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Committee on Herbal Medicinal Products (HMPC)

List of references supporting the assessment of *Fucus vesiculosus* L., thallus

Final

The European Medicines Agency acknowledges that copies of the underlying works used to produce this monograph were provided for research only with exclusion of any commercial purpose.

Abidov M, Ramazonov Z, Seifulla R, Grachev S. The effects of Xanthigen in the weight management of obese premenopausal women with non-alcoholic fatty liver disease and normal liver fat. *Diabetes Obes Metab* 2010, 12:72-81

Aisa Y, Miyakawa Y, Nakazato T, Shibata H, Saito K, Ikeda Y, Kizaki M. Fucoidan induces apoptosis of human HS-Sultan cells accompanied by activation of caspase-3 and down-regulation of ERK pathways. *AmJ Hematol* 2005, 78:7-14

Aksenov DV, Kaplun VV, Tertov VV, Sobenin IA, Orekhov AN. Effect of plant extracts on trans-sialidase activity in human blood plasma. *Bull Exp Biol Med* 2007, 143:46-50

Ale MT, Maruyama H, Tamauchi H, Mikkelsen JD., Meyer AS. Fucose containing sulfated polysaccharides from brown seaweeds inhibit proliferation of melanoma cells and induce apoptosis by activation of caspase-3 *in vitro*. *Mar Drugs* 2011, 9:2605-2621

Ale MT, Maruyama H, Tamauchi H, Mikkelsen JD, Meyer AS. Fucoidan from *Sargassum* sp. and *Fucus vesiculosus* reduces cell viability of lung carcinoma and melanoma cells *in vitro* and activates natural killer cells in mice *in vivo*. *Int J Biol Macromol* 2011, 49:331-336

Andersson M, de Benoist B, Darnton-Hill I, Delange F. Iodine deficiency in Europe: a continuing public health problem. World Health Organization, Geneva 2007, 21-25

Amster E, Tiwary A, Schenker MB. Case report: potential arsenic toxicosis secondary to herbal kelp supplement. *Environ Health Perspect* 2007, 115(4):606-608

Angulo Y, Lomonte B. Inhibitory effect of fucoidan on the activities of crotaline snake venom myotoxic phospholipase A2. *Biochem Pharmacol* 2003, 66:1993-2000

Arbaizar B, Llorca J. *Fucus vesiculosus* induced hyperthyroidism in a patient undergoing concomitant treatment with lithium. *Actas Esp Psiquiatr* 2011, 39(6):401-403



- Arum SM, He X, Braverman LE. Excess iodine from an unexpected source. *N Eng J Med* 2009, 360: 424-426
- Barnes J, Anderson AA, Phillipson JD. Herbal medicines. 3rd ed. Pharmaceutical Press London, Chicago 2007, 273-275
- British Herbal Compendium. Vol. 1. British Herbal Medicine Association, Dorset 1992, 37-39
- British Herbal Pharmacopoeia. Consolidated edition. British Herbal Medicine Association, Bournemouth, 1983
- Byun YY, Kim MH, Yoo ES, Hwang KK, Jee, Y, Shin T, Joo HG. Radioprotective effects of fucoidan on bone marrow cells: improvement of the cell survival and immunoreactivity. *J Vet Sci* 2008, 9(4):359-365
- Choi EM, Kim AJ, Kim YO, Hwang JK. Immunomodulating activity of arabinogalactan and fucoidan *in vitro*. *J Med Food* 2005, 8:446-453
- Clark CD, Bassett B Burge MR. Effects of kelp supplementation on thyroid function in euthyroid subjects. *Endocr Pract* 2003, 9(5):363-369
- Cumashi A, Ushakova NA, Preobrazhenskaya ME, D'Incecco A, Piccoli A, Totani L et al. A comparative study of the anti-inflammatory, anticoagulant, antiangiogenic, and antiadhesive activities of nine different fucoidans from brown seaweeds. *Glycobiology* 2007, 17(5):541-552
- de Azevedo TCG, Bezerra MEB, Santos MDGL, Souza LA, Marques CT, Benevides, NMB, Leite EL. Heparinoids algal and their anticoagulant, hemorrhagic activities and platelet aggregation. *Biomed Pharmacother* 2009, 63:477-483
- De Smet PAGM, Keller K, Hänsel R, Chandler RF. Adverse effects of herbal drugs 3rd ed. Springer Verlag Berlin Heidelberg 1997, 37-50
- De Smet PAGM, Keller K, Hänsel R, Chandler RF. Adverse effects of herbal drugs. 2nd ed. Springer Verlag Berlin Heidelberg 1993, 43-44
- Delfosse M. Drogues végétales et plantes médicinales. APB. Service scientifique, 1998, 208-209 [French]
- Diaz-Rubio ME, Perez-Jimenez J, Saura-Calixto F. Dietary fiber and antioxidant capacity in *Fucus vesiculosus* products. *Int J Food Sci Nutr* 2009, 60(2):23-34
- DiPiro JT, Talbert RL, Yee GC, Hatzke GR, Wells BG, Posey LM. Pharmacotherapy: A Pathophysiologic Approach. 6th ed. McGraw-Hill Medical Publishing, 2005
- Dürig J, Bruhn T, Zurborn KH, Gutensohn K, Bruhn HD, Beress L. Anticoagulant fucoidan fractions from *Fucus vesiculosus* induce platelet activation *in vitro*. *Thromb Res* 1997, 85(6):479-791
- EFSA. Tolerable upper intake levels of vitamins and minerals. European Food Safety Authority, 2006 135-150
- Eliason BC. Transient hyperthyroidism in a patient taking dietary supplements containing kelp. *J Am Board Fam Pract* 1998, 11:478-480
- European Pharmacopoeia 7th ed. Fucus. Council of Europe. 01/2008:1426
- Fabricant D. Arsenic in herbal kelp supplements: concentration, regulations, and labelling. *Environ Health Perspect* 2007, 115(12):576-577

- Fujimura T, Shibuya Y, Moriwaki S, Tsukahara K, Kitahara T, Sano T et al. Fucoidan is the active component of *Fucus vesiculosus* that promotes contraction of fibroblast-populated collagen gels. *Biol Pharm Bull* 2000, 23:1180-1184
- Fujimura T, Tsukahara K, Moriwaki S, Kitahara T, Sano T, Takema Y. Treatment of human skin with an extract of *Fucus vesiculosus* changes its thickness and mechanical properties. *J Cosmet Sci* 2002, 53:1-9
- Katzung BG. Basic and Clinical Pharmacology. 9th ed. Lange Medical Books, McGraw-Hill, New York 2004, 625-640
- Hänsel R, Keller K, Rimpler H, Schneider G. Drogen E-O. Springer Verlag Berlin Heidelberg 1993, 200-206 [German]
- Hyun JH, Kim SC, Kang JI, Kim MK, Boo -J, Kwon JM. Apoptosis inducing activity of fucoidan in HCT-15 colon carcinoma cells. *Biol Pharm Bull* 2009, 32:1760-1764
- Kim MH, Joo HG. Immunostimulatory effects of fucoidan on bone marrow-derived dendritic cells. *Immunol Lett* 2008, 115:138-143
- Kwak KW, Cho KS, Hahn OJ, Lee KH, Lee BY, Ko JJ, Chung KH. Biological effects of fucoidan isolated from *Fucus vesiculosus* on thrombosis and vascular cells. *Korean J Hematol* 2010, 45:51-57
- Lamela M, Anca J, Villar R, Otero J, Calleja JM. Hypoglycaemic activity of several seaweed extracts. *J Ethnopharmacol* 1989, 27:35-43
- Liu H, Gu L. Phlorotannins from brown algae (*Fucus vesiculosus*) inhibited the formation of advanced glycation endproducts by scavenging reactive carbonyls. *J Agr Food Chem* 2012, 60:1326-1334
- Luyckx VA, Naicker S. Acute kidney injury associated with the use of traditional medicines. *Nat Clin Pract Nephrol* 2008, 4(12):664-671
- Morel JM, Perrey F, Lejeune R, Goetz PF. *Fucus vesiculosus* L. *Phytotherapie* 2005, 5:218-221
- Myers SP, O'Connor J, Fitton JH, Brooks L, Rolfe M, Connellan P, Wohlmuth H, Cheras P A, Morris C. A combined phase I and II open-label study on the effects of a seaweed extract nutrient complex on osteoarthritis. *Biologics* 2010, 4:33-44
- O'Sullivan AM, O'Callaghan YC, O'Grady MN, Queguineur B, Hanniffy D, Troy DJ et al. *In vitro* and cellular antioxidant activities of seaweed extracts prepared from five brown seaweeds harvested in spring from the west coast of Ireland. *Food Chem* 2011, 126:1064-1070
- Oomizu S, Yanase Y, Suzuki H, Kameyoshi Y, Hide M. Fucoidan prevents Cε germline transcription and NFκB p52 translocation for IgE production in B cells. *Biochem Bioph Res Cos* 2006, 350:501-507
- Parys S, Kehraus S, Krick A, Glombitza KW, Carmeli S, Klimo K et al. *In vitro* chemopreventive potential of fucophloretols from the brown algae *Fucus vesiculosus* L. by anti-oxidant activity and inhibition of selected cytochrome P450 enzymes. *Phytochemistry* 2010, 71:221-229
- Price JA, Sanny C, Shevlin D. Inhibition of mast cells by algae. *Journal of Medicinal Food* 2002, 5(4):205-210
- Pye KG, Kelsey SM, House IM, Newland AC. Severe dyserythropoiesis and autoimmune thrombocytopenia associated with ingestion of kelp supplements. *Lancet* 1992, 339:1540
- Queiroz KCS, Medeiros VP, Queiroz LS, Abreu LRD, Rocha HAO, Ferreira CV et al. Inhibition of reverse transcriptase activity of HIV by polysaccharides of brown algae. *Biomed Pharmacother* 2008, 62:303-307

- Rhee KH, Lee KH. Protective effects of fucoidan against γ radiation induced damage of blood cells. *Archives of Pharmacal Research* 2011, 34(4):645-651
- Ritter LS, Copeland JG, McDonagh PF. Fucoidin reduces coronary microvascular leukocyte accumulation early in reperfusion. *Ann Thorac Surg* 1998, 66:2063-2071
- Roy MC, Anguenot R, Fillion C, Beaulieu M, Bérubé J, Richard D. Effect of a commercially-available algal phlorotannins extract on digestive enzymes and carbohydrate absorption *in vivo*. *Food Res Intl* 2011, 44:3026-3029
- Rupérez P, Ahrazem O, Leal JA. Potential Antioxidant Capacity of Sulfated Polysaccharides from the Edible Marine Brown Seaweed *Fucus vesiculosus*. *J Agric Food Chem* 2002, 50:840-845
- SCF (Scientific Committee on Food). Opinion of the Scientific Committee on Food on the tolerable upper intake level of iodine. European Commission Health & Consumer Protection Directorate, October 2002
- Skibola CF. The effect of *Fucus vesiculosus*, an edible brown seaweed, upon menstrual cycle length and hormonal status in three pre-menopausal women: a case report. *BMC Complem Altern M* 2004, 4:10
- Skibola CF, Curry JD, VandeVoort C, Conley A, Smith MT. Brown kelp modulates endocrine hormones in female Sprague-Dawley rats and in human luteinized granulosa cells. *J Nutr* 2005, 135(2):296-300
- Sweetman SC. Martindale, The Complete Drug Reference. 36th ed. Pharmaceutical Press, London 2009, 2384
- Thring, TSA, Hili P, Naughton DP. Anti-collagenase, anti-elastase and anti-oxidant activities of extracts from 21 plants. *BMC Complem Altern M* 2009, 9:27
- Todd RG. Martindale, The Extra Pharmacopoeia. The Pharmaceutical Press, London 1967, 79
- Trento F, Cattaneo F, Pescador R, Porta R, Ferro L. Antithrombin activity of an algal polysaccharide. *Thromb Res* 2001, 102:457-465
- Tyler VE. The honest herbal: A sensible guide to the use of herbs and related remedies. 3rd ed. The Haworth Press, Inc. NY London Norwood Australia, 1993, 189-191, 344-345
- Ulbricht C, Basch E, Boon H, Conquer J, Costa D, Culwell S, et al. Seaweed, Kelp, Bladderwrack (*Fucus vesiculosus*). *Alternative and Complementary Therapies* 2013; 19(4): 217-230.
- Van Hellefont J. Phytotherapeutisch compendium. Algemene Pharmaceutische Bond, 1985, 254-255
- Veena CK, Josephine A, Preeth, SP, Varalakshmi P., Beneficial role of sulfated polysaccharides from edible seaweed *Fucus vesiculosus* in experimental hyperoxaluria. *Food Chem* 2007, 100:1552-1559
- Verhelst G. Groot Handboek Geneeskrachtige Planten. 4th ed. BVBA Mannavita, 2010: 262-264 [Dutch]
- Walkiw O, Douglas DE. Health food supplements prepared from kelp, a source of elevated urinary arsenic. *Clinical Toxicology* 1975, 8(3):325-331
- Weiss RF, Fintelmann V. Lehrbuch der Phytotherapie. 9th ed. Hippokrates Verlag GmbH, Stuttgart, 1999, 148-149 [German]
- Wichtl M. Herbal Drugs and Phytopharmaceuticals. Medpharm GmbH Scientific Publishers, 1994, 212-213
- Williamson E, Driver S, Baxter K. Stockley's Herbal Medicines Interactions. 1st ed. Pharmaceutical Press, 2009, 265-266

Yarnell E, Abascal K. Botanical medicine for thyroid regulation. *Alternative and Complementary Therapies* 2006, 12(3):107-112

Zaragoza MC, Lopez D, Saiz MP, Poquet M, Pérez J, Puig-Parellada P et al. Toxicity and antioxidant activity *in vitro* and *in vivo* of two *Fucus vesiculosus* extracts. *J Agr Food Chem* 2008, 56:7773-7780

Zimmermann M, Delange F. Iodine supplementation of pregnant women in Europe: a review and recommendations. *Eur J Clin Nutr* 2004, 58(7):979-984