

Sea weeds - A gift from Nature to the Future - A review

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Abstract: Many researchers started Seaweed research for more than seven decades. In accordance with the need different aspects of sea weeds were studied separately. This review mainly aim to emphasis on the multi-dimensional uses of sea weeds. While comparing with the terrestrial food sources the sea weeds are having huge quantities of proteins, enzymes, lipids, polysaccharides essential vitamins, trace elements, and minerals. They are forming the sources of food, medicine, cosmetics, energy fodder, fertilizer and also used for industrial production of agar and alginate. Due to their nutritive value, they have increased uses in poultry. Nowadays they are being used in wastewater treatment to remove nitrogen and phosphorus containing compounds. Here there is an attempt to point out the application and uses of seaweeds and its products. This article will highlight about such a great living resource which is present in and around us.

Keywords: Algae, Agar agar, anti-microbial, anti-inflammatory, bio fertilizer

INTRODUCTION:

As per the literature the uses of sea weeds were realised before 2500 years ago in China (Tseng CK 2004). Owing to the presence of vitamins, minerals and fibre they became world-wide in use. From ancient time onwards countries like Japan, China and North America were using these seaweeds as food due its nutritive value. They have effective curative properties against influenza, cold and arthritis. In older periods the medicinal values of sea weeds were not much popular and limited only to folks and traditional groups (Lincoln *et al.*, 1991) Later in 1990s more studies were reported on the uses of Algae and it was also discovered that they are the cheap natural sources of chemicals (Ireland *et al.*, 1993).

Many sea weeds have anti-inflammatory and antimicrobial properties. They were widely used by Romans for curing wounds, rashes, burns etc. Egyptians used them against breast cancer. Some of them have anti-cancer properties and there for is a hope for future effective medicine against cancer. In short, we can say that due to multidirectional use they will form the source of our economic growth. Here an attempt is made to reveal the unlimited uses and properties of sea weeds by referring various other article, PhD thesis and current research etc.

MAJOR RESOURCES OF SEA WEED:

India is a country with 7500 km coastline. About 270 genera and 1150 species of marine were discovered from the Indian waters (Subba Rao and Mantri 2006). Sea weeds are macroscopic algae found attached with other substratum found in shallow coastal waters, estuaries intertidal and deep-sea areas of about 180 m depth.

Sea weeds are green, brown, or red type of macro algae mainly found in marine habitat. Taxonomists placed them under, Chlorophyceae, Phaeophyceae and Rhodophyceae respectively. They are important in the maintenance of the ecosystem and they are the important bioresources too. They are with multiple uses also. These seaweeds are otherwise known as "Gaint kelps" which can attain a height up to 20m or more. Green and red seaweeds are usually small but the brown one are gigantic in size. There are two types of sea weeds naturally growing and cultivated ones.

Sea weeds are commercially very useful. Sea weed industry is playing important role in gaining foreign currency. It can be used as food, fodder, hydrocolloids, animal feed fertilizer, medicine, cosmetics, fuel etc. It is reported that there are more than 10000 different types of sea weeds being utilized for the production of various economically useful products along the coastal regions of the world.

NUTRITIONAL VALUE AND BIOCHEMICAL COMPOSITION OF SEA WEEDS:

Undoubtfully we can say that sea weeds are the wealth of Ocean. They form good source of proteins, carbohydrates, minerals, vitamins, and fibres (Paul *et al.*, 1997). In addition to this many sea weeds are the treasure houses of minerals like sodium, calcium, magnesium, potassium, chlorine, sulphur, phosphorus and micronutrients such as iodine, iron, zinc, copper, selenium, molybdenum, fluoride, manganese, boron, nickel and cobalt. Phaeophyceae members are rich in iodine, they have low fat content and high protein and calcium content. Protein content is more in green and red algae than the brown one (Kolanjinathan *et al.*, 2014). Depending upon the habitat and depth of the sea there will be variation in protein and nutrient content of the sea weeds.

As compared to phaeophyceae and rodophyceae, the chlorophyceae members have more carbohydrate content (Parthiban 2014). They also have high protein content and low fat content (Satpathi and Pal 2011). Due to its high protein content as it is being used by many of the countries like Malaysia, Thailand, Indonesia Japan, China, Korea, South East Asia, Philippines and other. Some species of seaweeds like *Ulva Enteromorpha*, *Caulerpa*, *Codium*, *Monostroma*, *Sargassum*, *Hydroclathrus*, *Laminaria*, *Undaria*, *Macrocystis*, *Porphyra*, *Gracilaria*, *Euclidean*, *Laurencia* and *Acanthophora* are widely used in the preparation of soup, salad and curry etc (Kolanjinathan *et al.*, 2014).

SEA WEED AS FOOD:

It has been reported that the sea weeds are rich source of omega-3 fatty acids, amino acids, vitamins, minerals, and bioactive compounds.

As sea weeds can grow in varying conditions they can be easily cultivated and can be used as food with minimal impact on environment. It can be considered as an alternative for food security. Many European countries and Asian countries are using these sea weeds as general diet. Edible sea weeds are the vegetables of the sea and the food source for sea life. Sea weeds are rich source of iodine from the sea, and excellent source of micronutrients such as folate, calcium, magnesium, zinc, iron and selenium. As they are low caloried nutrient rich sources they are widely used by Japan and Korea and these dishes made from the sea weeds are popularly known by Japanese names. Some them are as follows:

Nori- a dried delicious sea weed food made from the red algae *porphyra*

Kombu : It is another sea weed food made from *Laminaria* which is a brown algae and popular in Japan.

Ogonori: It is another sea weed dish made from *Gracilaria* which is a brown algae and popular in Japan.

Umibudo: This sea weed dish is usually prepared from *Caulerpa* sps.

Sea weeds like culerpa, laminaria, Undaria, Ulva etc are used for preparation of soups, salad and curry in countries like Japan ,China, Corea, Malasia etc.

SEA WEEDS AS COSMETIC

In Algotherapy sea weeds are widely used as beauty enhancers. Sea weed extracts treatment, sea weed bath etc are widely spreading in all regions. *Ascophyllum nodosum* is widely used sea weed for sea weed powder towards beauty care items. Now a days many commercially popular products are prepared from sea weeds.

SEA WEED AS MEDICINE

Sea weeds are widely used as antimicrobial, antifungal anticancerous and anti-oxidant agents (Pooja 2014). According to Yuvaraj 2014 *Sargassum wightii* have anti-tumour and anti-microbial activities.

Due to anti-oxidant activities the sea weeds can fight against the cancer, chronic inflammation, cardiovascular disorders and ageing process (Richardson 1993). It can control herat disease and stroke also (Jiménez and Sánchez, 2000).

Various sea weeds have greater anti-bacterial and anti-fungal activities. Kolanjinathan and Stella 2011 proved that the methanol extract of *Gracilaria corticata* has highest antibacterial activities against pathogenic bacteria like *Streptococcus epidermis*, *Streptococcus pyogenes*, *Staphylococcus aureus* etc.. Similarly *Sargassum wightii* and *Turbinaria* also have good antimicrobial activities (Vijayabaskar , Shiyamala 2011).

Similarly *Undaria pinnatifida* and *Ulva linza* showed greatest suppression of erythema in mouse due to their anti-inflammatory activities (Mohammed *et al.* , 2008)

They have very effective anti-cancerous properties too. It has been proved that dietary intake of sea weeds can be a protective measure for breast cancer Ghislain *et al.*,2014. He explained that the brown algae *Fucus* is useful against colon and breast cancer. In ancient ayurvedics of china it is recorded that *Laminaria* can be widely used against cancer.

The antidiabetic activity of sea weeds are also well known. According to Abhirami 2013, there is significant reduction in the blood glucose and glyoxilated heamoglobin level while treating with aqueous extract of *Ulva fasciata*.

They have good anti-viral activities also. The carageenna, fucoids etc present in the marine algae have antiviral activities against enveloped viruses (Kolender *et al.*, 1995)

The chemical compounds like fatty acids, bromophenols, tannins, phloroglucinol, terpenoids and halogenated compounds found in phaeophyceae, chlorophyceae and rhodophyceae are acting as antibiotics and help in fighting against bacterial, viral and fungal diseases (Waiter *et al.*, 1975 Gloombitza 1979, Hashimoto 1979)

Some sea weed s have negative effect on the larval development of sea urchins. Caulerpinine extracted from *Caulerpa taxifolia* have adverse effect on the larval development of the sea urchin (Pesando *et al.*,1996)

Extract of the red algae *Digenea* is having vermifuge activity against *Ascaris* (WHO Expert Committee 1967).

These see weeds also have good anti-ulcer properties. As per the work of Kulandhaisamy and Murugan 2013 *Gracilaria crassa*, *Laurencia papillosa* and *Turbinaria ornata* have good wound healing properties.

Sea weeds contain rich amount of iodine and amino acid tyrosine it is helpful in protecting our thyroid health there by controlling our growth, energy metabolism, reproductive activities and repair mechanism which is done by proper functioning of the thyroid gland.

Owing to the presence of high amount of fibres and omega fatty acids it protects the heart by lowering the blood pressure. As sea weed contains high amount of dietary fibres which in the form of polysaccharides and food source of our gut microbes, it helps to keep our gut healthy.

The peptides and antioxidants in sea weeds helps in providing vitamin D and B12 which in turn are anti-inflammatory and antiviral.

The fucoxanthin, carotene etc helps in reducing the type 2 diabetics by balancing the blood sugar level.

SEA WEED IN INDUSTRY

Sea weeds are widely used in industrial sectors. Agar agar, a jelly-like solidifying agent is extracted on a large scale from *Gelidium*, *Gelidiella*, *Gracilaria*, *Pterocliadiella* and *Pterocladia*. Agar is a dietary source of iron, calcium, phosphorous and vitamins. It is also used in microbiology and biotechnology to create favourable conditions for microbial growth due to it inert nature. Gelidiaceae yields the best quality agar and agarose.

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Also in paper industry, alginates are used up in improving the quality of paper. (Subbaramaiah 2004). Instant foods constitute alginates in their preparation process as it acts as stabilizing and emulsifying agent (Krishnamurthy V. 2005). Biogas production from seaweeds was highly welcomed in developed countries (Dhargalkar VK, et al 2005). Ulva, Laminaria, Fucus, and Saccharina are the majorly exploited for biogas production.

Seaweeds are used as a parallel source of food other along with main fodder as it nullifies the nutritional deficiencies and provides a balanced dietary to farm animals. Seaweeds are rich in minerals, iodine, amino acids and lower in fatty acids (Kaladharan, et al., 1998). Gracilaria, Gelidiella, Hypnea and Sargassum are often used for dietary needs. They also find their application in aquaculture as it disinfects polluted water. (Dhargalkar, et al., 2005)

Around 75% of seaweeds is constituted of water and rest is humifying contents. Being rootless, seaweeds accumulate all of the nutrients from dissolved in seawater and drainage released into sea. Alginic acid is the primary constituent of organic matter which rapidly degrades into soil and enhance soil conditions. *Laminaria*, *Ascophyllum*, *Sargassum* are used as organic manures.

Seaweeds are also employed in sewage water treatment. Seaweeds filter out the majority of nutrients-nitrogen, phosphorous- from the sewage water and also disinfects the water. *Gracilaria verrucosa* and *Ulva fasciata* efficiently remove BOD & COD and ammonia respectively. (Sasikumar, et al., 1994). It also checks eutrophication in water bodies. Species like *Enteromorpha* and *Monostroma accumulates* phosphorous exceeding their requirements. Seaweeds are capable of eliminating hazardous metals-nickel, copper, lead etc- from waste water released by industries, mines and other sources. Seaweeds like *Sargassum*, *Laminaria*, *Ecklonia Ulva* and *Enteromorpha* acquires toxic metals from effluents and thus act as bio-indicator for heavy metal pollution.

OTHER USES

Seaweeds are also employed in food industry to improve the texture and quality of the products. Chocolate milk, frozen desserts, UHT milks, flans, puddings, low-fat cheese, and cheese imitation are all examples of dairy products that make use of it. In a water gel base and toothpastes, it provides structure and controlled release of active compounds such as fragrances.

Controlled release products, such as air freshener gels, are examples of its wider application. In a water gel base, it provides structure and slow release of active compounds such as fragrances.

Seaweeds in the marine ecology

Seaweeds serve an important role in the maintenance and balance of the marine food chain, in addition to the aforementioned purposes. Seaweed beds provide shelter and habitat for coastal animals for the duration of their lives or for a portion of it. It provides nutrients and energy directly or indirectly. Numerous commercial species, such as the rock lobster, abalone, and green-lipped mussel, rely on them as nurseries.

CONCLUSION

This review article takes an intensive look at the scope of seaweeds in not only India but also across the world. Now and even then, back in time, seaweeds always proved to be in rich in vitamins, minerals, trace elements and other nutrients. The medicinal and pharmaceutical aspects of seaweeds and their antibacterial, anti-diarrheal, analgesics, anti-diabetic, antioxidant and anticancer potentials are also validated (Mohammed AA, 2016). Moreover, they are a huge supplier of bioactive secondary metabolites like steroids, glycosides, flavonoids... (Kanimozhi AS, et al., 2015) In that way, use of seaweeds ensure very little or no side effects in treating various diseases in comparison with synthetic medicines (Tyagi Richa, et al., 2016). On the other hand, they also get accumulated by considerably large amount of heavy metals that are hazardous and in case, lethal. Bladderwrack, for instance, is a variety of brown algae that procures heavy metals namely iodine. Thyroid anomalies, skin deformities, high salivation, belly inflammation etc can be the results of regular intake of bladderwrack (Ramani Gade, et al., 2013). As aforementioned, seaweeds end up taking in all the nutrients in released into the sea, it also gathers up the hazardous metals which sometimes cause negative results upon their usage.

The main objective of this write up serves to the purpose of highlighting the application of seaweeds and its usage in different fields. The boundless scope of a very freely and naturally occurring resource like seaweeds in fact open a new door of innovations for the materialistic world.

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