



## Pharmacological Properties and Therapeutic Benefits of Seaweeds (A Review)

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### ABSTRACT

Seaweed is a general nomenclature used species of algae and marine plants breed in water bodies like rivers and oceans. They grow in a wide range of sizes from microscopic to stupendous. Seaweed, or macroalgae as it is known scientifically, includes over 10,000 species of the fastest growing plants on earth. Seaweeds come in an amazing variety of beautiful shapes, colors and sizes, and are found in all of the World. They are most abundant in shallow rocky coastal areas, especially where they are exposed at low tide. Seaweed is taxonomically classified under four groups according to the color of photosynthetic pigments namely red algae (rhodophyta), brown algae (phaeophyta), green algae (chlorophyta) and blue-green algae (cyanophyta).

Seaweeds are one of the most nutritionally and therapeutically valuable foods. Their value to health is largely due to their high mineral content and the therapeutic sulfated polysaccharides. Seaweeds are also a source of all the known vitamins, chlorophylls, lignans, polyphenols, antioxidants and chemical diversity including pigments, polysaccharides, organic, and inorganic compounds which are used as animal fodder, food, nutraceuticals, pharmaceuticals, and cosmeceutical.

The aim of this review is to accumulate in brief, the therapeutics and medicinal uses of seaweed on the some mentioned ailments.

**Keywords:** *Seaweeds, therapeutics, medicinal uses, bioactive compounds*

### Introduction

Seaweeds are an important source for food, fodder fertilizer and medicine from the ancient times. The earliest record of use of sea weed dates back to 2700 BC in the compilation of “Chinese herb” by Emperor Shen Nung (Kasimala *et al.* 2015). Seaweeds have been an important dietary component since fourth century in Japan, sixth century in China, in Egypt (1550 BC), and in India (300 BC). (Venugoapl 2009).

In 1950s, the therapeutical properties of seaweeds were restricted to traditional medicines (Lincoln *et al.* 1991). During the 1980s and 90s, compounds with biological activities and pharmacological properties were discovered in marine bacteria, invertebrates and algae (Mayer & Lehmann 2000).

In marine ecosystems, macroalgae have ecologically and biologically importance. Macroalgae provide nutrition, reproduction, and an accommodating environment for other organisms. Because of these properties, macroalgae maintain the ecosystem’s stability. Marine algae are also an important source of dissolved organic carbon in aquatic ecosystems. The organic carbon is represented by carbohydrates, polysaccharides, nitrogenous and polyphenol materials (Kasimala *et al.* 2015).

Seaweeds are a natural renewable resource with a rich structurally unique and diverse secondary metabolites. Marine macro algae have the potential utilized in the treatments of: cardiovascular diseases, diabetes, obesity, viral diseases (especially HIV and HPV), cancers, and disorder of the gastro-intestinal tract, hepatic diseases, anti-inflammatory issues (Roy & Anantharaman 2017).

Some seaweeds (especially coralline algae) have high levels of calcium carbonate, thus they are applicable to treat the osteoporosis. Some seaweeds are used in cosmetics to treat skin ailments and take care of skin health. Certain seaweeds have antioxidants such as polyphenolics, vitamins and fatty acids. Vitamins from some seaweed act as immune-stimulants. Antioxidants of seaweeds inhibit the oxidation of the low lipoproteins in the cell membrane.

Some certain seaweeds have been reported for having antihypertensive, anti-coagulating and anti-hemorrhagic activities. Specific seaweeds have high micronutrients and minerals used as nutritional supplement in dietary diets. All essential minerals are providing by dietary seaweeds. The elements abundant in seaweeds include: Potassium, Sodium, Calcium, Magnesium, Zink, Copper, Chlorine, Sulfur, Phosphorus, Cobalt, Manganese, Selenium, Bromine, Iodine, Arsenic, Iron and Fluoride (Cerna 2011).

Eating sea vegetables regularly can facilitate the excretion of heavy metals, radioactive elements, dioxins and PCBs from our bodies. They promote a healthy immune system, prevent thyroid disease, obesity, cancers and metastases, cardiovascular disease, diabetes, nervous system disorders, osteoporosis, reduce chronic inflammation, inhibit viruses (including herpes and human papilloma virus) (Brown *et al.* 2010).

Among the functional benefits of the seaweeds, apart from the nutritional effects, they have long been considered to possess powers of prolong life, prevent diseases, impart beauty and health (Shelar *et al.* 2012).

## MATERIAL AND METHODS

In the present review, information about seaweeds, their medicinal uses and therapeutical properties was gathered searching scientific databases including Elsevier, Google Scholar, PubMed, Springer, related books and manuscripts online or offline.

## PHARMACOLOGICAL AND THERAPEUTICAL PROPERTIES OF SEAWEEDS

Bioactive compounds from seaweeds currently receive the attention from pharmaceutical companies for the drug developments in recent years. Seaweeds are taking majority of attentions from researchers because of their phenomenon bioactive substances and their medicinal properties like anti-viral, anti-tumor, anti-inflammatory and anti-lipedimic and may more properties (Archana *et al.* 2014).

These properties make seaweeds more potential as a supplement in functional food or for the extraction of compounds. Active substances in marine algae are classified into two types based on their mechanisms: non-absorbed high molecular wt. materials (like dietary fibers) and low molecular wt. materials which are absorbed and effect the maintenance of human homeostasis (Murata & Nakazoe 2001).

Seaweeds have been used for a variety of purposes like food, medicinal, herbalism and other uses. Even though the therapeutic property of seaweeds are well known from many centuries, but the scientific research on therapeutic property on seaweeds began during 1970s (Uppangala 2010).

Seaweeds are the source of producing chemical compounds like agar-agar, carrageenan and alginates. These chemical compounds also known as phytochemicals and are used for human consumption, animal feed and manure in many countries. Seaweeds extracts are also a very important component of mast biostimulate products found in markets nowadays and it is best known for their richness in polysaccharides, minerals and certain vitamins (Holdt & Kraan 2011).

Seaweed extracts are rich in natural plant growth hormones and beneficial trace elements like auxin, cytokines and gibberellins (Haugan & Liaaen 1994). Their recent utilization as an animal feed is on the increase due to their nutritive constituents in recent years.

Seaweeds contain large variety of therapeutical components involved in the prevention and treatment of health diseases. Seaweeds also contain storage polysaccharides, notably laminarin in brown seaweeds and floridean starch in red seaweeds. Polysaccharides and fibers are the main class of potential bioactive molecules to interfere with several chronic ailments

such as cancer, cardiovascular diseases, obesity and diabetes (Deleris *et al.* 2016). Seaweeds also contain some other molecules (such as peptides or polyphenols) which may have their potential in human health. Carotenoids are also susceptible group of active molecules of the recent studies.

Among polysaccharides, fucoidans were particularly studied as they showed interesting biological activities (anti-thrombotic, anti-coagulant, anticancer, shown to vary according to species, wave exposure, anti-proliferative, anti-viral and anti-complementary seasonal, annual, environmental and physiological factors agent, anti-inflammatory) (Kolanjinathan *et al.* 2014).

Seaweeds are fairly simple foods for human health to break down and release the beneficial substances providing variety of vitamins and minerals. seaweeds are also low calorie foods rich in some health promoting molecules and minerals such as dietary fiber, omega-3 fatty acids, essential amino acids, vitamins (A,B,C,D and E), riboflavin, niacin, pantothenic acid, folic acid, Ca, P, Na, K (Blunden & Wildgoose 1977).

Seaweeds contain all the nutrients and very same minerals found in human body. The chemical composition of seaweeds is so close to human plasma that they are excellent at regulating and purifying the blood. They help to alkaline our blood neutralizing the acidic effects of modern diets (Dhargalkar 2014). Seaweeds are a rich source of iodine. Iodine is a vital nutrient required for growth for all age groups and essential for the regulation of thyroid function which involves the brain and pituitary gland. The thyroid hormone also plays an important role in the process of myelination of the central nervous system (<https://www.organicfacts.net/seaweed.html>).

Scientific research has shown that edible seaweeds prevent obesity. The fucoxanthin helps reducing the accumulation of fats and aids weight loss. Due to its ability to promote the oxidation of fats, it is used in making prescription diet pills and gastric banding pills (Gammone & Orazio 2015). Seaweeds have a laxative effect that is useful in maintaining healthy digestion. It helps in stimulating the release of digestive enzymes, supporting the absorption of nutrients, and facilitating the metabolism of fats.

The fucoxanthin compound present in brown algae has also been proven effective in exerting anti-diabetic effects. The triglyceride absorption of seaweed *Laminaria japonica* (known as kombu) has been mentioned for beneficial effects on diabetes (Sharifuddin *et al.* 2015).

The wealth of essential vitamins, minerals, amino acids and antioxidants in seaweed helps in keeping the skin revitalized, moisturized, and youthful. These elements guard the skin against the harmful effects of environmental pollutants and help to slow down the skin's aging process. This defensive effect can be attributed to the presence of fucoxanthin which aids in preventing cell damage and enhancing the survival rate of the pre-treated cells. The antioxidant effect of fucoxanthin protects the skin from photo-aging, pigmentation, and wrinkle formation (Urikura *et al.* 2011). The anti-ocular inflammatory effect exerted by fucoxanthin, present in seaweed, has shown promising results in the prevention of after-cataract. Fucoxanthin is utilized in the formulation of products used in ocular implants in the cataract surgery to avoid the risk of after-cataract (Peng *et al.* 2011).

The anti-inflammatory properties present in seaweed are useful in treating skin rashes and wounds. The phytonutrients elevate blood flow and bring a healthy glow to the face. Seaweed wraps detoxify and cleanse the skin by expelling toxins out of the pores. Scientific research has made it evident that seaweed extracts contain anti-aging properties and are a useful ingredient in the manufacturing of skin care cosmetics (Mhadhebi *et al.* 2014).

Alginate, a salt of alginic acid extracted from seaweeds, is quite useful in the production of dental molds. Also it has preventative effects in the growth of dental cavities with anti-inflammatory properties (Misurcova *et al.* 2012).

Many of the seaweeds possess bioactive components that inhibit the growth of some gram-positive bacteria and gram-negative bacterial pathogens. The algal extracts were used as a preventive and remedial agent for some diseases such as antibiotics, antihelminthics, antihypertensive, antitumour and antidiarrhoea (Siddhanata 1991).

Laboratory research showed that seaweeds possess antioxidant and anti-coagulant properties. Anti-coagulants, known as blood thinners, prevent the

occurrence of blood clots and vascular occlusion, decrease the threat of stroke and cardiac failure. Seaweed has been used for sustaining lower levels of triglycerides and cholesterol. This helps in maintaining a healthy heart, smooth circulation in the blood vessels, and prevents fatal conditions. Seaweeds also possess the ability to detoxify and facilitate the excretion of toxic waste. (Patel 2012).

Seaweeds have anti-viral properties proven in providing an effect against influenza virus. Its extracts prevent the absorption of harmful viral particles and provide the body from getting infected (Gheda *et al.* 2016).

Kolanjinathan *et al.* (2014) presented nutritional-medicinal value and antimicrobial activity of seaweeds. Different kind of bioactive compounds have been obtained from marine organisms.

Jimenez-Escrig *et al.* (2011) indicated seaweeds as a source of beneficial nutraceuticals with sulfated polysaccharides and peptides. Studies on seaweeds indicated that brown and red macroalgae possess a good nutritional quality and can be used for an alternative source of dietary diets.

The quality of proteins and lipids in seaweeds are acceptable for consumption due to their high content essential amino acids and relatively high level of unsaturated fatty acids (Dhargalkar 2014). Kasimala *et al.* (2015) studied on biochemical composition and nutritional aspects of seaweeds. It was reported that the seaweeds contain high protein levels that are very important for food industry. Most of the seaweeds contain ash, fibers, low protein and moderate amount of fatty acids. The most common edible seaweeds in Asian countries are *Porphyra sp.*, *Padina sp.*, *Undaria sp.*, and *Laminaria sp.* These are proper additives to improve the nutritive quality of various foods. Seaweeds have also more than 54 trace elements required for human body's physiological functions in quantities exceeding vegetables and other plants (Wong *et al.* 2000).

Skrovankova (2011) indicated that seaweeds are a good source of fatty acids include gamma-linoleic acid, linoleic acid, octadecatetraenoic acid, eicosadienoic acid, arachidonic acid, eicosapentaenoic acid (EPA), docosapentaenoic acid (DPA), docosahexaenoic acid (DHA), nervonic acid and adrenic acid. It was also reported that vitamins of

seaweeds decrease blood pressure (vitamin C), prevent cardiovascular diseases (beta-carotene) and reduce the risk of cancer (vitamins E and C, carotenoids).

The algal dietary fiber (ranged from 33% to 75% of dry weight) consists of soluble polysaccharides that have important activities such as antioxidant, anticoagulant, antimutagenic and antitumour activity. These polysaccharides have an important role in the modification of lipid metabolism in human body (Okai *et al.* 1996).

Other substances such as macroalgal lectins, fucoidans, kainoids and aplysiatoxins and are routinely used in biomedical research and a multitude of other substances have biological activities. As an herbal medicine, seaweed has been used for traditional cosmetics, treatments for cough, asthma, haemorrhoid, boils, goiters, stomach ailments and urinary diseases and for reducing the incidence of tumors, ulcers and headaches (Kandale *et al.* 2011). Many species of seaweeds have been investigated for antibacterial and antiviral activities belonging to the family Bonnemaisoniaceae. This group of seaweeds have a great variety of halogenated alkanes, saturated and unsaturated ketones, aldehyde, alcohols, epoxides and halogenated derivatives of acetic and acrylic acids. These bioactive compounds have been used for antibiotic activity against *Bacillus subtilis*, *Staphylococcus sp.*, *Fusarium sp.* and *Vibrio sp.* (Garg 1993).

Compounds with cytostatic, antihelminthic, antifungal, antiviral and antibacterial activities have been confirmed in both brown, red and green algae (Newman *et al.* 2003). There are inhibiting activities from macroalgae exhibited against human pathogens, fungi and yeasts (Liao 2003). Zheng Yi *et al.* (2001), tested four species of the Rhodophyta (*Laurencia okamurai*, *Dasya scoparia*, *Grateloupia filicina* and *Plocamium telfairiae*). The ethanol extract showed the strongest activity against the bacteria and fungi tested. Seaweeds contain cancer-fighting agents that may prove useful in curing tumors and other cancer conditions (like like colon cancer and leukemia). Brown seaweeds (such as kelp, wakame, and kombu) contain glycoprotein and sulfated polysaccharides called fucoidans. These bioactive compounds possess immuno-stimulant, anti-viral, and anti-cancer properties (MacArtain *et al.* 2007). Researches about effectiveness of seaweeds on breast cancer have

shown positive results in reducing the production of cancer-promoting hormones, including estrogen, and have the ability to inhibit the proliferation of cancer cells.

## CONCLUSION

Seaweeds are one of the most vital components involved in the prevention and treatment of health diseases by various mechanisms. Seaweeds are also nutritionally and therapeutically valuable foods. Their value to human health is largely due to high mineral content and the therapeutic sulfated polysaccharides they contain. Polysaccharides and fibers represent the main class of bioactive molecules to interfere with several chronic diseases such as cancer, cardiovascular diseases, obesity, and diabetes. Seaweeds are also an abundant source of all the known vitamins, chlorophylls, lignans, polyphenols and antioxidants which may have their potential in human health.

Seaweeds play a vital role in various aspects compared to other aquatic resources. Much attention should be given on seaweeds to compensate the food and health problems due to their important sources of nutrients and their applications in different work sectors.

Seaweeds can be an alternative remedy to solve the problems of nutritional deficiency in human by consuming them in dietary diets. The aim of the present study conclude that seaweeds are a potential healthy food in diets and may be use in food and drug industry as a source of ingredients with high nutritional and therapeutical value.

Seaweeds can provide dietary alternative valuable nutrients due to their commercial value enhanced by improving the quality and the range of seaweed-based products.

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