Research note

STUDY OF SEAWEED SUB SPECIES AND THEIR APPLICATIONS

Introduction & Background

Seaweeds are macrophytic algae, ubiquitously distributed along coasts from tropical to Polar Regions. They lack true roots, stem, leaves and generally grow in intertidal and sub-tidal regions of the sea. They belong to the Plantae kingdom, and being photosynthetic, constitute the basis of the food chain in aquatic ecosystems. Seaweeds are further classified as brown algae (Ochrophyta-Phaeophyceae), red algae (Rhodophyta) and green algae (Chlorophyta). Red seaweeds like *Gelidium Gracilaria* and *Pterocladis* are important for human consumption and are also used as a binder and gelling agents in food products. *Eucheuma* and *Kappaphycus* are used in manufacturing of carrageenan and in cosmetics, food processing and have a few industrial applications too.

Seaweeds have been reported as rich sources of proteins, lipids and dietary fibers, making them attractive raw material for bioactive substances with a wide range of applications in numerous fields like food, feed, cosmetics, agriculture, pharmaceutical, and biotechnological sectors. Seaweeds also contain high quantities of vitamins (A, K and B12), minerals and trace elements that are essential for the human diet. Many investigations demonstrated the nutraceutical, pharmaceutical and cosmeceutical value of the seaweeds as well. Moreover, seaweed is also the only non-fish source of natural omega-3 long-chain fatty acid, and has therefore, attracted major attention among different category of population for inclusion in diets.

Seaweeds are also known to possess anti-cancerous, antiviral, antifungal, antidiabetic, antihypertensive, immuno-modulatory, cytotoxic antibiotic, anticoagulant, anti-inflammatory, anti-parasitic, antioxidant and neuroprotective properties. It has also been confirmed that several species of seaweed have powerful antioxidant compounds such as phlorotannins, carotenoids and sterols, making seaweed a source of compounds with possible neuroprotective effects, may be useful in the treatment of neurodegenerative diseases such as Parkinson's and Alzheimer's.

Sulfated polysaccharides from seaweed have shown important potential pharmacological uses, against the bacteria *Helicobacter pylori*.

These marine organisms are generally used in the cosmetics sector as bioactive extracts, coloring agents, texturing stabilizers or emulsifiers and are a source of different compounds used in skincare. Due to seaweeds being photosynthetic, they generate compounds such as carotenoids and terpenes, mycosporin-like amino acids (MAAs) that are capable of absorbing UV rays. They also produce phenolic compounds, which are useful photo-protective elements that are used in the formulation of sunscreens.

Moreover, the biological productivity of the seaweed causes photosynthetic carbon storage. This carbon can be immobilized in sediments or moved to the depths of the sea resulting in a CO_2 sink. Thus, collecting algae and using them to produce biofuels and in other industries (food, feed, pharmaceuticals and fertilizers) can be used as carbon trap and can provide a sustainable alternative source of biomass for the fuel production and also for chemicals, such as bioethanol and bio-butanol. Furthermore, high levels of dissolved inorganic nutrients, such as nitrogen, phosphorous and carbon, are taken up by seaweed leading to the algal growth and helping to alleviate eutrophication in seas and oceans.

Several seaweeds are known to bring about environmental changes in coastal zones (by modifying light, sedimentation rates and hydrodynamics). In addition, marine seaweeds contribute to the coastal defense by reducing the hydrodynamic energy from waves and by maintaining a high bed-level at tidal flats, thus protecting those tidal areas from erosion.

Seaweed production does not compete for inland arable land, freshwater or agricultural fertilizers. However, it does compete with other activities such as saliculture, fish and invertebrate's aquaculture. Seaweed aquaculture may offer a variety of opportunities to mitigate and adapt to climate change and support biodiversity. The demand for seaweeds and their products has been growing globally and so has the interest in their production and the attraction of stakeholders to invest more widely in the production of various algal species that may fill different economic sector needs. All these characteristics make seaweeds as a potential candidate to be researched on as a sustainable resource.

Diversity of seaweeds

India, with a coastline of 7517 km long across its coastal states and islands harbour around 844 species of seaweeds of which 434 species of Red Algae, 194 species of Brown Algae, and 216 species of Green Algae have been reported from Indian seas. Different research surveys had estimated India to harvest approximately 870,000 tonnes of seaweed every year, but in 2016, the farmed seaweed production from the country was only 3000 tonnes (wet weight), which was less than 0.1% of the global seaweed production for the same year. The Red Algae *Gelidiella acerosa, Gracilaria edulis, G. crassa, G. foliifera and G. verrucosa* are farmed for manufacturing Agar and Brown Algae *Sargassum spp., Turbinaria spp.* and *Cystoseira trinodis* for the production of alginates and liquid seaweed fertilizer. The quantity of seaweeds available currently is inadequate to meet the raw material requirement of Indian seaweed industries.

Seaweeds are abundant along the Tamil Nadu and Gujarat coasts and around Lakshadweep and Andaman & Nicobar Islands. Rich seaweed beds occur around Mumbai, Ratnagiri, Goa, Karwar, Varkala, Vizhinjam and Pulicat in Tamil Nadu, Andhra Pradesh and Chilka in Orissa (seaweed cultivation.

Site selection plays an important role in the success of any sustained commercial farming activity. It significantly influences the economic returns and viability of the farming system. In the same manner seaweed farming also needs best suitable farming sites for successful operation. Expansion of seaweed farming as an additional livelihood option in the Indian coastal region will pave the way for socio-economic upliftment of coastal fishers/farmers. Further it will be helpful for mitigating the negative effects of climate change along with many other natural benefits. Owing to the importance of seaweed, the Government of India is promoting seaweed farming and its related activities through the recently launched flagship programme *Pradhan Mantri Matsya Sampada Yojana* (PMMSY) by providing financial, marketing and logistical support. Thus this is the ideal moment to take seaweed farming forward in the country.

Despite the presence of a large number of sheltered bays and lagoons suitable for mariculture, commercial large-scale farming of seaweed has not commenced in the country. The dependence is more on natural collection from marine areas and at present, there are about 25 actively operating seaweed-based chemical industries in India. However, due to lack of raw material, all industries are presently working at half of their capacities, and are mostly importing seaweeds from other countries. Available information indicates India to have good potential for seaweed culture, however, a huge gap exists between resources available and produced. In this backdrop, scope for increasing seaweed production in the country is huge and this necessitates active participation from different coastal states of India.

Research Gaps

1. Demand to Supply ratio
2. Identification of specific growth parameters that would enable optimal growth and biomass production of selected seaweed species
3. Existing culture system for seaweeds needs to be modified and tailor-made to suit the topography and the environment of the culture sites in the respective Indian states.
4. To provide sufficient, sustainable biomass to be processed into a multitude of products to benefit humankind.

Aims & Objectives

To enlist and understand the distribution of the numerous seaweed species along the Indian coastline.

To understand their probable applications in domestic, agriculture and industrial sector.

To carefully select the area for development of seaweed cultivation.

To develop a tool that could identify the potential of certain area specific seaweed species which could generate a higher biomass yield without affecting their production of secondary metabolites.

Methodology

Enlisting the several seaweed subspecies available in the literature and databases.

To find prime location for seaweed cultivation location that will enable maximal growth of the species under interest.

Understanding their optimal growth parameters that would enable maximum biomass without hampering their normal lifecycle.

Analyzing the effects of alterations in parameters on the growth and productivity of the species under experiment.

Input of this information in a tool so developed as to aid in generating optimal data for cultivation on any seaweed sub species in the selected location.

Expected outcome:

Large-scale cultivation of commercially important seaweeds that would comply the demand-supply gap in the country.

Development of a multifarious database of the wide variety of seaweed species available along the Indian coastline and to help the community and industries cultivate and benefit from the seaweed species accordingly.

This would in turn save time and efforts in trial & error of selection of optimal geographical location for selected seaweed species.