bhavnagar. Contract farming of *K. alvarezii* by the fisherfolks of East Coast of India has touched 2000 tons dry/year. It is estimated that the entire global harvest of *Kappaphycus* production is 1,83,000 tons (dry) and it comes from cultivation alone. The Philippines and Indonesia contribute (92%) of the entire global production. The production of other countries *viz.* Malaysia, China and Solomon Islands is considerable, while Indian contribution is so meagre. According to the recent report of FAO (2013) rapid expansion of *Kappaphycus* and *Eucheuma* cultivation has resulted in production increase from 944000 wet tons in 2000 (48% of total red seaweed production) to 5.6 million wet tons in 2010 (63%) with corresponding farm gate value from USD 72 million to USD 1.4 billion.

Cultivation of this seaweed generated self employment for hundreds of thousands of fisher folk in some coastal districts of Tamil Nadu *viz.*, Ramanathapuram, Pudukkottai, Tanjore, Tuticorin and Kanyakumari districts earning Rs. 15000/- to Rs. 16000/- per person per month. In July 2008 M/S PepsiCo India Holdings Pvt. Ltd. transferred this project to M/S Aquagri Processing Pvt. Ltd., New Delhi. Currently some companies like M/S Linn Plantae Private Limited, Madurai and M/S Snap Natural and Alginate Products Pvt. Ltd, Vellore, are involved in *Kappaphycus* cultivation by purchasing this seaweed through buyback arrangement with Self Help Groups (SHG's). The feasibility of cultivation of this seaweed was successfully done on Okha

Mandal coast at Mithapur, Okha and Beyt Dwaraka on Northwest coast of India. Subsequently cultivation of this seaweed was carried out at different locations on Indian coast: Tamil Nadu - Mandapam - Ramanathapuram, Vellar estuary - Parangipettai and different places of Palk Bay waters; Kerala - Vizhinjam; Gujarat - Okha; different places of Saurashtra coast and Andhra Pradesh - Chepala Timmapuram and Mukkam (Sakthivel *et al.*, 2015).

Gelidiella acerosa is the preferred source of raw material for production of pharmaceutical grade agar. The agar obtained from this seaweed is of superior quality and widely used in a number of preparations in biomedical, food, cosmetics and pharmaceutical industries. *G. acerosa* is harvested from the wild stock occurring in the Gulf of Mannar coast of southeast India. The over-harvesting of *G. acerosa* throughout the year from the wild stock caused severe loss in its resource. Studies carried out on biomass estimation of *G. acerosa* in the Gulf of Mannar region at periodical intervals over a decade revealed that the biomass of 1400 g. fr.wt / m^2 recorded during 1996-1998 was drastically reduced to 600 g fresh wt./ m^2 during 2004-2005 and gradually reduced to 450 g fresh wt./ m^2 during 2009- 2010. So there is an urgent need to conserve and restore the germplasm of *G. acerosa*. Cultivation of *G.acerosa* at industrial scale is the only viable option to conserve its resources. The farming of *G. acerosa* will ensure consistent production of quality and pure raw materials.

Acute shortage of agar yielding red seaweeds all over the world is going to jeopardize the research programmes in the fields of biology, and medicine for want of agar and agarose (*Nature* 528,171-172, 10 December 2015). The crustose red alga *Gelidiell aacerosa* growing along the intertidal regions of our peninsular coasts as well as the reef flats of Andamans and Lakshadwip Islands is the most important agarophyte that can yield agar with gel strength above 650 g/cm^2. The Bhavnagar based Central Salt and Marine Chemicals Research Institute (CSIR) has already developed successful technology for the mariculture of this species. Hence large scale mariculture of this red alga can not only help resolve the crisis but also sequester dissolved CO_2 that can check ocean acidification to a larger extend and can offer alternative livelihood to the coastal fishers (Rs. 75000/ton dry weight).

Seaweeds are proved to be excellent bio-remediating agents and are capable of improving water quality by uptake of dissolved metals, ammonia and phosphates. It is estimated quantitatively that seaweeds are also capable of sequestering dissolved CO_2 at the rate of 80.5 mg/g wet weight/day while their rate of emission through respiration is only 10 mg/g wet weight/day as majority of brown and green seaweeds are capable of utilizing the respiratory

emission of CO_2 within the cells for photosynthesis. Mariculture potential of seaweed in India is estimated to two million tons by the year 2020. Hence large scale mariculture of seaweeds which is a green technology employing *Gracilaria*, *Gelidiella* for agar, *Kappaphycus alvarezii* for *k*-carrageenan and *Ulva* and *Caulerpa* for their nutraceuticals and other secondary metabolites can help mitigate major green house gas and can check ocean acidification, while the seaweed farmers can make a living out of the harvest.