

# SEAWEEDS: A SOURCE OF NUTRACUTICALS FROM MARINE ORIGIN

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Marine algae which are popularly termed as seaweeds belong to the primitive group of on- flowering plants known as Thallophyta. Seaweeds have been used for centuries in south and South East Asian countries. Seaweeds generally grow in rocky or coral substratum and are autotrophic which grows in intertidal and sub-tidal regions of the sea (Cooksley, 2007). In India, these seaweeds are abundant along the coasts of Gujarat, Tamil Nadu, Lakshadweep, Andaman and Nicobar Islands. These are used as food, chemical, fertilizer and for medical applications. Seaweeds and bioactive compounds derived from these seaweeds have been used in many applications including food, cosmeceutics and others. Seaweeds are rich source of proteins, vitamins, minerals and various trace elements as well. They are used as a source for production of agar, alginate and carrageenan. Traditionally macroalgae consumption in Asian countries is common and in Western countries, these marine microalgae are utilized in various food applications such as a source of phycocolloids, as thickener and gelling agent, etc. (Iso et al., 2007). Marine microalgae have been considered as rich sources of bioactive compounds having great potential from industrial point of view (Blunt et al., 2010). Marine microalgae i. e. seaweeds are considered as one of the valuable sources of bioactive compounds and could be utilized for the preparation of novel functional ingredients for functional food and also a good approach for the treatment or prevention of chronic diseases. Due to the



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attention of consumers towards naturally derived biological compounds for their functional properties, these can be utilized as alternative for synthetically derived components.

## Consumption of seaweeds

Seaweeds therapeutic ingredients are available in unprocessed dried form as well. Consumption of small amount of seaweed

on daily basis is more effective than consumption of seaweeds on in higher quantities but on occasional basis. The persons who are oral adverse to seaweeds can prefer to have powdered seaweeds with flavoured material such as spices.

## Seaweed as nutraceuticals

Development of nutraceutical and functional food is comparatively a recent trend. New biologically active molecules with higher potency and therapeutic importance are discovered by scientist from food, biochemistry, biomedical and nutrition area. Seaweeds consist of brown algae from which biologically active compounds have been isolated such as phlorotannins and fucoxanthin. In Asian countries especially Korea and Japan, seaweeds are commonly used in diets as condiments, seasonings, wrappings and as vegetables. Seaweeds possess therapeutic properties. Brown algal species such as; Laminaria, Undaria, Sargassum are few of them. In China, many species of seaweed have been used as herbal medicine for treatment of goiter, urinary diseases, hemorrhoids, etc. Nutraceutical and pharmaceutical

products need continuous supply of the raw material wherein price is also an important factor. Brown algae are an important species as it is possible to undertake mass production through aquaculture. Brown algae are considered as rich source of novel and bioactive natural compounds and the activities include antioxidant, anti-obesity, anti-allergic, anti-inflammatory, and hypoglycemic effects (Huang and Wang, 2004). Health benefits from seaweed consumption are relief from obesity, radiation poisoning and diabetes related complications. It improves digestive, dental, dermal, and cardiovascular health.

#### **Antioxidant Activity**

Important physiological functions are carried out by produced reactive oxygen species during normal metabolic activities. However, excess production of these reactive oxygen species may lead to loose cell integration and oxidative damage to cell (Halliwell et al., 1995). With the antioxidant molecules inside the cell, ROS are scavenged before damage to cell which reduces oxidative stress. However, overwhelming of antioxidant system by ROS can lead to oxidative stress. Use of naturally occurring compounds possessing antioxidant properties may help to prevent many disease conditions such as reducing the risk of heart diseases and many chronic diseases occurring as a result of ageing. Phytochemicals are not essential for normal functioning but are beneficial from health point of view (D'Archivio et al., 2004). Antioxidants alleviate negative effects of ROS. Brown algae contains rich amount of antioxidative compounds. Examples are phlorotannins in *Sargassum*, *Laminaria* and some marine algal extracts. Unsaturated fatty acids from seaweed also exhibited antioxidant and prooxidant activities (Henry et al., 2002). The antioxidants include enzymatic processes such as superoxide dismutase defence and biologically active molecules such as l-ascorbic acid, glutathione and carotenoids as well as secondary metabolites such as the phlorotannins in brown algae (Athukorala et al., 2006).

Antidiabetic effect and anti-obesity activity

Presence of fucoxanthin in certain types of seaweed is effective antidiabetic. Absorption of triglycerides due to presence of alginic acid is considered to be responsible for antidiabetic effect. Obesity is closely related to health problems such as diabetic conditions, cancer and cardiovascular associated problems (Ntambi and Kim, 2000). Obesity results from accumulation of lipids and increased adipocyte number. Brown algal extracts are effective against diabetes of type II, arteriosclerosis and also effective in control of cholesterol level. Antiobesity property of seaweeds is mainly due to fucoxanthin and fucoidan. Seaweeds reduce fat accumulation in body and aid in weight loss. As it promotes fat oxidation, seaweeds are utilized in diet pills.

#### **Anti Cancer Activity**

Seaweeds are considered as anticancer compounds and can be beneficial for cure of tumors and leukemia and colon cancers. Due to their glycoprotein and sulfated polysaccharide content they possess anticancer properties.

#### **Antiallergic and anti-inflammatory properties**

Food allergy is world-widely common and it has been frequently reported that the allergy induced by ingestion of food can cause severe hypersensitive reaction in humans (Daul et al., 1990; Daul et al., 1993). Hyaluronidase (HAase, EC 3.2.1.35), an enzyme which cleaves the polysaccharide hyaluronic acid in the extracellular matrix of connective tissue, is mainly known to be involved in allergic reaction (Kakegawa et al., 1988; He et al., 2001). Thus, anti-allergic agent had a strong inhibitory effect on the activation of hyaluronidase (Fujitani et al., 2001). Ethanol extracts of brown algae such as *Sargassum tennerimum*, *Sargassum cervicorne*, *Sargassum graminifolium* turn, *Sargassum thunbergii*, and *Laminaria japonica* were analyzed inhibitory activity of hyaluronidase and *Sargassum tennerimum* showed the highest inhibitory activity of hyaluronidase, indicating a promising natural antiallergic medicines or functional food source (Abad et al., 2008)

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**Prevention of dental cavities**

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Extracts from seaweed exhibit dental cavities prevention effect. Dental molds fabrication involves use of alginic acid. Salivary gland functioning is improved which makes oral tissues resistant against damage.

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**Anticoagulant activity**

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Seaweeds are blood thinners which prevent blood clots and decrease the cardiovascular related complications. Fucoidans present in brown algae exhibit such effect.

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**Improvement of cardiovascular health**

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Seaweeds are beneficial in maintaining lower levels of triglycerides and cholesterol which maintains heart in healthy condition allowing smooth blood circulation preventing fatal conditions such as failure of heart, atherosclerosis and peripheral artery ailments.

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**Protective effect against radiation poisoning**

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Seaweeds exhibit ability to protect skin from damage by UV B radiation from sunlight. Presence of fucoxanthin prevents damage to cells and enhance survival rate of cell. Antioxidant activity of seaweeds protects skin from aging, pigmentation and wrinkle development and making it useful in cosmetic industry as well.

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**Protection of eyes**

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Antioctular inflammatory effect of fucoxanthin is useful in prevention of after-cataract. Posterior capsule opacification occurring after cataract surgery is the complication in which fucoxanthin is useful and can be used in ocular implants to avoid risk of after-cataract.

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**Improvement of skin health and hair**

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Essential components in seaweeds such as vitamins, minerals, antioxidants and amino acids help in skin revitalization, moisturization. Effect of pollutants on skin is guarded by these elements which are showing antiageing effect as well. Minerals are important in maintenance of healthy hair by root strengthening of roots making hair thick with lustrous shine.

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**Source of essential minerals**

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Seaweeds are rich sources of essential minerals. Land plants can't even approach seaweeds as a source of

minerals required for metabolism (Bergner, 2003). It is a source of minerals which are often not observed in freshwater and food crops grown on soils depleted in minerals. Seaweeds contain minerals in the range of 20 – 50 % on dry weight basis. Mineral elements which are found in seaweeds include; sodium, calcium, potassium, magnesium, zinc, copper, sulfur, phosphorus, iodine, iron, fluorine and many more. Brown seaweeds contain higher proportions of minerals when compared with red seaweeds. These mineral elements are important for body functioning as well as for enzymatic reactions as co-factors for enzyme. Optimum functioning of body is depending on mineral supply.

Iodine is abundantly found in seaweeds than all other plants and animals. Vertebrate animals need iodine which is used in thyroid hormones. Cretinism would be developed in case of lack of iodine supply. Seaweeds absorb iodine from seawater.

All living cells need potassium for normal nerve and muscle functioning. Selenium is essential for thyroid functioning. Both of these minerals are available in seaweeds in larger proportions.

Seaweeds are rich in phycopolymers. Algin and fucoidan are sulfated galactans. Algin is heavy metal detoxifying compound. It binds with the heavy metals and carry them out of stool as that are not digestible. This heavy metal removal treatment is recommended for both acute and chronic exposure to heavy metals. Fucoidan stimulates the production of antiviral cytokines and can be used as antiviral compound. It is helpful in various therapeutic drugs.

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**Antiviral properties**

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Seaweed possesses anti-viral properties that have been proven promising in providing a protective effect against Influenza B virus. Seaweed extracts obstruct the absorption of harmful viral particles in the cells and prevents the body from getting infected. Polymers from red algae include agar, carrageenan and nori. These are sulfated galactans and water soluble in nature. Carrageenan extraction is

possible simply by boiling seaweeds to obtain the liquid extract. It is useful to treat sore mouth conditions. Respiratory ailment treatment using carrageenan is commonly practiced. Some red algal species are strong antiviral in nature.

### **Thyroid hormones regulation**

Thyroid hormone is important in myelination of central nervous system of new borns. Goiter, hypothyroidism, mental retardation are few of the conditions caused due to deficiency of iodine. Only known non-animal source of thyroid hormones is brown seaweeds. *Fucus* is the species which is used in treatment of thyroid related disorders. Thyroxine production is enhanced due to the presence of iodine in seaweeds. T3 and T4 are found in brown seaweeds notably in *Laminaria* and *Sargassum*.

### **Essential vitamins and lipid**

Seaweeds are rich in vitamins of B-group especially B12. It also contains vitamin A and Vitamin C. Along with it seaweeds are rich in omega 3 fatty acids.

### **Improvement in digestive health**

Seaweeds exhibit mild laxative effect and are useful for healthy digestion process. It stimulates digestive enzymes release, supports nutrient absorption and facilitates fat metabolism.

### **Enhanced rate of excretion of Dioxins and PCBs**

Detoxification and cleansing ability of seaweeds is helpful in facilitation of toxic waste excretion. Natural absorbant in seaweeds possess binding properties which enables binding the, with heavy metals and other pollutants which are eliminated through bowel movements. Brown seaweeds enhance the rate of excretion of dioxins and PCBs allowing speedy clearing of these compounds from body. These toxic compounds are lipophilic and insoluble in water which are absorbed by body rapidly. Brown seaweeds can reduce Dioxin and PCB uptake and speed the fecal elimination of body-accumulated Dioxins and PCBs. The authors intend to use human subjects for equivalent research to demonstrate seaweed-enhanced dioxin and PCB excretion.

### **Inhibition of HPV Infection**

Genital Human papilloma virus (HPV) infection is common in human beings and may progress to cancer. Carrageenan extracted from red seaweeds inhibits HPV infection by acting primarily by prevention of binding of HPV virions to cell surface and also exhibits post attachment inhibitory effect on virions.

Kombu is useful in various health conditions such as in resolution of coronary heart problems, liver functioning, higher rate of metabolic activities, faster food transit time, higher HDL and lower LDL levels, etc.

### **Other applications of seaweeds**

*As culinary ingredient:* Seaweeds are considered as delicacy in many countries from Asian continent. Nori, Kombu and wakame are few popular culinary dishes made from seaweeds. Agar and carrageenan are commonly used in processed food such as yogurt, non-veg recipes, drinks, etc. As emulsifier and gelling agent: Seaweeds exhibit good emulsifying properties along with good water holding, gelling and binding effect making them suitable for use in manufacturing industry especially in making of jellies, gels, paint industry, adhesive industry and also used as softening agent in organic skin care products.

*As ingredient in fertilizers and soil conditioners:* Due to the beneficial effect of seaweeds in plant growth, these are used in fertilizers and soil conditioner manufacture.

*As agent for treatment of waste water:* These are utilized in agricultural waste water treatment to lower the toxic elements concentration such as nitrogen and phosphorus (Carlsson et al., 2006).

### **Side effects of seaweeds**

Along with benefits if consumed in excess, seaweeds also exhibit few side effects which include excess iodine intake in case of higher amount consumption, medical complications like gastrointestinal problems, kidney related problems may occur as a result of excess seaweed consumption. Surgical application of seaweed extract during childbirth is not safe as it alters hormonal levels causing serious/ fatal conditions for both mothers and babies.