

# Fucus

## Species (Family)

*Fucus vesiculosus* L. and other *Fucus* species (Fuca-

## Synonym(s)

Black Tang, Bladderwrack, Kelp, Kelpware, Rockweed, Seawrack

Brown seaweeds refer to species of *Fucus*, *Ascophyllum*, *Laminaria* and *Macrocystis*. 'Kelps' refer to species of *Laminaria* and *Macrocystis*, although kelp is often used in reference to species of *Fucus*.

## Part(s) Used

Thallus (whole plant)

## Pharmacopoeial and Other Monographs

BHC 1992<sup>(G6)</sup>

BHP 1996<sup>(G9)</sup>

BP 2001<sup>(G15)</sup>

Martindale 32nd edition<sup>(G43)</sup>

PDR for Herbal Medicines 2nd edition<sup>(G36)</sup>

Ph Eur 2002<sup>(G28)</sup>

## Legal Category (Licensed Products)

GSL<sup>(G37)</sup>

## Constituents<sup>(G2,G6,G64)</sup>

**Carbohydrates** Polysaccharides: alginic acid (algin) as the major component; fucoidan and laminarin (sulfated polysaccharide esters).<sup>(1)</sup>

**Iodine** Content of various *Laminaria* species has been reported as 0.07–0.76% of dry weight.<sup>(2)</sup>

**Other constituents** Various vitamins and minerals, particularly ascorbic acid (vitamin C) (0.013–0.077% of fresh material).<sup>(2)</sup>

## Food Use

Seaweeds are commonly included in the diet of certain populations. The gelling properties of alginic acid, the major polysaccharide in brown seaweeds, including fucus, are extensively utilised in the dairy

and baking industries to improve texture, body and smoothness of products.<sup>(1)</sup> *Fucus* is listed by the Council of Europe as a natural source of food flavouring (category N2). This category indicates that fucus can be added to foodstuffs in small quantities, with a possible limitation of an active principle (as yet unspecified) in the final product.<sup>(G16)</sup>

## Herbal Use

*Fucus* is stated to possess antihypothyroid, anti-obesic and antirheumatic properties. Traditionally, it has been used for lymphadenoid goitre, myxoedema, obesity, arthritis and rheumatism.<sup>(G2,G6,G7,G8,G64)</sup>

## Dosage

**Dried thallus** 5–10 g or infusion three times daily.<sup>(G6,G7)</sup>

**Liquid extract** 4–8 mL (1:1 in 25% alcohol) three times daily.<sup>(G6,G7)</sup>

## Pharmacological Actions

There is a paucity of information documented specifically for *Fucus vesiculosus*, although pharmacological activities are recognised for individual constituents and other brown seaweed species.

Alginic acid is a hydrophilic colloidal substance that swells to approximately 25–35 times its original bulk in an alkaline environment and as such exerts a bulk laxative action.<sup>(3)</sup> It is stated to compare favourably with the carboxylic type of cation exchange resins. The colloidal properties of alginates have been utilised in wound dressings and skin grafts.<sup>(3)</sup>

Anticoagulant properties have been documented for brown seaweeds.<sup>(3)</sup> The glucose polymer laminarin has been identified as the anticoagulant principle in a *Laminaria* species.<sup>(4)</sup> A fucoidan fraction has been isolated from *Fucus vesiculosus* with 40–50% blood anticoagulant activity of heparin.<sup>(5)</sup>

The iodine content of seaweeds is well recognised. The low incidence of goitre amongst maritime people has been attributed to the inclusion of seaweeds in their diet.<sup>(3,4)</sup> Similarly, the traditional use of *Fucus vesiculosus* in 'slimming teas' is thought to be attributable to the effect of iodine on hypothyroidism.<sup>(4)</sup>

Extracts of various brown seaweeds including *Ascophyllum nodosum* and *Fucus vesiculosus* have been reported to exhibit a high *in vitro* inhibitory activity towards mammalian digestive enzymes ( $\alpha$ -amylase, trypsin and lipase) isolated from the porcine pancreas.<sup>(6)</sup> Activity was attributed to high molecular weight (30 000–100 000) polyphenols.<sup>(6)</sup>

Inhibitory effects of laminarin sulfate on lipid-aemia and atherosclerosis (*in vivo*, rabbit) have been partially attributed to the *in vitro* inhibition of lipid synthesis observed in cultured chick aortic cells.<sup>(7)</sup>

Hypotensive activity observed in rats intravenously administered extracts of commercial seaweed (*Laminaria* species) preparations has been attributed to their histamine content.<sup>(8)</sup> However, histamine concentrations varied considerably between preparations, and authentic specimens of the *Laminaria* species were devoid of histamine.

Kelp extracts have antiviral activity<sup>(9)</sup> and laminarin is reported to have exhibited some tumour-inhibiting actions.<sup>(1)</sup>

### Side-effects, Toxicity

Hyperthyroidism has been associated with the ingestion of kelp and is attributable to the iodine content in the plant.<sup>(10,11)</sup> Typical symptoms of hyperthyroidism (weight loss, sweating, fatigue, frequent soft stools) were exhibited by a 72-year-old woman following ingestion of a commercial kelp product for six months.<sup>(10)</sup> Laboratory tests confirmed the hyperthyroidism although no pre-existing evidence of thyroid disease was found and the condition resolved in six months following discontinuation of the tablets. Analysis of the kelp tablets reported an iodine content of 0.7 mg/tablet representing a daily intake of 2.8–4.2 mg iodine.<sup>(10)</sup> Clinically evident hyperthyroidism developed in an otherwise healthy woman following the daily ingestion of six 200-mg kelp tablets.<sup>(11)</sup> Symptoms gradually resolved on cessation of therapy.

The association between halogen salts and acneiform eruptions is well established.<sup>(12)</sup> Ingestion of kelp products has been associated with the worsening of pre-existing acne and the development of acneiform eruptions, which improved following withdrawal of the tablets.<sup>(12)</sup>

The ability of marine plants to accumulate heavy metals and other toxic elements is recognised, and the uptake of various radioactive compounds by seaweeds has been reported.<sup>(3,13,14)</sup> Fifteen samples of kelp-containing dietary supplements have been analysed for their iodine and arsenic contents.<sup>(15)</sup> The levels of arsenic were low in all but one product. The

iodine levels varied widely, even between different samples of the same product, and in some products the iodine levels were high in relation to safe daily intake.

Brown algae (*Ascophyllum nodosum* and *Fucus vesiculosus*) have been found to be capable of synthesising volatile halogenated organic compounds (VHOCs).<sup>(16)</sup> VHOCs are considered to be troublesome pollutants because land plants and animals have difficulty in degrading the compounds which consequently persist in terrestrial ecosystems.<sup>(16)</sup> VHOCs released into the seawater predominantly contain bromine with iodine-containing compounds showing a slower rate of turnover.<sup>(16)</sup> Concentration of iron by brown seaweeds has been attributed to fucoidan, and alginic acid exhibits a high specificity for the binding of strontium.<sup>(13)</sup> Elevated urinary arsenic concentrations (138 and 293  $\mu\text{g}/24$  hour) in two female patients have been associated with the ingestion of kelp tablets. Subsequent analysis of the arsenic content of various kelp preparations revealed concentrations ranging from 16 to 58  $\mu\text{g}/\text{g}$  product.<sup>(17,18)</sup> The botanical source of the kelp in the products was not stated.<sup>(18)</sup>

*Ascophyllum nodosum* is commonly added to animal foodstuffs as a source of vitamin and minerals, with beneficial results reported for dairy cattle, sheep, pigs and poultry.<sup>(13)</sup> Feeding studies using *A. nodosum* have highlighted an atypical toxic response for rabbits compared with that of rats and pigs.<sup>(13,19)</sup> Addition of *A. nodosum* to the diet of rabbits (at 5–10%) caused a severe drop in haemoglobin content, serum iron concentrations and packed cell volume, leading to weight loss and death in two-thirds of the animals.<sup>(13)</sup> No differences in renal and liver function, and in lipid metabolism were found between test and control animals.<sup>(13)</sup> Similar, but much milder, toxicity has also been observed in rabbits fed *Fucus serratus*.<sup>(19)</sup> Subsequent studies incorporating *A. nodosum* into the feed of rats and pigs failed to demonstrate the toxic effects observed in rabbits.<sup>(19)</sup> The toxic components in *A. nodosum* have been reported to be non-extractable with chloroform, ethanol, water and 20% sodium carbonate solution, remaining in the insoluble residue.<sup>(19)</sup>

### Contra-indications, Warnings

The iodine content in kelp may cause hyper- or hypothyroidism and may interfere with existing treatment for abnormal thyroid function. In view of this, ingestion of kelp preparations by children is inadvisable. The iodine content in kelp has also been associated with acneiform eruptions and aggravation of pre-existing acne. In general, brown sea-

weeds are known to concentrate various heavy metals and other toxic elements. Elevated urinary arsenic concentrations have been traced to the ingestion of kelp tablets. Prolonged ingestion of kelp may reduce gastrointestinal iron absorption (binding properties of fucoidan), resulting in a slow reduction in haemoglobin, packed cell volume and serum iron concentrations. Prolonged ingestion may also affect absorption of sodium and potassium ions (alginic acid) and cause diarrhoea.

**Pregnancy and lactation** The safe use of kelp products during pregnancy and lactation has not been established. In view of the potential actions on the thyroid gland and possible contamination with toxic elements, the use of kelp should be avoided.

### Pharmaceutical Comment

Kelp is a generic term that strictly speaking refers to *Laminaria* and *Macrocystis* species of brown seaweeds, although in practice it may be used in reference to other species of brown algae including *Nereocystis* and *Fucus*. The species *Fucus vesiculosus* is reported to be commonly used in the preparation of kelp products.<sup>(G60)</sup> The principal constituents of seaweeds are polysaccharides. For brown seaweeds the major polysaccharide is alginic acid (algin). Fucoidan, present in all brown algae, is thought to refer to a number of related polysaccharide esters whose main sugar component is fucose. The traditional uses of kelp in obesity and goitre are presumably attributable to the iodine content, although the self-diagnosis and treatment of these conditions with a herbal remedy is not suitable. There have been no documented studies supporting the traditional use of kelp in rheumatic conditions. In view of the iodine content and potential accumulation of toxic elements, excessive ingestion of kelp is inadvisable. Doubt over the quality of commercial seaweed preparations has been reported.<sup>(10)</sup>

### References

See also General References G2, G6, G9, G11, G15, G16, G21, G28, G36, G37, G43, G48, G60 and G64.

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