

Current data and the growth of seaweed ingredients

The use of known, verifiable data to assist formulation and regulatory compliance

3. PREBIOTIC VALUE

From time to time we are pleased to provide our Partners and customers with information and research data which may be helpful in understanding and using seaweed in the development of products in nutrition, food and beverage applications.

Recently, probiotic assistance for the gut microflora has become the subject of heightened discussion, the world's largest study of the population microbiome has been set up in America and the UK, and gut health is on every nutrition therapist's agenda.

The evidence of several studies on the prebiotic nature of Seagreens' native wild seaweed species, has begun to fit into the wider picture of their nutritional benefits in the body and brain.

Seagreens has harvested and produced seaweed for human consumption at five

different locations in the British Isles and Nordic region over the past 20 years. It has

specialised in the production of brown Wrack seaweeds with comprehensively documented compositional profiles which include high levels of polysaccharides, soluble fibre and a very broad and useful nutrient profile.

This paper details some preliminary findings and more general considerations and will be updated in a future issue in this series.



This paper is intended to provide scientific and educational information. It is not intended to promote or sell any product. The statements herein have not been evaluated by the Food and Drug Administration. The ingredients discussed are not intended to diagnose, treat, cure, or prevent any disease.
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Contents

• Seagreens®: a nutritious prebiotic	2
• What are prebiotics?	2
• Why Seagreens can be a probiotic	4
• Conclusions	6

Seagreens®: a nutritious prebiotic

Seagreens® is a leading seaweed producer which over 20 years has developed particularly high standards of production, shown to retain high levels of nutrition in its seaweed ingredients. This has been shown to provide species that are effective prebiotics, beneficial and protective for gut health.

Seagreens seaweeds are sustainably wild harvested in the British Isles and Nordic region and prepared to human food standards. Independent research used 3 particularly nutritious brown wrack seaweed species provided in convenient forms for use in food and nutrition supplements and therapy.

Some markers of Seagreens Quality	Seagreens compared to seaweed not produced to Seagreens production standards ^f
Antioxidants	Over 3.5 times higher
Phenols	Over 3.5 times higher
Vitamin C	Over 16 times higher
Tannins	2 times higher

^fTypical analysis

Figure 1: *Seagreens quality seaweed is proven to be of higher nutritional quality than the same species, from the same locations, where production is not to the documented Seagreens standard.*

Seagreens is high in dietary fibres, high in antioxidants, and contains all the vitamin groups, minerals, trace elements and essential amino acids in a balanced and comprehensive natural whole food. This

review will investigate possible use of Seagreens as an effective prebiotic in human nutrition.

What are prebiotics?

A prebiotic is a component that is colonised and fermented by beneficial bacteria of the gut microflora, enhancing the growth of these bacteria and consequently maintain the health of the gut and the absorption capabilities of nutrients. Those foods and components of foods that make for good prebiotics must be able to pass through the stomach and small intestine without being broken down by the gastric acidity and enzyme activity. An ideal prebiotic must have following Criteria:

1. Short-chain carbohydrate (oligosaccharides) with low-digestibility and absorption (resistance to low pH gastric acid, enzymatic digestion and intestinal absorption).
2. Selective substrate for fermentation by the intestinal microbiota and stimulate their growth and activity.
3. Maintain healthier composition of the gut microflora.
4. Confer health benefits to the host.

It has been recommended that prebiotic should make up about 10% of the total energy requirement and about 20% of

the total volume of food ingested by humansⁱ.

The most studied non-digestible oligosaccharides are human milk oligosaccharides and non-milk derived galacto-oligosaccharides, fructo-oligosaccharides and inulin.

A suggested summary of mechanisms of prebiotic are presented in Table -1.

Table 1: Mechanism of action of commercially available prebiotic

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- Provides low molecular weight polysaccharides and oligosaccharides for carbohydrate fermenting probiotic bacteria and enhance their growth
 - High molecular weight polysaccharides increase faecal weight and boosts intestinal transit.
 - Decreases concentration of putrefactive, toxic, allergic, mutagenic, genotoxic substances or bacterial metabolites
 - Enhances detoxification of secondary bile acids and cancer-promoting enzymes
 - Increases acidification of colonic environment which decreases nitrogenous end-products and reductive enzymes; increases mineral solubility and uptake
 - Exerts antibacterial effect through release of short-chain fatty acids during fermentation processes.
 - Stimulates regeneration of intestinal epithelium
 - Increased expression carrier protein and enhances active absorption of mineral through the gut epithelium.
 - Reduces nitrogenous end-products and reductive enzymes
 - Enhances immunity and regulates mucin production
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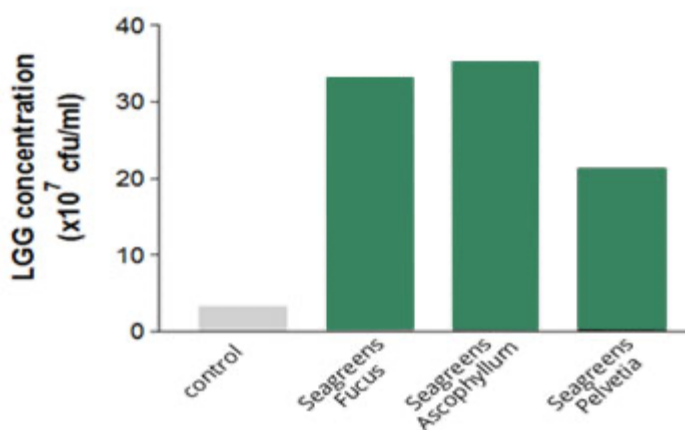
Table 2: Examples of health benefits in human associated with prebiotic intake:

Prebiotic	Source	Effect	Ref
Fucosylglycans from Human milk	Human milk	Reduced diarrheal incidence	Morrow, A. L. & Rangel, J. M. (2004) <i>Pediatr. Infect. Dis.</i> 15: 221-228.
Mix of oligofructose and inulin	Chicory root	Increased the levels of bifidobacteria early after the antibiotic therapy	Brunser et al (2006), <i>Pediatr Res</i> 59: 451-456
Lactulose	commercial	Significant reduction in colorectal cancer recurrence	Roncucci L et al (1993), <i>Dis Colon Rectum</i> ,36(3):227-34.
Mix of oligofructose and inulin	Chicory root	improve mineral absorption and impact markers of bone turnover in postmenopausal women	Holloway et al (2007), <i>British Journal of Nutrition</i> (2007), 97, 365-372
Mix of oligofructose and inulin	Chicory root	Reduced biochemical markers for inflammatory bowel disease	Casellas et al (2007) <i>Alimentary Pharmacology & Therapeutics</i> , vol 25(9), 1003-1134.

Xylooligosaccharides	commercial	Reduced glucose, HbA1c, total cholesterol, LDL, Ox-LDL and catalase activity in RBC	Sheu et al (2008), L Nutr Sci Vitaminol, 54, 396-401.
Oligofructose	commercial	Promoted weight loss and improved glucose regulation in overweight adults. It also modulated appetite associated hormones and reduction in energy intake.	Parnell and Reimer (2009) Am J Clin Nutr; 89:1751-9. Verhoel et al (2011), British Journal of Nutrition, 106, 757-1762

Why Seagreens® can be a prebiotic

Seagreens is produced to the Nutritious Food Seaweed standard, using techniques developed over more than 20 years. The products available are produced to enable convenient and easy addition to the daily diet, whether that is as Food Capsules, food ingredients or condiments. Independent research studies on the prebiotic value of Seagreens® are under way at Newcastle, Leeds and Dublin universities. Seaweed derived polysaccharides (hydrocolloids) have traditionally been used as thickening and gelling agents in food stuffs, medicine and other industrial applications.



Use of wholefood Seagreens species as effective prebiotics; demonstrated with *Lactobacillus* (LGG)
- Preliminary results

Seagreens are rich in dietary fibres from the high levels of polysaccharides present, which have shown to be resistant to gastric acidity, enzyme hydrolysis and absorption in the gastrointestinal tractⁱⁱ. As such, the polysaccharides present in Seagreens are ideal candidates as effective prebioticsⁱⁱⁱ but this yet to be elucidated in both in the laboratory setting using cell culture and animal model or in human subjects. Hitherto little is known about the chemical, physicochemical and fermentation characteristics of Seagreens fibre in the human gut. In particular, there is little information on the fermentation characteristics and potential beneficial effects of lower molecular weight derivatives of seaweed hydrocolloids and whether they exhibit similar properties to current commercially available oligosaccharides such as inulin, fructo-oligosaccharides (FOS), galacto-oligosaccharides (GOS) and lactulose in terms of stimulation of beneficial bacteria in the gut. Some bioactive compounds of seaweed with

possible effect on human are presented in the following table 3, all of which are present in the Seagreens® species.

Table 3: Some bioactive compounds of seaweeds with possible health benefits

Seaweeds	Bioactive compounds	Specific compounds	Possible health effects	References
<i>Pelvetia siliquosa</i>	Phlorotannin	fucosterol	Anti-diabetic	Lee et al., (2004), Archives of Pharmacal Research, 27, 1120-1122.
<i>E. cava</i>	Phlorotannin	Dieckol	Anti-oxidant	Heo et al., (2009), Toxicology in Vitro, 23, 1123-1130
<i>E. cava</i>	Phlorotannin	dioxinodehydroeckol	Anti-cancer	Kong et al., (2009) Food and Chemical Toxicology, 47, 1653-1658
<i>U. pinnatifida</i>	sulfated polysac		Anti-viral	Hemmingson et al., (2006), J. of Applied Phycology, 18, 185-193
<i>A. utricularis</i>	Fucoidan	Galactofuran	Anti-viral; Inhibitory against HSV 1 and 2	Ponce et al., (2003), Carbohydrate Research, 338, 153-165.
<i>Eisenia arborea</i>	Phlorotannin	Phlorofucofuroeckol-B	Anti-allergy	Sugiura et al., (2007), Food Sci and Tech Res 13, 54-60
<i>F. vesiculosus</i>	Fucoidan	sulphated fucose	Prevents chemotherapeutic agent-induced immunosuppression, anti-cancer	Jeong et al (2012), food and che Tox 50, 1480-1484.
<i>I. okamurae</i>	Phlorotannin	diphlorethohydroxycarmalol	Anti-diabetic	Heo et al., (2009), Eu J of Pharm, 615, 252e256
<i>M. myagroides</i>	fucoxanthin	carotenoids	Anti-inflammatory	Heo et al., (2010), Food and Che Tox, 48, 2045 -2051.
<i>U. pinnatifida.</i>	sulfated polysac		Anti-viral	Hemmingson et al., (2006), Applied Phycology, 18, 185-193
<i>S. vulgare,</i>	Alginic acid, xylofucans		Anti-tumor	de Souza, Marques et al. (2007), Carbohydrate Polymers, 69, 7-13

The Seagreens species *Ascophyllum nodosum* (with common names including Egg Wrack, Knotted Wrack, Rock Weed) has the highest polysaccharide content of between 42-70% dry weight^{iv} of all the brown seaweeds – the largest group of all the seaweeds. It is also among the most balanced nutritionally.

Studies to date on species produced by Seagreens are extremely positive, with examples including improved feed intake in post-weaning pigs, reduced diarrhoea, **increased presence of good bacteria (*Lactobacilli*) and reduced presence of bad bacteria (*E.Coli*)** when diets were supplemented with seaweed polysaccharides^v. Another example, in dairy cows, resulted in increased blood glucose for those supplemented with *Ascophyllum*, thought to be due to the **improved digestion** and utilisation of feed^{iv}.

Conclusions

An imbalance of probiotics has been seen in gastrointestinal disorders such as inflammatory bowel disease and cancer, and in the elderly. It is now well recognised that prebiotics can beneficially modulate the intestinal microbiota which is essential for the maintenance of a normal healthy gut. However, recent literature suggests that they can also be a therapeutic agent for treating different gastrointestinal disorders as well as in maintaining a healthy balance in the gut. So far there is little information about prebiotic products in the market.

The prebiotic potential of the Seagreens species is vast because of their sustainable abundance and year-round availability. There is evidence that its bioactive compounds are biologically effective as prebiotics *in vitro*. The information available on the prebiotic potential of seaweeds being fed to farm animals is also promising. Future work in

the area of seaweed-derived bioactive compounds should be aimed to elucidate the detail of molecular mechanisms to understand their actual potential.

For more information on the many health benefits of Seagreens, visit the *Seagreens Healthcare Summary*:
<http://www.seagreens.co.uk/University/SeagreensHealthcareInformation.aspx>

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References

- ⁱ Premysl, Fric (2007) *Probiotic and prebiotic-renaissance of a therapeutic principle*. CEJMed, 2(30), 237-270.
- ² Patel, S. & Goyal, A. (2012) *The current trends and future perspectives of prebiotics research: a review*. 3 Biotech, V2, pp. 115-125.
- ⁱⁱⁱ O'Sullivan, L., Murphy, B., McLoughlin, P., Duggan, P., Lawlor, P.G., Hughes, H. & Gardiner, G.E. (2010). *Prebiotics from Marine Macroalgae for Human and Animal Health Applications*. Marine Drugs, V8, pp. 2038-2064.
- ^{iv} Karatzia, M., Christaki, E., Bonos, E., Karatzias, C. & Paneri, P.F. (2012). *The influence of dietary Ascophyllum nodosum on haematological parameters of dairy cows*. Italian Journal of Animal Science, V11, pp169-173.
- ^v O'Doherty, J.V., McDonnell, P. & Figat, S. (2010). *The effect of dietary laminarin and fucoïdan in the diet of the weanling piglet on performance and selected faecal microbial populations*. Livestock Science, V34(1-3), pp 208-201.