

Kelp

versatile, delicious
and healthy

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In Asia, seaweeds or algae have been part of the staple diet for at least 2000 years. They have traditionally been used for human food and alternative medicine. Looking at a global scale the value of cultivated, managed and wild harvested seaweeds exceed over 6.0 billion Euro with 87% of this value derived from aquaculture. The most valued of the cultivated seaweeds is the red alga *Porphyra*, or Nori. It is a major source of food for humans throughout the world, although it is almost exclusively cultivated in Japan, South Korea and China. Worldwide production has an annual value of over 1.8 billion Euros. In addition to *Porphyra*, other edible seaweeds include *Gracilaria*, *Undaria*, *Laminaria* and *Caulerpa* with their collective value exceeding 3.0 billion Euros. Seaweeds are also the industrial sources of carrageenans (*Chondrus*, *Eucheuma* and *Kappaphycus*), alginates (*Ascophyllum*, *Laminaria*, and *Macrocystis*) and agars (*Gelidium* and *Gracilaria*). These important polysaccharides are used in the food, textile, paint, biotechnological and biomedical industries and have a global value of approximately 580 million Euros. Seaweeds have significant value in agriculture as soil additives, fertilizers and seaweed meals with their value over 20 million Euros. The increasing demand for safe, healthy, and minimally processed foods is

creating an opportunity for seaweed products as functional foods, nutraceuticals, and alternative medicinal products. Moreover, new applications of algae and specific algal compounds in different sectors, such as food supplements, cosmetics, biomedicine and biotechnology are developed.

Kelp is the colloquial name given to the large brown seaweeds of the order Laminariales that dominate much of the shallow sub littoral in temperate parts of the world. When present in dense stands, they are known as 'kelp forests' and form an important habitat for organisms. The kelp forests that are found fringing the temperate seashores of the world are possibly the most ecologically dynamic and diverse habitats on the planet.

Kelps in northern Europe consists of different species of *Laminaria*, *Laminaria hyperborea* (Gunnerus) Foslie, *Laminaria digitata* (Hudson) J. V. Lamouroux, *Laminaria Saccorhiza* (L) J.V. Lamouroux and *Sacchorhiza polyschides* (Lightfoot) Batters, of which *L. digitata* and *L. hyperborea* are the most prominent species. It is estimated that there is over 2 million tonnes of this natural sustainable resource along the Irish west coast.

Ireland has a tradition of kelp harvesting dating back to the 17th

century. Coastal people would collect and harvest kelp, mainly the gathering of storm cast, which was burnt in kelp kilns. The ash contained a high level of potash (Potassium) which was used in the glass and soap making industry. The discovery of iodine in the ash mid 18th century kept this tradition alive till the WWII. Early 19th century a total of 60,000 tonnes of kelp was harvested/collected for iodine extraction (Guiry & Blunden, 1991). Nowadays a small amount of kelp is harvested for the sea vegetable industry and as feed for macro herbivores like urchin and abalone.

Currently, there are two European countries harvesting large tonnages of kelp; France, which mainly harvests *L. digitata* and a small amount of *L. hyperborea*, and Norway where they



harvest large amounts of *L. hyperborea*.

During the 17th century kelps were used as raw material for extraction of Iodine. The Chinese for centuries have treated iodine deficiency goitre with iodine obtained from *Laminaria* (kelp) species. Brown algae in general are very high in iodine content up to 0.7 % of the wet weight. The uptake of dietary iodide (I-) by the human and animal thyroid glands leading to thyroid hormone formation is a well established phenomenon. An antitumorogenic role *Undaria pinnatifida*, an Asian kelp species or its equivalent iodine content in inhibiting tumorigenesis in rats with carcinogen induced mammary tumours has been reported although the mechanism of action is not understood. It has also been suggested that the high dietary seaweed content may account for the relatively low prevalence of breast cancer in Japanese women.

Besides high iodine levels kelp contain carbohydrates like fucoidans and laminarins and other polysaccharides like alginates all with their own specific workings and benefits. Fucoidan and laminarin compounds can make up 4-7% of the dry weight of the kelp. Fucoidans, first isolated by Kylin almost one century ago, are sulphated polysaccharides (fucans) extracted from kelps. As it is the case for Laminarans, the Fucoidans have not yet found wide practical use even though interesting bio-activities of these polyanionic polysaccharides have been described. These include antiangiogenesis, antiproliferation for tumor cells and more recently anti-inflammatory, anticoagulant, inhibition of the development of plasmodium (bacteria inducing malaria) in cell culture and inhibition of scavenger receptors that could lead to future applications in atherosclerosis treatments.

Some anti-viral properties of sulphated fucans have also been characterized on HIV for examples, inhibition of infection of human immunodeficiency virus but also inhibition of replication of other viruses like the Herpes Simplex Virus or HSV.

The numerous important biological effects of fucoidans seem related to their ability to modify cell surface properties. Depending on the activity observed but generally, their biological potential is linked to the number of sulphated compound of molecule (role in the charge of the molecule) and the weight of the molecule. It is likely that some structural features are required for certain specific activities like for anticoagulant properties.

The alginates provide besides their jellifying properties also a protection against infection by bacterial pathogens, protection against severe irradiation and are able to boost the immune system by an increase of the B-cells and helper T-cells.

Laminarins are known for inhibition of Tumour growth/reduction in tumour size

Provide protection against radiation damage, help in wound repair and reduce serum cholesterol levels (and total serum lipid).

Moreover, kelp is an excellent source of vitamins and minerals (see Table 1).

Especially the B vitamins are present in high quantities. In general Kelp is a versatile sea vegetable, which can be used in many dishes and provides you with important vitamins and minerals.

More information can be obtained from the Irish Seaweed Centre at www.irishseaweed.com Or Stefan.kraan@nuigalway.ie

Protein	8-14 %	Mannitol	4-16 %
Fat	1 %	Calcium	12400-13200 ppm
Carbohydrates	48 %	Iodine	2479 ppm
Vitamin C	12-18 ppm	Iron	50-70 ppm
Vitamin B1	5 ppm	Magnesium	6400-7860 ppm
Vitamin B2	22 ppm	Manganese	1-16 ppm
Vitamin B3	34 ppm	Sodium	2-5.2 % †
Vitamin B12	0.6-0.12 ppm		
Laminaran	0-18 %		



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