

For professional use only

Seagreen's[®]

Certified Ingredients



*Shelf life
in sausages*



*Complexity in
flavouring*



*Reducing salt
in snacks*



*Stimulating
appetite*



*Regulating
weight*



*Lowering
glycemic
index*



About seaweed

Land-grown foods are highly specialised, each having a *narrow spectrum of nutrients*.

For this reason, a *wide daily variety* of land foods is needed for a balanced diet.

However, the spectrum of nutrients in seaweed can be so comprehensive that *it fills all the gaps in land foods*.

Certain seaweed species are rich in all the micronutrients and minerals.

Many of these must come from our daily food because the body doesn't 'manufacture' them.

A gram of seaweed each day provides all these nutrients.

Precisely what is missing from the average daily diet.

What to look for

There are many seaweed producers worldwide, but few produce to any consistent standard for human consumption. Native European species are increasingly available.

The reality of most production is rejected material, interruptions during manufacturing, regulatory obstacles, and continuing risk of recall.

How can you determine nutritional and physical quality? How well is it documented?

Look for magnetic metallic or insoluble particles, allergenic or toxic components. Ask for long term averages on critical markers like antioxidants, polyphenols, fatty acids and micro-vitamins. Avoid fossil fuels and heat in drying and milling.

Which species is best for your application?

Where are your markets?

Which ingredient *form* is best?

What are the options?

Consider market concerns like regulatory compliance and competitive advantage.

Perhaps *a distinctive blend of seaweeds* would make it difficult for others to copy your formula.



The level of data you can expect from most producers can be found in a good seaweed sourcebook.

And a *Certificate of Analysis* for any species should cover more than moisture, ash, basic microbials and heavy metals.

Value lies in long term nutrient data, absence of harmful contaminants, and international regulatory compliance.

Typical Seaweed Composition						
Protein	Carbohydrates	Fats	Vitamins		Minerals	
Enzymes	Monosaccharides	Monounsaturated	Water soluble	Fat soluble	Calcium	Manganese
Non-essential	Oligosaccharides	Polyunsaturated	B1	A	Iron	Copper
Amino Acids			B2	E	Iodine	Zinc
Essential	Polysaccharides	Omega-3	B3	K	Phosphorus	Cobalt
Amino acids		Fatty Acids	B6		Potassium	Molybdenum
			B12		Sodium	Chlorine
			C		Sulphur	Chromium
- Mouritsen O. G., 2013. 'Seaweeds. Edible, available & sustainable'					Magnesium	Selenium

Summary

- *A very small amount of nutritious dried seaweed in daily foods and supplements, can deliver disproportionate nutritional and therapeutic benefits.*
- *There are brown, red and green species, from very different sources. Most are for gourmet restaurants or farmed overseas for mass markets. Seaweed ingredients is an emerging industry. Examine quality and documentation, provenance and processing.*



About Seagreens®

Seagreens have been harvesting our most nutritious native species for 20 years at 5 remote locations in the British Isles and Nordic region, *solely for human consumption* – the UK's first Soil Association organic producer.


More than 10 years of comprehensive data and know-how, plus award-winning research, underpins *a unique product specification and level of quality assurance*.

Seagreens® ingredients have a known composition, are fully documented, and sustainable. Production is monitored by independent bodies and accredited analysis, *transparent to all brand customers*.

Today this is reflected in our BDA certified *Nutritious Food Seaweed standard*.

Stocks of fresh dried seaweed across a range of 15 ingredient products are held in the UK, USA and EU, exceeding 35,000 kgs – *produced to British Retail Consortium and this unique seaweed standard*.

Our nutritional data is unparalleled in this industry. *Customers use our know-how to assess market and product development opportunities*.



Seagreens have an outstanding balance of Omega 3, 6 and 9

*“The important Omega 3 and 6 long-chain fatty acids typically derived from fish oil, make up 1 – 5% of the dry matter in nine seaweeds analysed. Egg Wrack *Ascophyllum nodosum*, Toothed Wrack *Fucus serratus*, Kelp *Laminaria hyperborea*, Wakame *Undaria pinnifitada*, Carragheen *Chondrus crispus*, and Dulse *Palmaria palmata*, contained the highest proportion of these important PUFAs.”**

Seagreens® *Pelvetia* is even richer than Seagreens® *Ascophyllum

Seagreens® specific mineral comparison with other foods

mg/100g (dry weight)	Calcium	Potassium	Magnesium	Sodium	Copper	Iron	Iodine	Zinc
Seagreens <i>Ascophyllum</i>	1,350	1,820	826	3,440	0.10	14.20	71.20	4.39
Seagreens <i>Fucus</i>	1,090	1,880	687	2,890	0.15	14.20	52.20	3.52
Seagreens <i>Pelvetia</i>	1,140	2,220	876	4,150	0.15	18.40	24.30	1.87
Brown rice	110	1,160	520	28	1.3	12.9	NA	16.2
Whole milk	115	140	11	55	Tr	0.1	15	0.4
Cheddar cheese	720	77	25	670	0	0.3	39	2.3
Sirloin steak	9	260	16	49	0.1	1.6	6	3.1
Lentils green & brown	71	940	110	12	1	11.1	NA	3.9
Spinach	170	500	54	140	0	2.1	2	0.7
Bananas	6	400	34	1	0.1	0.3	8	0.2
Brazil nut	170	660	410	3	1.8	2.5	20	4.2
Peanuts	60	670	210	2	1	2.5	20	3.5

Values for whole foods other than Seagreens® from McCance et al (1993).¹⁶ Abbreviations: NA, no data available. Tr, trace

Seagreens® are comprehensively more nutrient dense

Fruit, veg and seaweed comparison – nutrient density in most nutrient dense species in class

Seagreens in a loaf of bread has approximately the same amount of vitamin B2 as 100g of blackberries or broccoli

Nutrient	Fruit	Vegetable	Seaweed
per 100g	Raw Blackberry	Boiled Broccoli	Seagreens® Dried <i>Ascophyllum</i>
Vitamin B1	0.02mg	0.05mg	0.03mg
Vitamin B2	0.05mg	0.05mg	0.75mg
Vitamin B3	0.5mg	0.70mg	2mg
Folate	34mcg	64mcg	60mcg
Vitamin C	15mg	44mg	125mg
Vitamin D	0mcg	0mcg	1mcg
Potassium	160mg	170mg	1820mg
Calcium	41mg	40mg	1350mg
Magnesium	23mg	13mg	830mg
Iron	0.07mg	1mg	57.5mg
Zinc	0.2mg	0.4mg	13mg
Selenium	trace	trace	15mcg

– Food Standards Agency 2008, Seagreens Healthcare Summary 2009

Dried seaweed contains: 15 times the vitamin B2, 3-4 times the vitamin B3, 3-8 times the vitamin C. 15 times the potassium, 50 times the calcium, 50 times the iron, 30 times the magnesium, an element in which a large proportion of the population is deficient and in which deficiencies are well correlated to high blood pressure. Many elements present in seaweed are not present in fruit and vegetables, namely B12, D and K, trace elements such as selenium and zinc, and polysaccharides such as algin, fucoidan, laminarin and mannuronic acid.

Application-specific data to formulate superfood blends

Seagreens® can provide guidance and information to NPD, QA, marketing and other members of your team.

Magnesium

Seagreens Ascophyllum 8.26mg/g

Seagreens Fucus 6.87mg/g

Seagreens Pelvetia 8.76mg/g

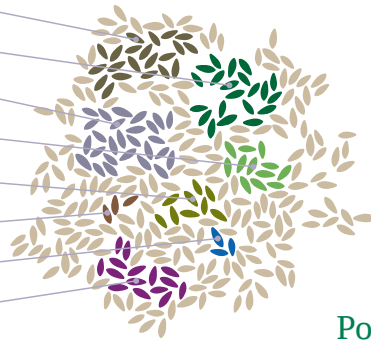
Spirulina 4mg/g

Chlorella 3mg/g

Barley Grass 1mg/g

Wheat Grass 1mg/g

Brown Rice 5.2mg/g



Calcium

Seagreens Ascophyllum 13.5mg/g

Seagreens Fucus 10.9mg/g

Seagreens Pelvetia 11.4mg/g

Spirulina 7mg/g

Chlorella 3mg/g

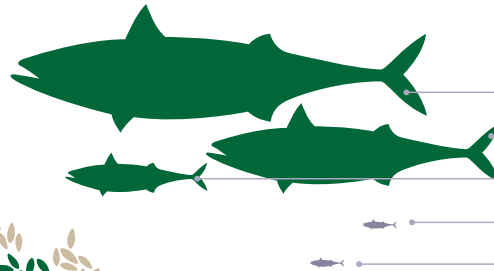
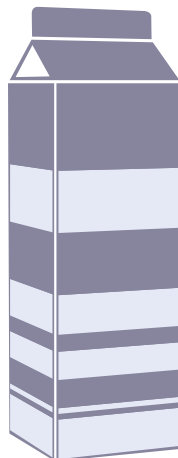
Barley Grass 5.2mg/g

Wheat Grass 5.2mg/g

Brown Rice 1.1mg/g

Whole Milk 1.15mg/g

Cheddar Cheese 7.2mg/g



Iodine

Seagreens Ascophyllum 0.712mcg/g

Seagreens Fucus 0.522mcg/g

Seagreens Pelvetia 0.243mcg/g

Whole Milk 0.0003mcg/g

Mackerel 0.001mcg/g

Potassium

Seagreens Ascophyllum 18mg/g

Seagreens Fucus 19mg/g

Seagreens Pelvetia 22mg/g

Spirulina 14mg/g

Chlorella 8mg/g



Seagreens® contain more minerals, trace elements, amino acids, vitamin groups, and a diverse range of antioxidants, polysaccharides, phenols and compound nutrients than other foods including superfoods that are 'best in class'.

Our seaweed ingredients blend well and taste good in green and superfood smoothies, juices and teas.

Nutrition and food research 2008-2019

Permitted health and nutrition claims and benefits may be used in connection with all of these study areas.

Antioxidant and detoxification studies

Published Seagreens research at Leeds, Newcastle and Sheffield Hallam universities.

“Fucus seaweed phlorotannins more effective radical scavengers than green tea”¹

Bacteriological studies as a natural preservative

Published Seagreens research at the Centre for Food Innovation, Sheffield.

“Wrack species reduce acidity and microbial count over shelf-life in sausages”²

Dental and oral hygiene research

Published species research in Japan, Sweden and the USA.

“US and Swedish patents on seaweed and alginate extract to reduce dental plaque”³

Iodine supplementation and thyroid studies

Published Seagreens research at Glasgow University.

“Effective at increasing UIC after 2 weeks with no adverse effect on thyroid function”⁴

Mental health and ageing research

Published international research reviews including Seagreens studies.

“May help ameliorate risk factors for dementia, depression & bipolar disorders”⁵

Prebiotic and digestive studies

Published Seagreens research at Leeds, Newcastle, and other universities.

“Significant evidence in the prevention and treatment of diabetes and obesity”¹

Salt replacement and cardiovascular studies

Published Seagreens research at the Sheffield Centre for Food Innovation and international peer reviewed studies.

“Seagreens® can be used to achieve salt levels below the recommended limit”^{2,6}

Umami and flavour studies

Published research at Copenhagen and Tohoku universities.

“Umami has been shown to significantly improve appetite in the elderly and infirm”⁷

Weight management and obesity studies

Published award-winning research at Sheffield Hallam University.

“Overweight males consumed over 16% less calories per day with no loss of nutrition”⁸

References

- ¹ **Chater PI, et al.** *Inhibitory activity of brown seaweeds on lipase activity.* Journal of Applied Phycology, 28:1303-1313, 2016. Also: **Wheater H.** *Release of polyphenols from brown seaweeds in vitro following enzymatic digestion.* Newcastle University, post-graduate dissertation ACE8095, 2012.
- ² **Fairclough A, et al.** *Wild wrack seaweed a replacement for sodium chloride in bread products.* Study series and Camden BRI presentation, Centre for Food Innovation, Sheffield Hallam University, 2010. Research broadened to various foods, endorsed by UK Research Councils, Big Ideas For The Future, 2012.
- ³ *Merck in the US and Swedencare in Sweden hold long-standing patents for reducing and inhibiting dental plaque and calculus using in one an extracted sodium alginate formulation and in the other a particular whole ground seaweed species. Seagreens® has also been used successfully since 2002 as a detoxifier in dental mercury amalgam extraction.*
- ⁴ **Combet E, et al.** *Low-level seaweed supplementation improves iodine status in iodine-insufficient women.* British Journal of Nutrition, 9:1-9, 2014. Further research: Seagreens *Current data and the growth of seaweed ingredients.* Issue 2 - Iodine, 2018.
- ⁵ **Cornish ML, et al.** *Consumption of seaweeds and the human brain.* Journal of Applied Phycology, Vol. 29 No. 5:2377-2398, 2017.
- ⁶ **Cornish ML, et al.** *A role for dietary macroalgae in the amelioration of certain risk factors associated with cardiovascular disease.* Phycologia, Vol. 54(6):649-666, 2015.
- ⁷ **Sasano T, et al.** *Umami in oral and overall health.* Flavour, 4:10, 2015. Also: **Mouritsen OG, et al.** *Umami taste, free amino acid composition, and volatile compounds of brown seaweeds.* Journal of Applied Phycology, Vol. 31, Issue 2:1213-1232, 2019.
- ⁸ **Hall AC, et al.** *Ascophyllum enriched bread reduces subsequent energy intake with no effect on post-prandial glucose and cholesterol in healthy, overweight males.* Journal of Appetite, 58:379-386, 2012.

Dedication to quality

Producing nutritious food seaweed as ingredients which can deliver on these exciting research findings, has been our business goal since 1998 – ‘*a gram of the best seaweed in the daily diet*’.

Every aspect of production is subjected to continuous analysis – nutrient and contaminant groups, allergens and microbials, physical properties like moisture and particle size.

Against benchmarks set and gradually improved over many years, this ongoing data enables us to spot compositional changes and trends, and by skilled interpretation, amend our production parameters and procedures to maintain our very high standards.

Markers of Quality	Seagreens® compared in 2011 to the same species not produced to Seagreens proprietary standards (Sheffield Hallam University)
Vitamin C	Vitamin C 16 times higher
Tannins	Tannins 2 times higher
Antioxidants	Antioxidants 3.5 times higher
Phenols	Phenols 3.5 times higher
Silicon	Silicon 4.5 times lower

Nutrient Data - averages over 10 years from 2008-2018

	Specification	Measure	All <i>Ascophyllum</i> to 2016	All <i>Fucus vesiculosus</i>	All Scotland <i>Ascophyllum</i>	<i>Ascophyllum</i> since 2016
Nutrients - markers						
Iodine	700	µg/g	781.750	424.714	735.222	921.33
Vitamin C	>6	mg/100g	12.320	7.650	5.490	28.475
Polyphenols	>1500	mg/kg	27,954.833	26,596.667	25,780.000	29,784.500
Tannins	TBA	g/100g	3.667	4.000	4.500	-
Silicon	TBA	mg/kg	75.116	123.597	83.283	-
Moisture	<14	%	11.591	11.056	12.715	5.970
Total phenolics (Gallic Acid equiv)	TBA	mg/g	29.343	144.495	28.850	-
Antioxidant capacity ORAC	TBA	µmole/TE/g	72.455	244.495	201.667	-
<i>Particle size</i>	TBA	% <0.6mm	-	-	-	-
Amino acids						
Alanine	TBA	g/kg	0.177	0.241	-	-
Arginine	TBA	g/kg	0.115	0.150	-	-
Asparagine	TBA	g/kg	-	0.250	-	-
Aspartic acid	TBA	g/kg				
Cystine	TBA	g/kg				
Cystathionine (free)	TBA	g/kg				
Glutamic acid	TBA	g/kg				
Glutamine (free)	TBA	g/kg				
Glycine	TBA	g/kg				

This table shows typical improvements made in nutritional values over the past decade.

Vitamin C up a further 131%

Polyphenols up a further 6.5%

(part of spreadsheet)

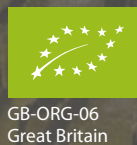
Contaminant Data - averages over 10 years from 2008-2018

	Specification	Measure	All <i>Ascophyllum</i> to 2016	All <i>Fucus vesiculosus</i>	All Scotland <i>Ascophyllum</i>	<i>Ascophyllum</i> since 2016
Heavy metals						
Arsenic (total)	None	mg/kg	28.375	47.008	28.771	26.594
Arsenic (inorganic)	≤1	mg/kg	0.324	0.291	0.360	0.310
Cadmium (EU Reg is ≤3)	≤1	mg/kg	0.551	0.820	0.385	0.686
Lead	≤3	mg/kg	0.675	0.891	0.785	0.534
Mercury	≤0.1	mg/kg	0.026	0.014	0.030	0.020
Aluminium	None	mg/kg	-	-	-	-
Microbiology						
Total Plate Count	≤10000	cfu/g	231.875	29.091	287.273	183.333
Coliforms	≤100	cfu/g	12.733	16.364	17.000	7.000
Yeast and mould	≤1000	cfu/g	63.875	73.636	74.545	67.333
Enterobacteriaceae	≤10	cfu/g	6.867	16.364	8.100	7.333
Escherichia coli	≤10	cfu/g	6.067	8.182	7.000	7.000
Staphylococcus aureus	≤10	cfu/g	8.000	25.455	9.000	10.000
Salmonella	ND	cfu/25g	-	-	-	-
Vibrio species	ND	cfu/25g	-	-	-	-
Contaminants						
Pesticide residues	≤0.01	mg/kg	0.001	0.003	0.003	-
Aromatic hydrocarbons PAH4	≤50	µg/kg	18.40	9.160	27.000	6.700
<i>Radioactivity</i>						
Activity in Cesium 134	TBA	Bq/kg	Correspondingly in the 10 year contaminant profile Polyaromatic hydrocarbons reduced by more than 60%.			
Activity in Cesium 137	TBA	Bq/kg				

(part of spreadsheet)

Summary

- *Seagreens® means you know what you are using. 15 ingredient forms of 5 brown and red native species from stock, to a consistently high standard. The world's broadest range of quality seaweed ingredients.*
- *No other wild seaweeds for human consumption also deliver Seagreens' experience, know-how and data. Seagreens has pioneered the production of nutritious food seaweed, resulting in BRC accredited processing and UKAS accredited certification to the independent Nutritious Food Seaweed standard.*



Choosing your seaweed ingredient

Whichever species is suitable for your product, a range of different forms is available.

This example shows various forms of Seagreens® *Palmaria palmata* (Dulse).

It is also possible to blend different species to achieve your product goals.



Dulse



Dulse - Large pieces



Dulse - Chopped pieces



Dulse - Medium granules



Dulse - Fine granules



A finished product for Waitrose.



Pioneering nutritious food seaweed since 1998

Seaweed production is characterised by 2 conventional models – industrial and artisan.

Seagreens® has been the innovator, combining traditional and new methods and technologies.

Seagreens unique business model is an international consortium of independent partners, which extends from production to markets through consulting, contract manufacturing, and customer brand partnerships.

Industrial scale	Artisan production	Seagreens®
Rapid heat drying Low nutrient values Fossil fuels	Ambient air drying Inconsistent nutrient values Some fossil fuels	Ambient air circulation technology, ground source heat, no fossil fuels, high nutrient values
Very large volumes	Very small volumes	All volumes, from stock
Markets in agriculture, horticulture and seaweed extracts	Gourmet and fine foods	Food and nutrition ingredients
Single or few species, low standard	Many species, variable standard	5 'nutritious' species to a consistently high standard
No nutrition research	No nutrition research	Leading nutrition research
Limited analytical data	Limited analytical data	Comprehensive 10+ years data
No regulatory food use	Variable regulatory status	International regulatory compliance & standards
Very cheap	Very expensive	Competitive ingredient pricing
Single site harvesting	Single area of shoreline	5 remote harvesting locations British Isles and Nordic region
Some organic	Many organic	Fully certified BRC, NFS, Organic and for niche markets eg. Kosher

A large-scale indoor seaweed cultivation facility. The image shows a long, narrow aisle formed by rows of yellow pipes and black tubes, likely used for growing seaweed. The structure is supported by a complex network of metal beams and arches, creating a tunnel-like effect. The lighting is bright and even, highlighting the industrial nature of the setup.

Cultivated seaweeds

A fourth model is emerging, but no current exemplars are commercially viable.

The problem with cultivation, as with any farm produce, is that when you cultivate and then harvest a crop, you suddenly have a large volume of seaweed to sell.

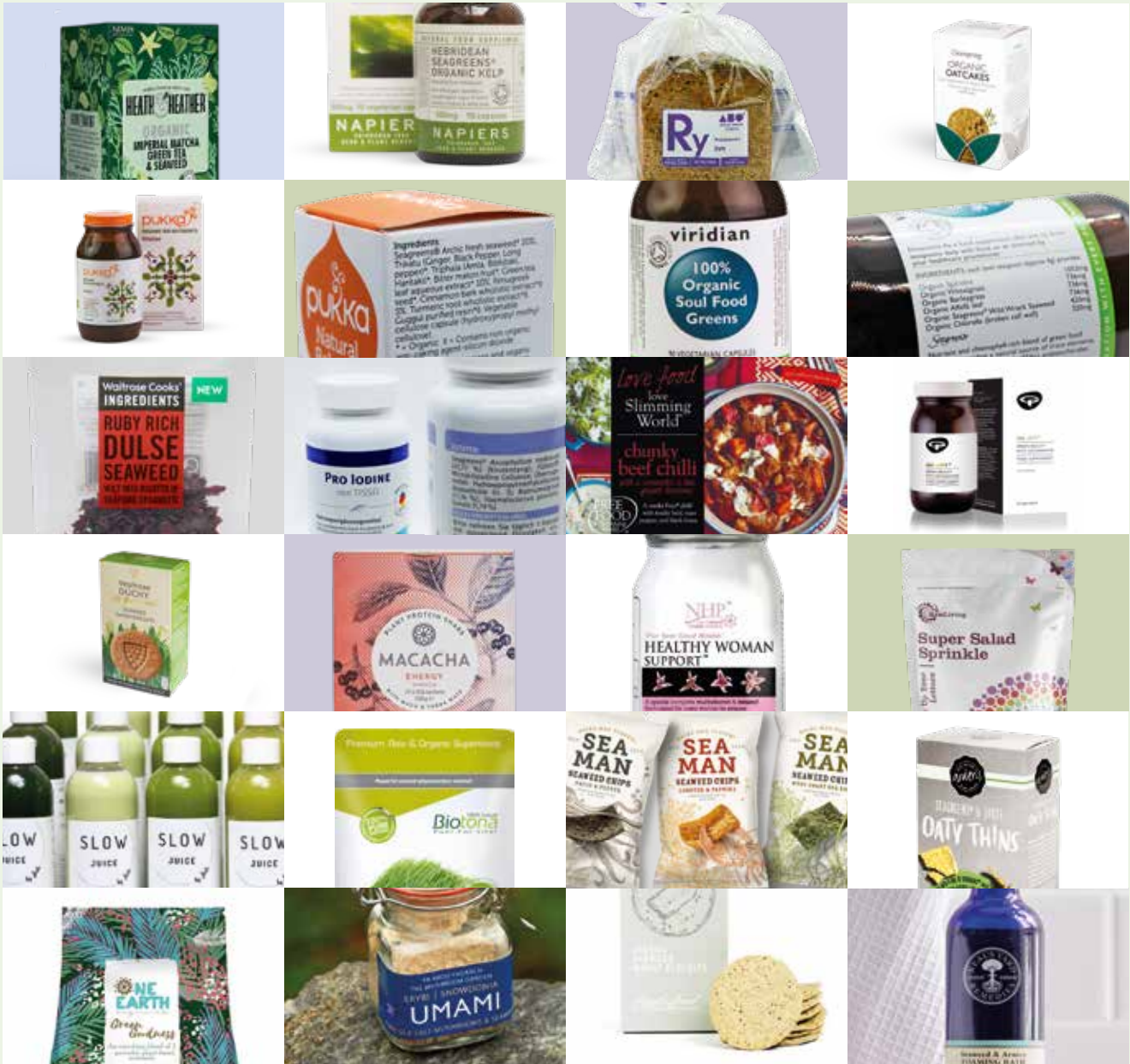
It cannot simply be left ‘in the field’ to spoil. But the markets are still relatively small, so ‘dumping’ at low prices defeats the object.

Cultivation technology is embryonic and many crops have failed. It is an expensive model and so far offers no significant advantage over wild harvesting.

Seagreens is nevertheless involved in developmental projects in Britain and the Nordic region. If and when the time comes, the brand will deliver, as it has done for 20 years.

Commitment leads to brand partnership

Most customers identify Seagreens® as their seaweed ingredient, and we actively promote these products.



Summary

- 20 years in production specifically for human consumption
- 10 years leading nutrition research and compositional data
- Awarded for sustainable production, products and research
- 15 nutritious ingredients from 5 seaweed species

- 1kg to 5,000kg available from stock with global distribution
- Price consistency and equivalence in worldwide markets
- Respected international brand name for use by customers
- First British seaweed producer certified Organic in 1998
- First certified to Nutritious Food Seaweed Standard 2016



Who to contact

For help in
selecting the
right species
& form of
ingredient



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*Nutrients for
free from foods*



*Making a
meal of soups*



*Balancing salt
for breakfast*



*Mineralising
men & women*



*Oral and
topical nutrition*



*Supernutrients
for smoothies*

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Known for nutrition