
Seagreens®
Pioneering Nutritious Food Seaweed since 1998

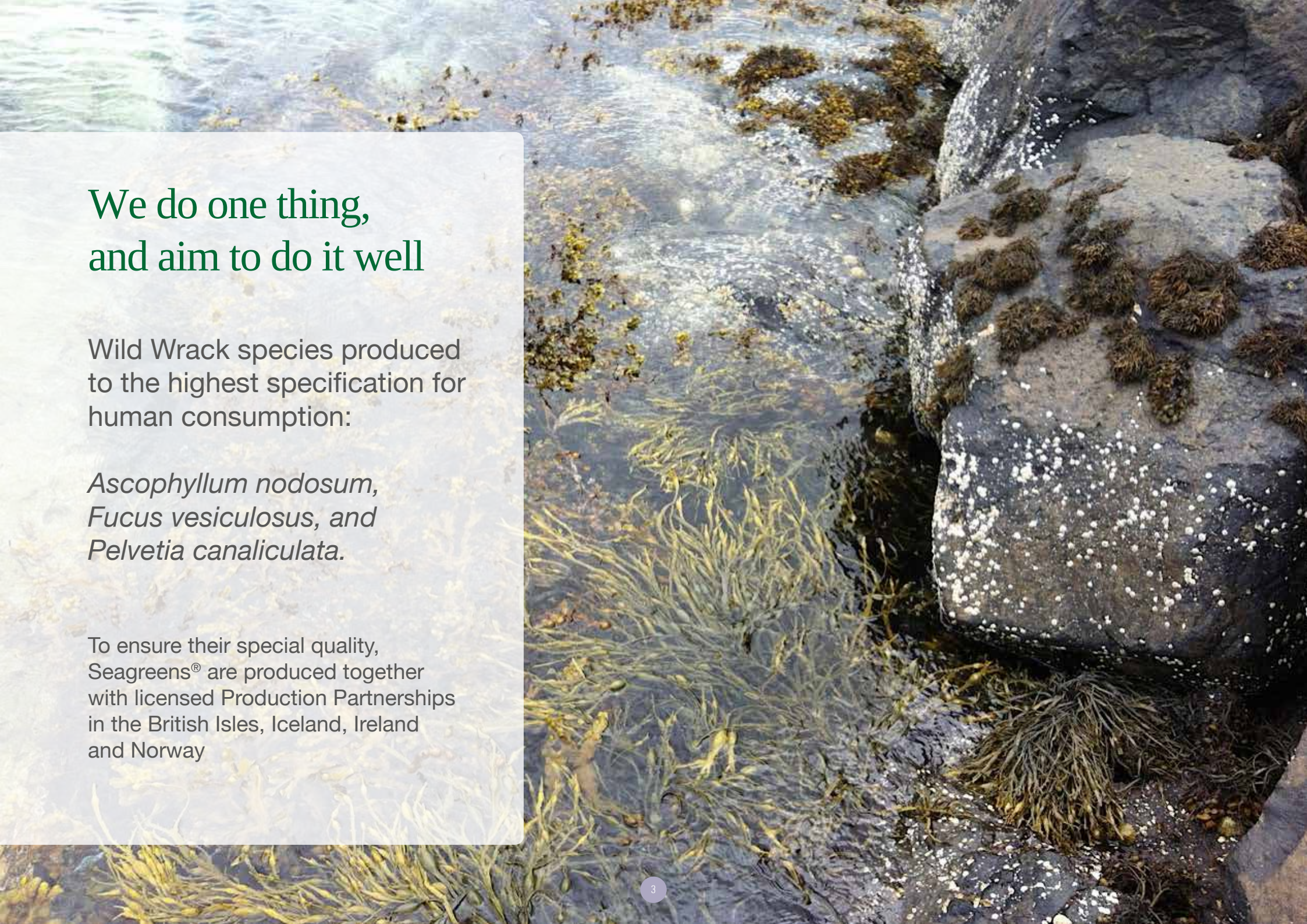
For professional use only

The way we make them, Seagreens® are easily included in the daily diet or therapeutic protocol. Behind the iconic green jars in natural food stores and clinics, our research continues. Seagreens® is food for health.

For retail trade ordering, please contact Seagreens Trade Direct on **01342 888095**. Practitioner accounts are serviced by Natural Dispensary on **01453 757792**.

For nutrition information or any other queries please call **01444 400403** (from outside the UK **+44 1444 400403**) or email us at **info@seagreens.co.uk**

www.seagreens.co.uk



We do one thing, and aim to do it well

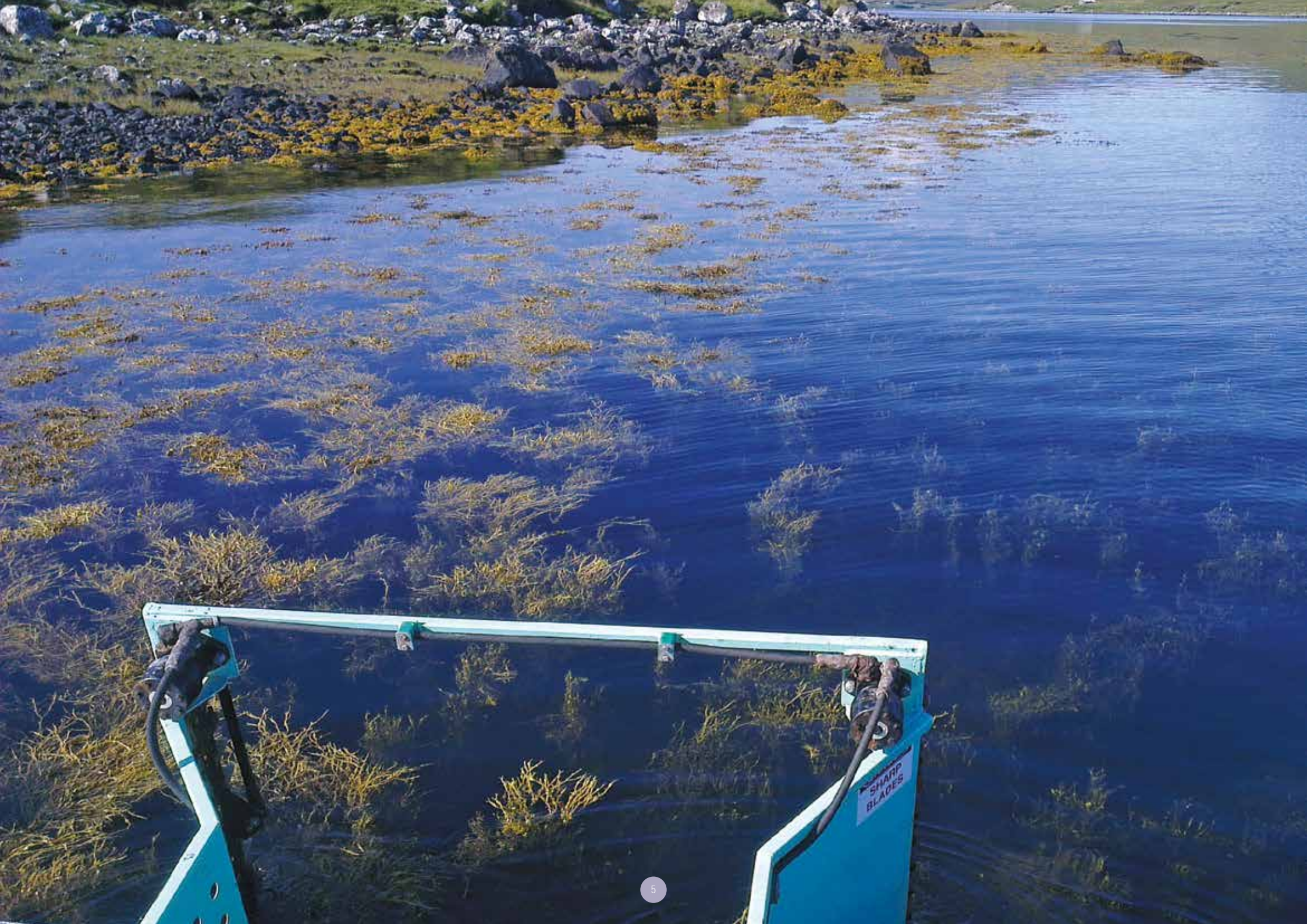
Wild Wrack species produced to the highest specification for human consumption:

Ascophyllum nodosum, Fucus vesiculosus, and Pelvetia canaliculata.

To ensure their special quality, Seagreens® are produced together with licensed Production Partnerships in the British Isles, Iceland, Ireland and Norway

Harvesting wild Wrack species *Ascophyllum nodosum* – Knotted Wrack

Loch Seaforth, Isle of Lewis
September harvest 2013


SHARP
BLADES

The range of products is unrivalled – customers worldwide

Unique ingredients developed over two decades

Selection	Water and environment certified clean, single species, plants prior cut
Harvesting	Known and consistent growth; documented, monitored, sustainable
Handling	Clean bagging and transport, optimum time to processing
Processing	Food facility, consistent moisture content & particle size, metal detection
Regulatory	Analytical conformity, GFSI, HACCP, GMP, BRC, MSDS, batch traceability
Nutrition	Uniquely certified nutritional profile, batch tested free from harmful allergens, pesticides, toxins, petrochemicals, nothing added or extracted
International	Nutritious Food Seaweed certified by the Biodynamic Association
Niche markets	Organic, kosher, halal, raw food, vegan compliant. No irradiation
Brand	International trade mark, registrations pending in all key markets
Research	World leader in applied nutrition research on Wrack species since 2008

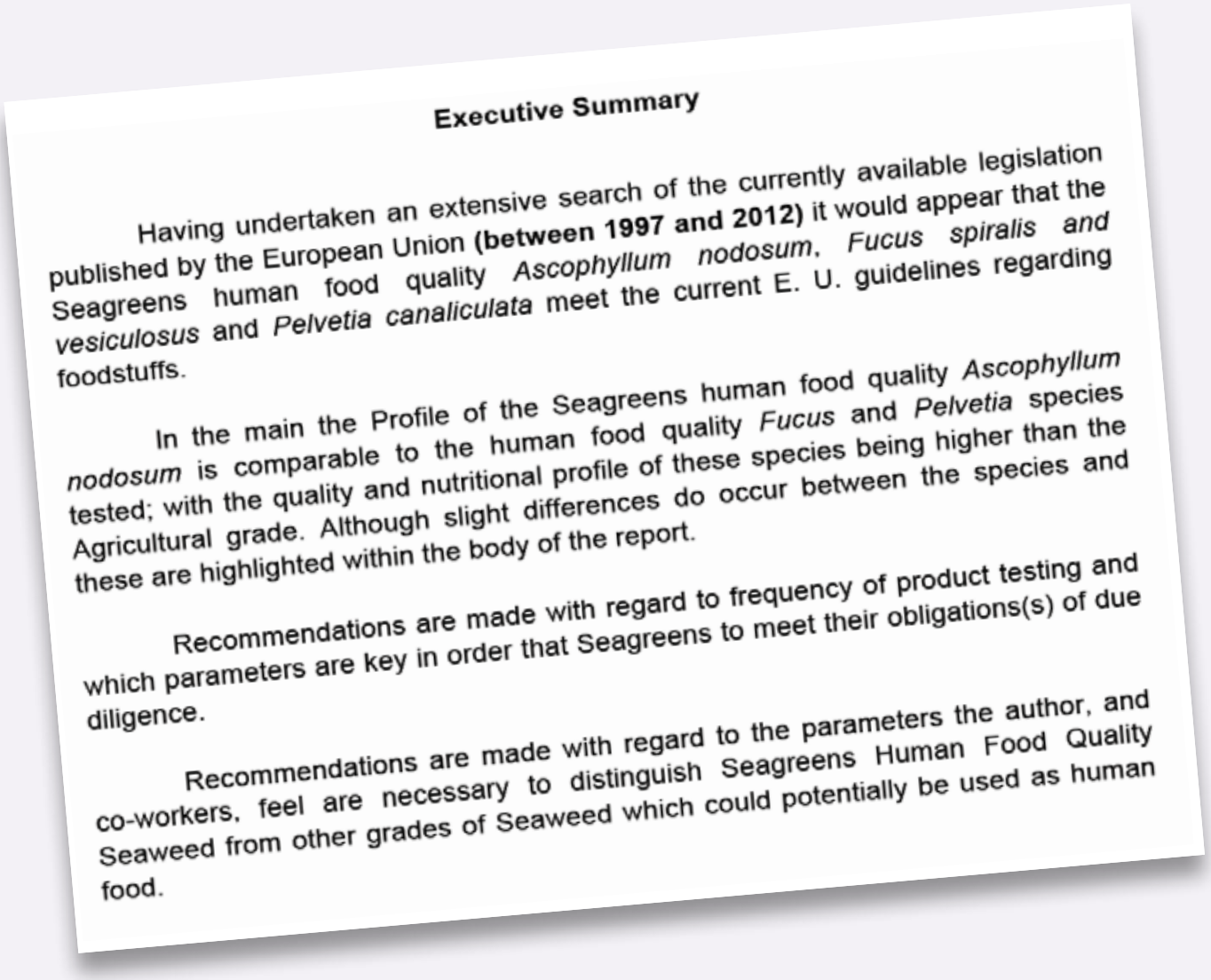
In-depth knowledge of our chosen species

This 2-year study completed 2012 is the largest comparative analysis ever undertaken on the wild Wrack species.

An independent study of nutritional quality in three Wrack species produced independently and blind sourced from Ireland, Iceland, Norway and Scotland.

Quality scored against sensitive nutritional markers.

No other production is to Seagreens® quality standard



Executive Summary

Having undertaken an extensive search of the currently available legislation published by the European Union **(between 1997 and 2012)** it would appear that the Seagreens human food quality *Ascophyllum nodosum*, *Fucus spiralis and vesiculosus* and *Pelvetia canaliculata* meet the current E. U. guidelines regarding foodstuffs.

In the main the Profile of the Seagreens human food quality *Ascophyllum nodosum* is comparable to the human food quality *Fucus* and *Pelvetia* species tested; with the quality and nutritional profile of these species being higher than the Agricultural grade. Although slight differences do occur between the species and these are highlighted within the body of the report.

Recommendations are made with regard to frequency of product testing and which parameters are key in order that Seagreens to meet their obligations(s) of due diligence.

Recommendations are made with regard to the parameters the author, and co-workers, feel are necessary to distinguish Seagreens Human Food Quality Seaweed from other grades of Seaweed which could potentially be used as human food.

"The profile of Seagreens® human food quality Ascophyllum nodosum is comparable to the human food quality Fucus and Pelvetia species tested… quality and nutritional profiles also higher than agricultural grade produced at the same factory"

Certified to the highest international standard in 2016

Nutritious Food Seaweed

BDA CERTIFICATION

Nutritious Food Seaweed certification is specifically for seaweed for human consumption. It assures consumers of consistent nutritional value, rooted in the principles of sustainable food and biodynamic production.

No other Wrack seaweed is to Seagreens® nutrition standard

Seagreens®

Markers of Quality

Seagreens® are produced to standards, methods and technologies (Patents Pending) specifically for human nutrition, quite distinct from seaweed widely produced for animal feed, horticulture and extracts, or from small scale artisanal collection.

Seagreens proprietary methods ensure a consistently superior nutritional and physical quality with international regulatory compliance through the selection, harvesting, handling, drying, processing and packaging of particular seaweed species for human food whose quality and provenance is certified.

Markers of nutritional quality were independently selected by Sheffield Hallam University, Centre for Food Innovation. This study demonstrated Seagreens® nutritional value to be higher than seaweeds of the same species from the same location, produced by conventional methods that do not meet the Nutritious Food Seaweed Standard.

Markers of Quality	Seagreens® compared to the same species not produced to Seagreens proprietary standards
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

No other Wrack seaweed has Seagreens® nutritional profile

Typical nutritional values

Food Capsules per gram (2 x 500mg capsules) & Food Granules per gram (¼ teaspoon)

Protein: 50mg
Carbohydrate/Fibre: 550mg of which Dietary Fibre 500mg (including the non-starch polysaccharides Algin, Fucose, Fucoidan, Mannitol, Methylpentosans, Laminarin, Mannuronic Acid and Chlorophyll
Enzymes (units per gram): Lipase 254 (pH 7.4), Carbohydrase 53.75 (pH 8.0), Protease 653.50 (pH 7.4)
Essential Fatty Acids (EFA): Total EPA + DHA Omega-3 1.43mg, Omega-3 3.43mg, Omega-6 9.50mg, Omega-9 16.30mg, Alpha-linolenic Acid 1.143mg, Eicosapentenoic Acid 1.42mg
Vitamins: A (antioxidant carotenoids including beta carotene, fucoxanthin and violaxanthin) 178µg, B1 (thiamin) 0.62µg, B2 (riboflavin) 0.15µg, B3 (niacin or vit PP) 104.13µg, B9 (folate) 0.554µg, B12 (cobalamin) 0.0014µg, C (antioxidant) 66.35µg, D (cholecalciferol) 0.01µg, E (antioxidant) 62.15µg, H (biotin) 0.30µg, K (menadione) 10µg
Minerals: Calcium 12.33mg, Magnesium 8.03mg, Nitrogen 8.10mg, Phosphorus 1.58mg, Potassium 19.35mg, Sodium 34.8mg, Sulphur 23.38mg
Trace Elements: Antimony 0.05µg, Barium 6.48µg, Boron 87.71µg, Cerium 0.27µg, Cobalt 0.47µg, Copper 0.75µg, Germanium 0.07µg, Gold 0.05µg, Iodine 390µg, Iridium trace, Iron 139µg, Lanthanum 0.06µg, Lithium 0.33µg, Manganese 44.9µg, Molybdenum 0.54µg, Palladium 0.76µg, Platinum trace, Praseodymium 0.013µg, Rhemium 0.1µg, Rubidium 6.79µg, Ruthenium 0.004µg, Scandium trace, Selenium 0.04µg, Silicon 63.34µg, Silver 0.064µg, Thallium 0.006µg, Tellurium trace, Titanium 2.15µg, Vanadium 1.79µg, Zinc 70.84µg. A total of 67 mineral elements have been analysed in all Seagreens human food species
Amino Acids: Alanine 2.15mg, Arginine 2.88mg, Aspartic acid 7.53mg, Cystein +Cystine 0.83mg, Glutamic acid 5.35mg, Glycine 3.69mg, Histidine 0.53mg, Isoleucine 1.323mg, Leucine 4.74mg, Lysine 1.60mg, Methionine 0.88mg, Phenylalanine 1.36mg, Proline 1.83mg, Serine 1.52mg, Threonine 1.53mg, Tryptophan 0.54mg, Tyrosine 0.85mg, Valine 1.23mg
Betaines: Glycine Betaine trace, Gamma Amino Butyric Acid Betaine trace, Delta Amino Valeric Acid Betaine trace, TML (Laminine) trace, L-Carnitine trace, Trigonelline trace, enzymes, lipids, lioproteins and many compound which cannot be artificially replicated or formulated.
Note: 1g (gram) = 1000mg (milligram) = 1,000,000µg (microgram)

Typical nutritional values per 100g

Protein	5g	
Carbohydrate	55g	
Sugars	3g	
Fat	4g	
	of which:	
	Saturates	0.45g
	Mono-unsaturates (cis)	1.23g
	Mono-unsaturates (trans)	< 0.01g
	Polyunsaturates	0.39g
	Polyunsaturates (trans)	<0.01g
Dietary Fibre	50g	
	of which:	
	Insoluble fibre	40g
	Soluble fibre	7g
Sodium	3.5g	
Moisture	10%	
Energy	167 kcalories (683 kJoules)	

Comparison of typical iodine levels

The British Health Food Manufacturers' Association advises that iodine supplementation should not exceed 500µg per day. We introduced Seagreens® Iodine+ Capsules in 2000 after requests from Vegans and vegetarians for a pure 100% organic quality single daily capsule to provide adequate, properly balanced natural iodine with no manufacturing incipients or other additives.

	Iodine
2 Seagreens® Food Capsules (1 gram)	390µg
1/4 teaspoon Food Granules (1 gram)	390µg
1 Seagreens® Iodine+ Capsule (500mg)	350µg
Common kelp (laminaria species) (1 gram)	700-5000µg

Independent analytical data

British Government analytical laboratories FERA and accredited labs Eurofins, ILS, and at Aberdeen, Newcastle and Sheffield Hallam universities, 2012.

We select, monitor, harvest and process Seagreens wild seaweed as a raw food and have won numerous awards for our products, research and environmental sustainability. Nothing is added or extracted. Allergen and contaminant free. Internationally certified Organic and Kosher.

Seagreens' quality is proven, for example by higher antioxidants, phenols, vitamin C and tannins than in seaweed not produced to the standards* we developed over 15 years in Norway and Scotland.

That's why other leading food and health brands also use our seaweed ingredients in their products. Seagreens grows through many partnerships with people like you.

Seagreens® comprehensive nutritional profiling is unique, provided for consumers on our information website:

www.seagreens.co.uk/nutrition

Nutrition Research since 1998

"At least a gram of the best seaweed in the daily diet" - founding purpose

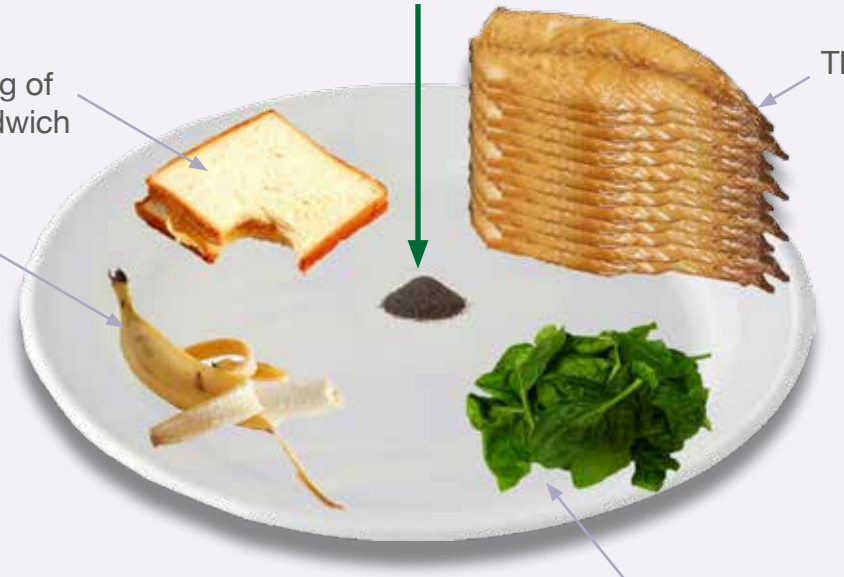
- Chronic inflammatory responses
- Imbalanced gut flora
- Metabolic abnormalities
- Nutritional energy imbalances
- Obesity and overweight
- Oxidative stress
- Unhealthy plasma cholesterol levels

"…the Japanese, influenced by vegetarian Buddhists who learned how to use seaweed extracts (dashi), with large amounts of natural glutamate to flavour vegetable dishes (umami), managed to establish a diet consisting predominantly of low-calorie, high-fibre vegetables, seaweeds, and fruits"

"At least a gram of the best seaweed in the daily diet" – founding purpose

A complete natural wholefood

Just 2g of Seagreens is...



The same calcium as 4g of cheese in a cheese sandwich

The same potassium as 11g of a banana

The same iodine as 13 whole mackerel

Iodine contributes to normal thyroid, nervous system and cognitive function, the normal growth of children, normal energy-yielding metabolism, and the maintenance of normal skin

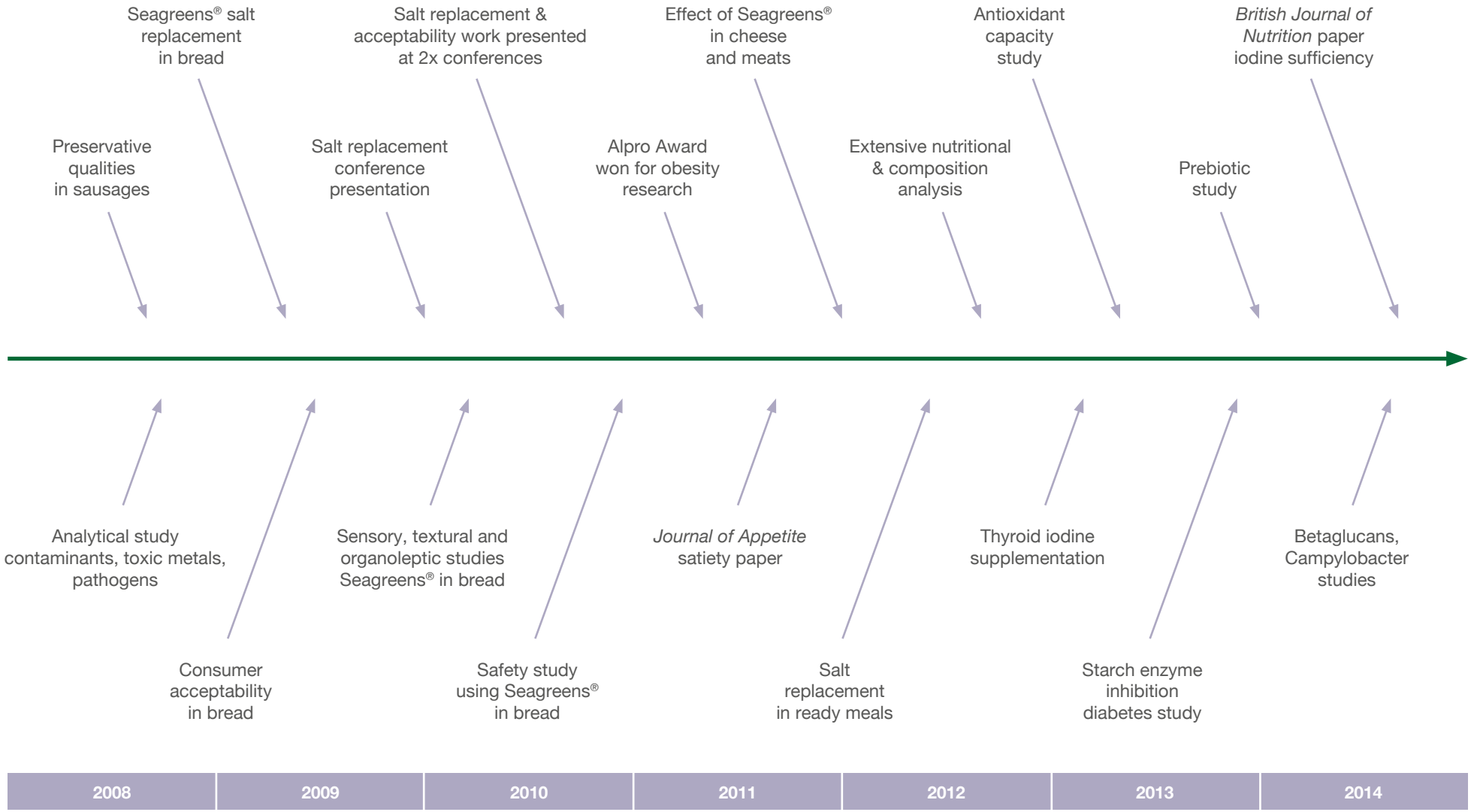
... as well as containing:
- all the minerals
- all trace elements
- all essential amino acids and non-essential
- all the vitamin groups
- wide range of polysaccharides
- antioxidant and phenols

The same iron as 11g of spinach

Typical analysis for Seagreens® *Ascophyllum.* Further details available on request.

www.seagreens.co.uk/nutrition

Leading applied nutrition research on the Wrack species since 2008



Nutrition Research since 2008

Macroalgae Composition

Food

Protein	Carbohydrates	Fats
Enzymes	Monocharides	Monunsaturated
Non-essential	Oligosaccharides	Polyunsaturated
Amino Acids		
Essential	Polysaccharides	Omega-3
Amino acids		Fatty Acids

Micronutrients

Vitamins		Minerals
Water soluble	Fat soluble	Calcium
B1	A	Iron
B2	E	Iodine
B3	K	Phosphorus
B6		Potassium
B12		Sodium
C		Sulphur
		Magnesium
		Manganese
		Copper
		Zinc
		Cobalt
		Molybdenum
		Chlorine
		Chromium
		Selenium

- Mouritsen O. G., 2013. ‘Seaweeds. Edible, available & sustainable’

Seaweed mineral composition compared with other foods

Comparison in foods using atomic absorption spectrophotometry

Minerals: Sodium, Potassium, Calcium, Magnesium
Trace elements: Iron, Zinc, Manganese, Copper

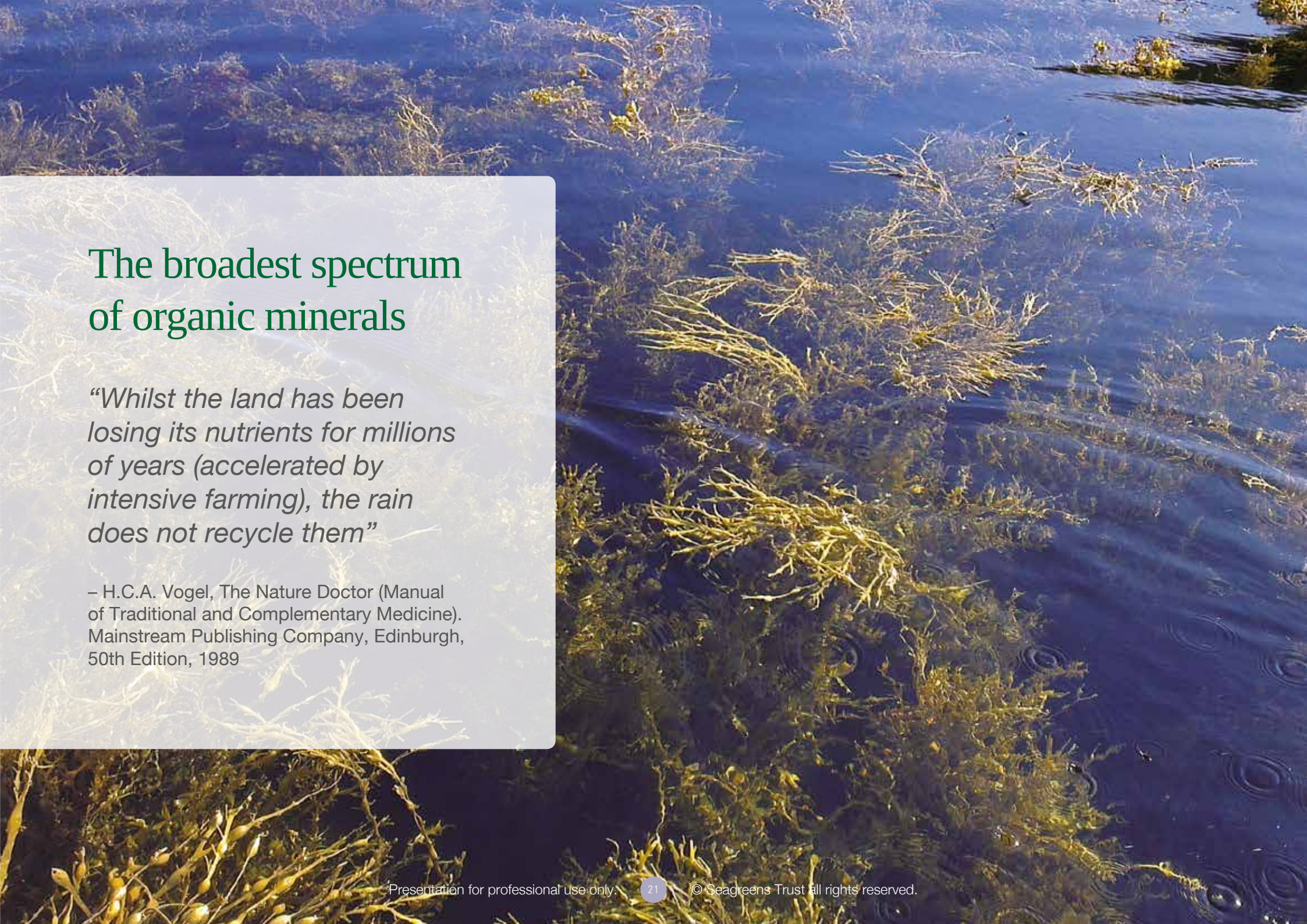
		Minerals mg/100g	Trace elements mg/100g
Bladderwrack	*Fucus vesiculosus*		
Kelp	*Laminaria digitata*		
Wakame	*Undaria pinnifitada*		
Carragheen	*Chondrus crispus*		
Laver	*Porphyra tenera*	8,000 - 17,900	5-15
Spinach		9,700	
Tomatoes		6,000	
Potatoes		3,400	
Carrots		3,300	
Green peas		1,450	
Sweet corn		1,350	

- Ruperez. P., 2002. Mineral content of edible marine seaweeds. Food Chemistry 79: 23-26

Seagreens® specific mineral comparison with other foods

mg/100g (dry weight)	Calcium	Potassium	Magnesium	Sodium	Copper	Iron	Iodine	Zinc
Seagreens *Ascophyllum*	1,350	1,820	826	3,440	0.10	14.20	71.20	4.39
Seagreens *Fucus*	1,090	1,880	687	2,890	0.15	14.20	52.20	3.52
Seagreens *Pelvetia*	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



The broadest spectrum of organic minerals

“Whilst the land has been losing its nutrients for millions of years (accelerated by intensive farming), the rain does not recycle them”

– H.C.A. Vogel, The Nature Doctor (Manual of Traditional and Complementary Medicine). Mainstream Publishing Company, Edinburgh, 50th Edition, 1989

Seagreens® provide the full array of minerals and trace elements

"In the 51 years from 1940 to 1991, farmed meat lost 41% of its calcium and 54% of its iron, while vegetables lost an average 50% calcium, 25% iron and magnesium, 76% copper and 59% zinc"

– D. Thomas, research compilation for *"Overfed and Undernourished"*, London Conference on Obesity, April 2005

Fortunately...
Seagreens wild Wrack species are the most comprehensive and consistent natural whole food source of minerals and trace elements.

Seagreens® are comprehensively more nutrient dense

Fruit, veg and seaweed comparison

Nutrient density in most nutrient dense species in class

COMPARE

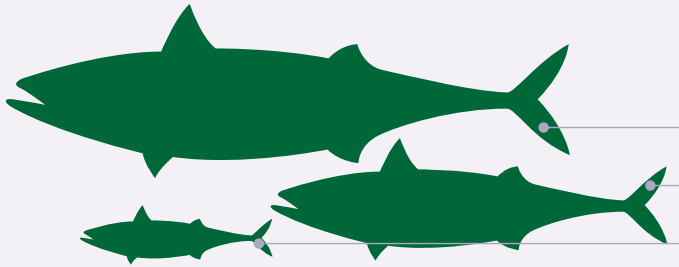
Seagreens in a loaf of bread has approximately the same amount of vitamin B2 as 100g of blackberries or broccoli

Nutrient	Fruit	Vegetable	Seaweed
per 100g	Raw Blackberry	Boiled Broccoli	Dried Ascophyllum
Vitamin B1	0.02 mg	0.05 mg	0.03 mg
Vitamin B2	0.05 mg	0.05 mg	0.75 mg
Vitamin B3	0.5 mg	0.70 mg	2 mg
Folate	34 mcg	64 mcg	60 mcg
Vitamin C	15 mg	44 mg	125 mg
Vitamin D	0 mcg	0 mcg	1 mcg
Potassium	160 mg	170 mg	2,500 mg
Calcium	41 mg	40 mg	2,000 mg
Magnesium	23 mg	13 mg	700 mg
Iron	0.07 mg	1 mg	57.5 mg
Zinc	0.2 mg	0.4 mg	13 mg
Selenium	trace	trace	15 mcg

– 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.

Ideal as a standalone supplement, or in complement with other ingredients, Seagreens provides a phenomenal source of nutrition, having no nutritional ‘gaps’. Seagreens contains all the minerals, trace elements, essential amino acids, vitamin groups, and a diverse range of polysaccharides, antioxidants and phenols. As such, it works extremely well in ‘superfood’ and ‘green’ blends, providing specific strength with key minerals and trace elements such as:

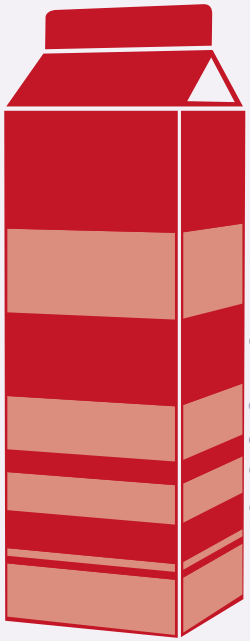


Iodine

- Seagreens Ascophyllum 0.712 mcg/g
- Seagreens Fucus 0.522 mcg/g
- Seagreens Pelvetia 0.243 mcg/g
- Whole Milk 0.0003 mcg/g
- Mackerel 0.001 mcg/g

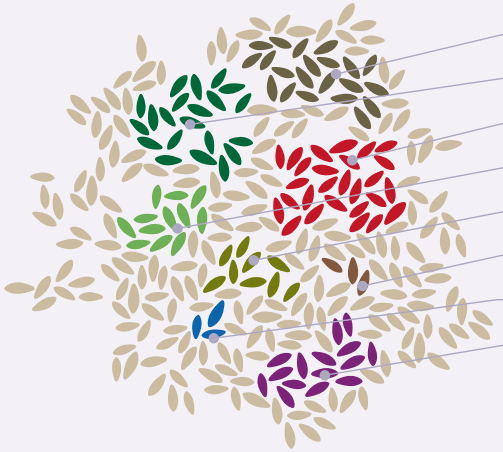
Potassium

- Seagreens Ascophyllum 18 mg/g
- Seagreens Fucus 19 mg/g
- Seagreens Pelvetia 22 mg/g
- Spirulina 14 mg/g
- Chlorella 8 mg/g



CALCIUM

- Seagreens Ascophyllum 13.5 mg/g
- Seagreens Fucus 10.9 mg/g
- Seagreens Pelvetia 11.4 mg/g
- Spirulina 7 mg/g
- Chlorella 3 mg/g
- Barley Grass 5.2 mg/g
- Wheat Grass 5.2 mg/g
- Brown Rice 1.1 mg/g
- Whole Milk 1.15 mg/g
- Cheddar Cheese 7.2 mg/g

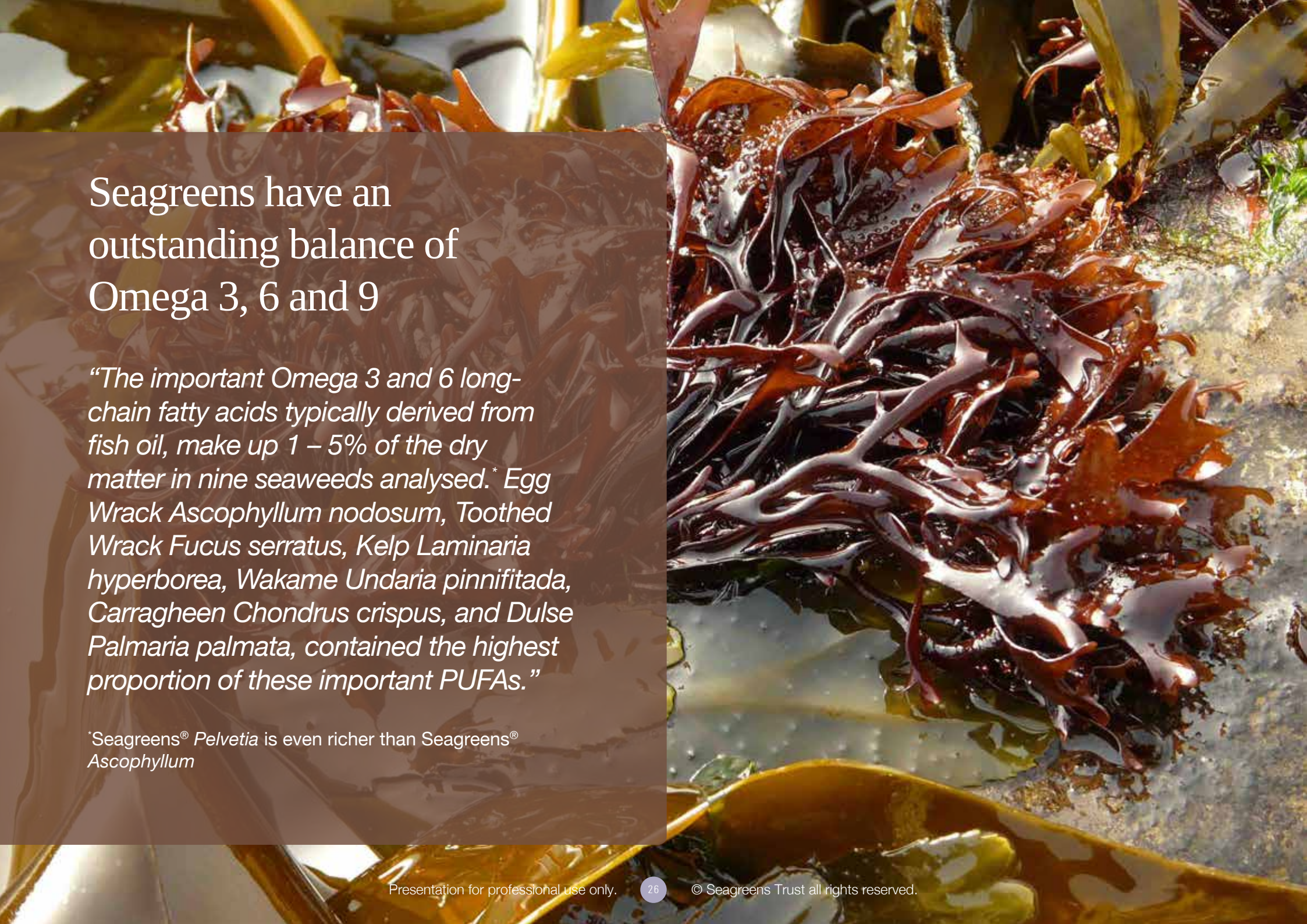


Magnesium

- Seagreens Ascophyllum 8.26 mg/g
- Seagreens Fucus 6.87 mg/g
- Seagreens Pelvetia 8.76 mg/g
- Spirulina 4 mg/g
- Chlorella 3 mg/g
- Barley Grass 1 mg/g
- Wheat Grass 1 mg/g
- Brown Rice 5.2 mg/g

"It doesn't matter how you use them – capsules, granules, or large pieces of Seagreens®. Just as long as a person has at least a gram in the daily diet – every single day. Nutritionally, that's what is needed – better than a whole meal of seaweed every week."

- Simon Ranger, Seagreens' founder



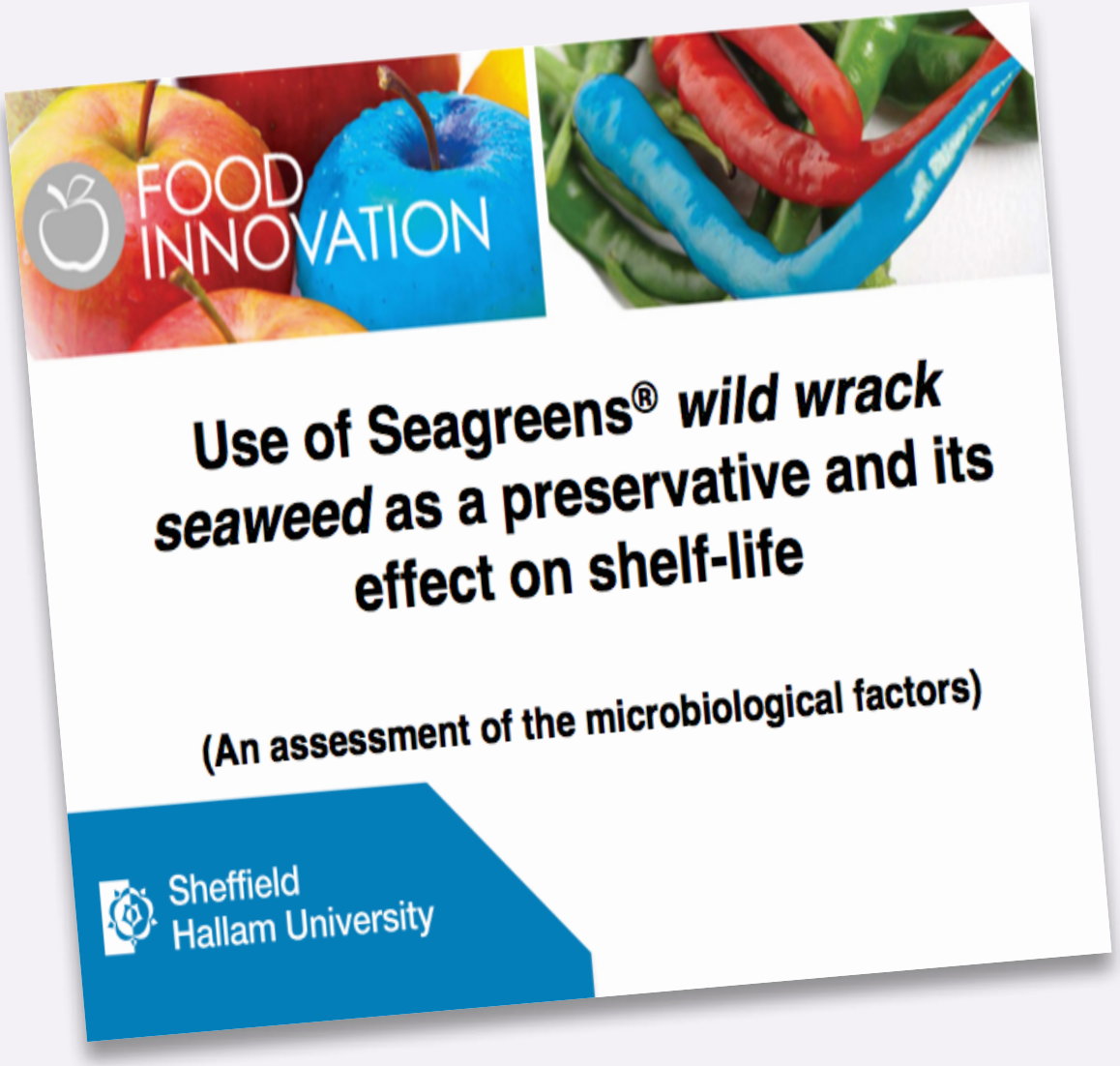
Seagreens have an outstanding balance of Omega 3, 6 and 9

"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*

Salt Replacement Research 2008-2010

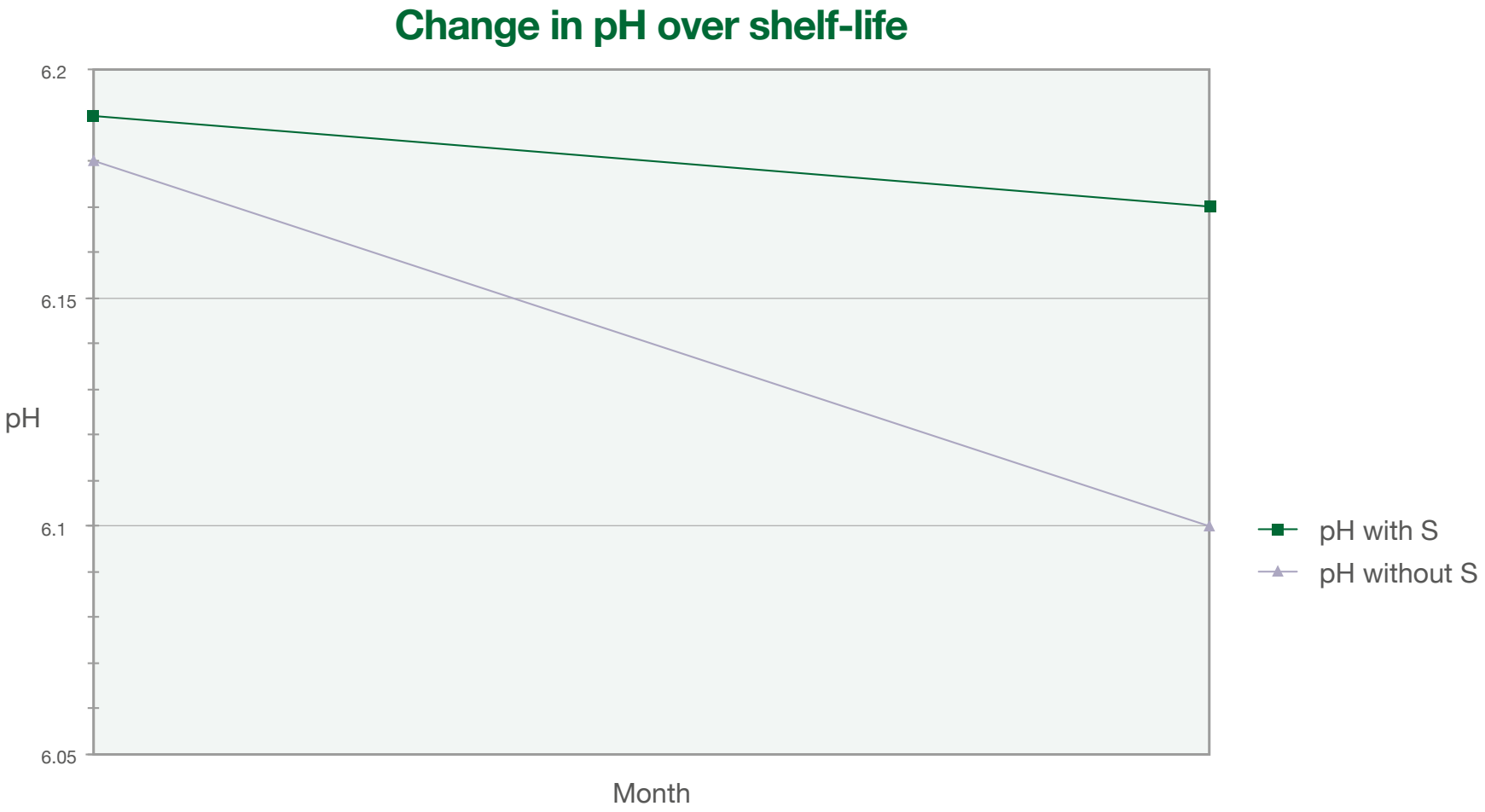
Salt replacement in sausages & bread 2008-2010



Trialled in shop packaged pork sausages at 3% w/w

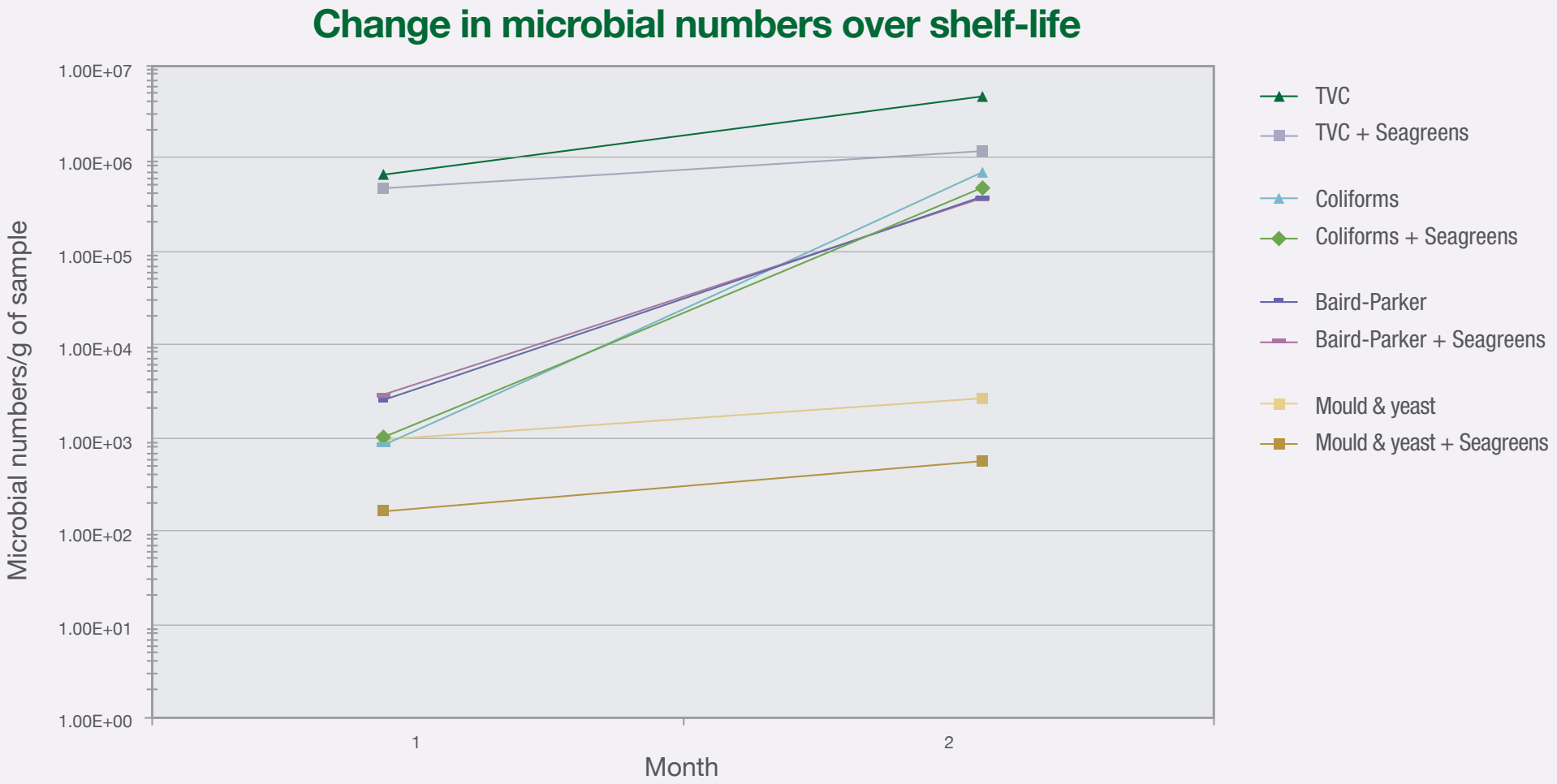
- a significant drop in microbial activity and numbers
- a significant improvement in acid alkaline stability in H2O (possibly due to polysaccharides)
- lower carbon dioxide within sealed packaging (counters growth of e.g. Clostridia)
- effective against gram positive and gram negative bacteria
- effective replacement of salt (the usual preservative)
- possible shelf life extension, later proven in bread and other studies

Shelf life studies, replacing salt in sausages



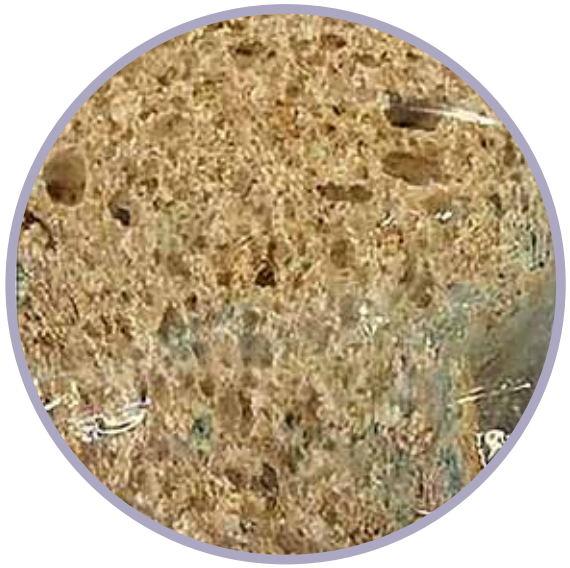
Salt replacement in sausages, 2008. The **top line** shows a blend of Wrack species ***significantly reduced acidity, inhibiting microbial growth.***

Reducing bacteria by improving pH balance



Salt replacement in sausages. The **"plus Seagreens"** lines show s***ignificant reduction in total viable count*** in the aerobic colony – coliforms, staphylococci, moulds & yeasts.

And in bread, a proven effective natural preservative



Control loaf (day 9)
Normal Salt

Trial loaf (day 9)
50% Salt Reduced
50:50 mix Salt Seagreens

Trial loaf (day 9)
100% salt reduced
(the only salt combination comes from the seaweed itself)

The **green** colour of the control is mould. Seagreens replaces, salt, improves shelf life, adds nutritional value. Between 65% and 70% of consumers preferred a 50% blend of Seagreens® Ascophyllum Medium Granules (coarse grain) and salt - still effective at only 50% inclusion.

Wider health implications of salt replacement

Formulation of white/wholemeal bread samples

	Control Bread	White Bread 50:50 coarse	White Bread 100% coarse	Wholemeal Bread 50:50 fine	Wholemeal Bread 100% fine
Flour	400g	400g	400g	400g	400g
Salt	5g	2.5g	0g	2.5g	0g
A. nodosum	0g	2.5g	5g	2.5g	5g
Sugar	5g	5g	5g	5g	5g
Butter unsalted	15g	15g	15g	15g	15g
Yeast	5g	5g	5g	5g	5g
Water	250ml	250ml	250ml	250ml	250ml

The control bread contains 5g salt. In White and Wholemeal comparisons, salt was replaced by 50% and by 100% Seagreens®. By replacing salt a significant balance of nutrition is being added ino the daily bread.

2.5g Seagreens in a family loaf cut salt intake in half. This could deliver just over 200mg seaweed per slice.

UK nutritionists find 2-6g per day therapeutic. 4.6g per day is the traditional daily use in Japan (1965).

Organoleptic studies conclude salt replacement research

Amount of Seagreens	0g		5g		10g		15g		20g	
per 400g loaf	M	SD	M	SD	M	SD	M	SD	M	SD
Appearance	6.42[a]	1.80	6.46[a]	1.58	6.41[a]	1.38	6.58[a]	1.38	6.45[a]	1.39
Aroma 6.38[a]	1.55	6.14[a]	1.45	6.06[a]	1.53	6.30[a]	1.55	6.09[a]	1.44	
Flavour[*] 6.31[b]	1.83	5.56[a]	1.74	5.50[a]	1.74	5.67[ab]	1.65	5.52[a]	1.75	
Aftertaste[¥]	6.34[b]	1.67	5.58[a]	1.59	5.63[a]	1.59	5.70[a]	1.50	5.54[a]	1.70
Texture 6.44[a]	1.80	5.94[a]	1.62	6.14[a]	1.62	5.92[a]	1.72	6.00[a]	1.71	
Overall Acceptability[$]	6.60[b]	1.68	5.79[a]	1.52	5.95[a]	1.52	5.93[a]	1.59	5.86[a]	1.64

Data are presented as means and standard deviations. Different letters in the same row denote means that are significantly different to one another ([*]p =.008, [¥]p=.003, [$]p=.002).

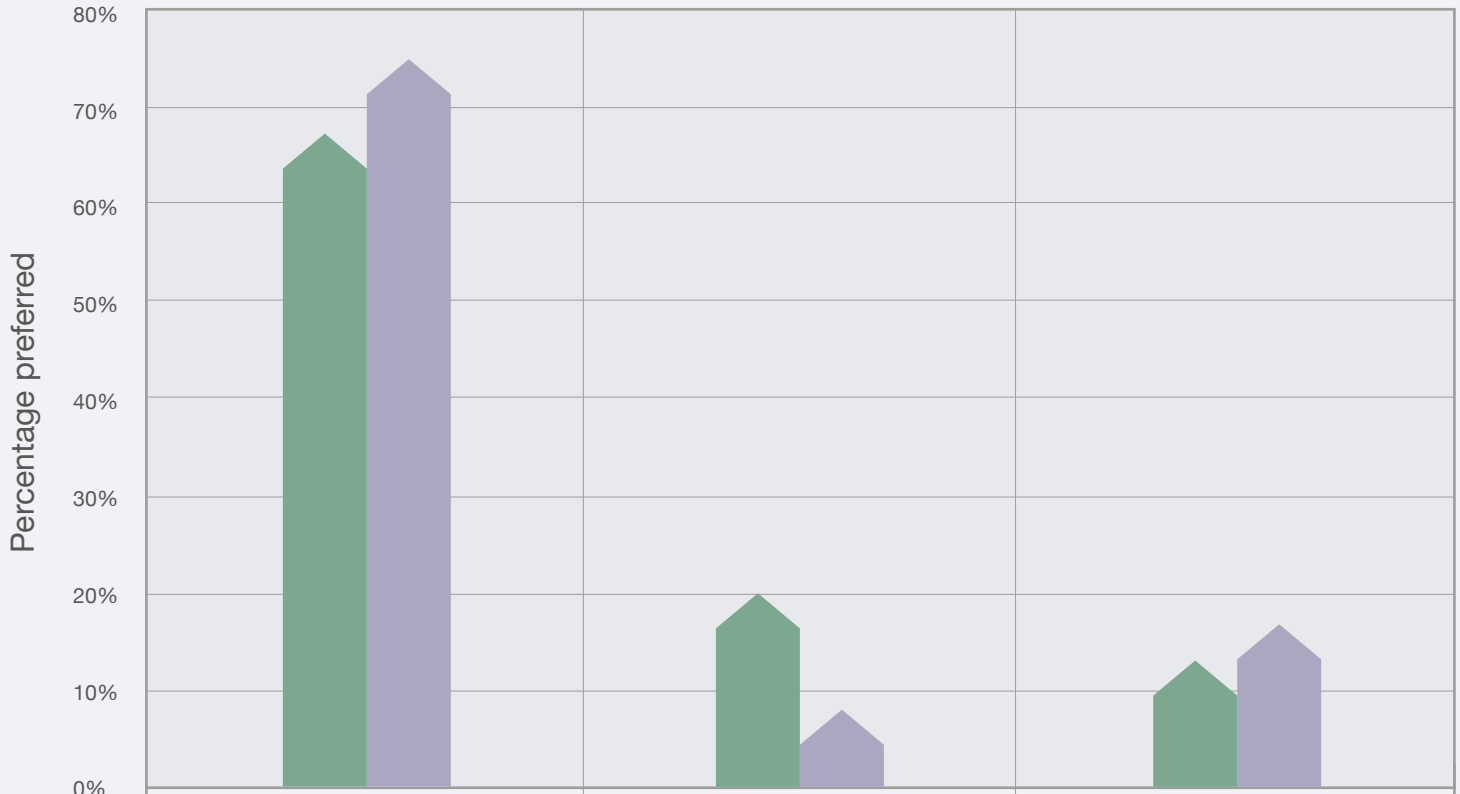
For the first time, this study has shown that seaweed enriched bread, a high fibre food, is acceptable when up to 20g SG are added to a 400g loaf. Previous studies have included alginate in drinks[2-3,5] and foods[4,9], and most authors[2-5], but not all[9] have reported beneficial health effects at levels similar to those found in SG enriched bread. Seaweed presents an attractive option for food manufacturers who are keen to maximise the health-giving potential of their dietary fibre rich products. This work was supported by Simon Ranger (Seagreens Health Foundation) with funding from the Weight Management Foundation. With thanks Paul Ash and Chris Trueman for their assistance.

"Up to 5% Seagreens® Ascophyllum enriched bread acceptable to consumers"

Higher levels do not deter consumers, but subsequent taste studies confirm that:

- **Choice of Seagreens ingredient is important - medium sized granules preferred**
- **Some salt is needed for mass consumption - 50% seaweed / salt blend preferred**

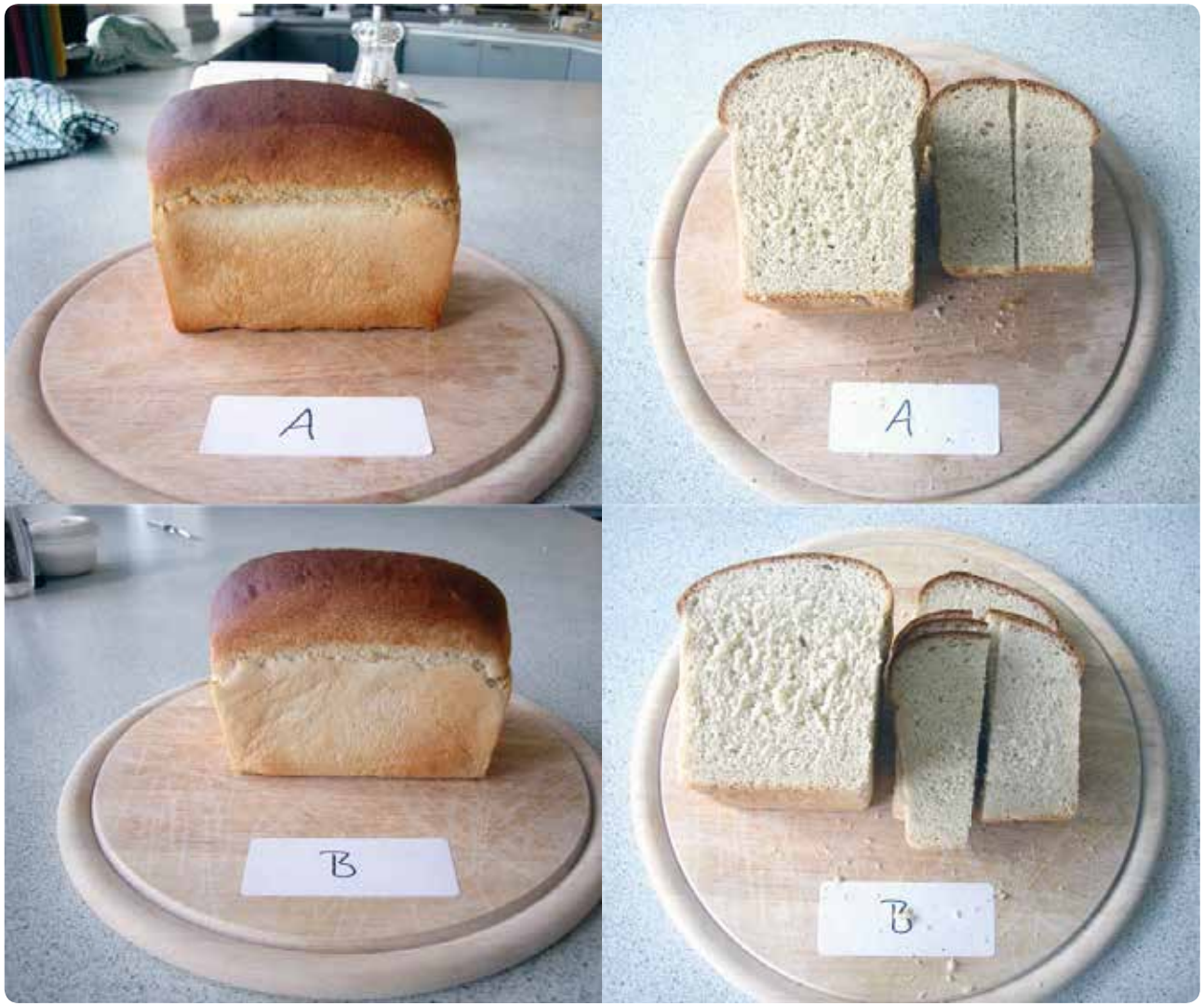
Consumer taste studies replace salt in bread 2009



	50/50 coarse Seagreens/salt	Control	50/50 fine Seagreens/salt
Wholemeal	67%	20%	13%
White	75%	8%	17%

Consumer taste studies 2009

Consumer preference is for use in brown and natural breads, and with additions such as dried tomato, basil, poppy seeds, walnuts, focaccia, multigrain.



- Hall AC et al., 2009. Seaweed *Ascophyllum nodosum* enriched bread is acceptable to consumers. Centre for Food Innovation, Sheffield Hallam University.

Salt replacement results published 2010

Wild Wrack (*Ascophyllum nodosum*) – A replacement for salt (as sodium chloride) in bread products

Andrew Fairclough[1] and Kritika Mahadevan[1,2]

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K.Mahadevan@shu.ac.uk; A.Fairclough@shu.ac.uk

INTRODUCTION

FSA salt reduction targets for 2012 recommend 1g and 1.2g of salt/100g for bread and breads with additions respectively. This pilot study was conducted to explore the potential of using a whole food like seaweed to reduce levels of sodium in the bread products.

AIM

To evaluate the effect of Seagreens Human Food Quality Wild Wrack Seaweed (*Ascophyllum nodosum*) as a replacement for salt in bread products.

OBJECTIVES

- Incorporate *Ascophyllum nodosum* as a partial or complete substitute for salt in a selection of breads.
- Identify the preferred sample in each product category based on sensory and bake quality.
- Evaluate the suitability of different grades of the wrack for production of acceptable products.

METHODOLOGY

Coarse and fine grade Seagreens *Ascophyllum nodosum* inherently contain only 0.09g salt/g. They were incorporated separately into standard white and wholemeal bread recipe as 50:50 wrack:salt or 100% salt replacement (Table 1).

Table 1: Formulation of white / wholemeal bread samples

	Control	50:50 coarse	100% Coarse	50:50 fine	100% fine
Flour	400g	400g	400g	400g	400g
Salt	5g	2.5g	0g	2.5g	0g
A.nodosum	0g	2.5g	5g	2.5g	5g
Sugar	5g	5g	5g	5g	5g
Butter unsalted	15g	15g	15g	15g	15g
Yeast	5g	5g	5g	5g	5g
Water	250ml	250ml	250ml	250ml	250ml

This reduced the salt content of the loaves to 0.6g/100g and 0.09g/100g bread respectively. Controls (1.1g salt/100g loaf) were used for comparison.

For breads with additions i.e. sundried tomato and basil bread, only coarse wrack at 50% and 100% salt replacement were included (Table 2). The control samples had 1.3g salt/100g loaf.

Table 2: Formulation of sundried tomato and basil bread

	Control	50:50 coarse	100% Coarse
Flour	400g	400g	400g
Salt	5g	2.5g	0g
A.nodosum	0g	2.5g	5g
Sugar	5g	5g	5g
Butter unsalted	15g	15g	15g
Yeast	5g	5g	5g
Water	250ml	250ml	250ml
Sundried tomato paste	10g	10g	10g
Sundried tomatoes	25g	25g	25g
Basil	2.5g	2.5g	2.5g

Sliced samples with no butter were presented to 12 panellists for assessment of bake and sensory qualities. Panellists were asked to select the preferred sample under each category and provide feedback on the organoleptic properties of the bread.

RESULT

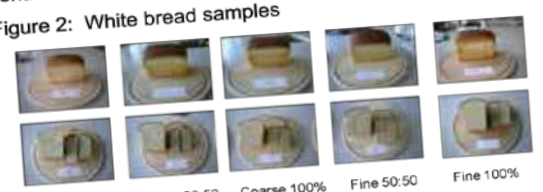
In wholemeal bread, samples containing 50:50 coarse wrack : salt were preferred (67%) followed by control (20%) and 50:50 fine wrack:salt (13%).

Figure 1: Wholemeal bread samples

Control Coarse 50:50 Coarse 100% Fine 50:50 Fine 100%

Similarly, for white bread, 75% of the panellists preferred samples containing 50:50 coarse wrack:salt; 17% preferred the samples with 50:50 fine wrack:salt and 8% preferred the control.

Figure 2: White bread samples



Control Coarse 50:50 Coarse 100% Fine 50:50 Fine 100%

Total salt replacement with wrack elicited some negative organoleptic attributes in terms of darker appearance of crumb, sea/fishy flavour and cardboard-like texture.

Sundried tomato and basil bread with 100% coarse wrack (0.3g salt/100g bread) was preferred by all panellists with no negative effect on bake and sensory quality.

Figure 3: Sundried tomato and basil bread

Control Coarse 50:50 Coarse 100%

CONCLUSION

This study demonstrates for the first time that Seagreens *Ascophyllum nodosum* is a potential replacement for salt and can be used to achieve salt levels below the recommended limit specifically in breads with additions.

ACKNOWLEDGEMENT

The authors wish to thank Seagreens® Ltd for providing samples of *Ascophyllum nodosum* and Mr Chris Trueman for his baking skills.

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Sheffield Hallam University

National recognition from UK Research Councils published 2012

RECREATION AND LEISURE:

HEALTHY LIFESTYLE

IT'S NOT ALWAYS EASY to maintain a healthy lifestyle, but the benefits can be worth the effort. With the knowledge that exercise and a healthy diet should help us live longer and more active lives, researchers are working to find new ways to help people lead a healthy life.

SEAWEED INSTEAD OF SALT

Salt may add flavour to our food, but excessive amounts of it are not good for our health with a high salt diet leading to raised blood pressure and heart problems. Researchers at the Centre for Food Innovation at Sheffield Hallam University are researching alternatives to salt that can be added to food to make it more healthy without ruining the taste.

There are salt substitutes available, many based on potassium chloride, but they are not suitable for use in all foods and can sometimes leave a bitter taste in the mouth. The research team at Sheffield Hallam has been exploring the potential of Seagreens®, a wild wrack seaweed that can be used in food. The great thing about this product is that it has a salty taste, but only 3.5 per cent sodium and a good balance of other minerals. It appears to be allergy free and is 100 per cent vegetable in origin so suitable for vegetarians and vegans.

BIG IDEAS FOR THE FUTURE

UK Research Councils

Seagreens has worked well in a variety of food products

- **On-going work**
- **Development of 3 ready meals**
  - Bolognese
  - Beef Stew
  - Seafood risotto

- Nutritional smoothie blends
- Development of ready meals
- Sausages & meat products
- Cheese & dairy products
- Soups, sauces & gravies
- Teas & tonics

Seagreens® strategic products gain consumer interest and acceptance

Twice the flavour, half the salt.

50% wild Wrack seaweed from Scotland with 50% unrefined sea salt from Cornwall is a healthier option than salt alone.

50% Wrack seaweed was an antidote in rats fed salt at levels causing heart failure.

- Yamori Y. et al., Journal of Hypertension 1986.

Nutrition has a place in most degenerative diseases

"...risk of stomach cancer in men with a low-salt intake of 4g to 6g daily was 1 in 1,000 per year, but double in men consuming 12g to 15g per day. The risk for women on a low-salt diet was 1 in 2,000 per year but on a high level diet increased to 1 in 1,300"

– Japanese study reported in the *British Journal of Cancer* (*The Week*, Health & Science section, Issue 443, 17.01.04).

Seagreens® flavour benefits digestion, particularly in the elderly

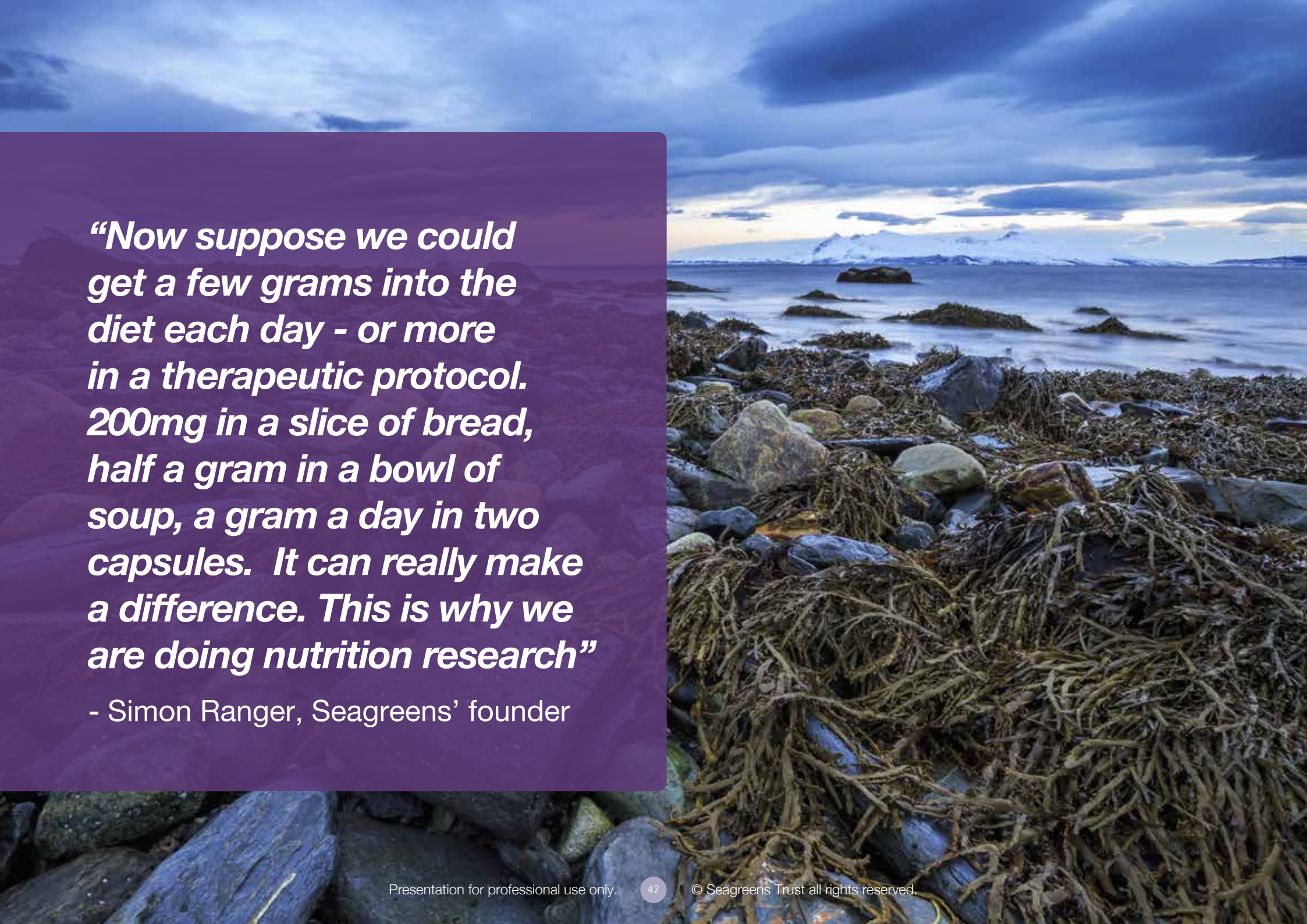
"Many of my patients are on restricted diets, and they often complain that the food is 'bland' and lacking flavour. By using the Seagreens® condiments they will still be able to enjoy a flavoursome diet."

- Helen Heap, Nutritionist, Women's Nutritional Advisory Service (dietary advisory service specialising in PMS, the Menopause, and IBS), England, April 1999 Seagreens® flavour benefits digestion, particularly in the elderly

FLAVOUR ENHANCEMENT

Brown Wrack seaweed adds the fifth 'umami' flavour which increases salivation and taste, and improves digestion. In the elderly and infirm, umami has been shown to significantly improve appetite, weight gain and general health.

– Sasano, T., et al., 2015. Umami in oral and overall health. Flavour, 4:10.



"Now suppose we could get a few grams into the diet each day - or more in a therapeutic protocol. 200mg in a slice of bread, half a gram in a bowl of soup, a gram a day in two capsules. It can really make a difference. This is why we are doing nutrition research"

- Simon Ranger, Seagreens' founder

Addressing the Pathologies of Public Health Concerns

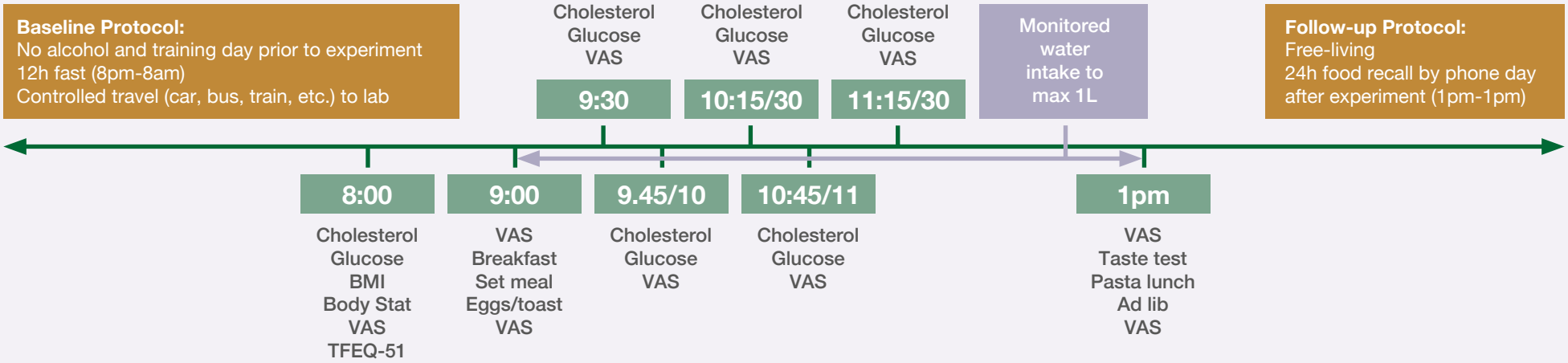
Addressing the aetiology of obesity

If up to 5 grams of Seagreens® can be included in a variety of daily foods, what other health benefits might this deliver in the overall daily diet?

Previous research had shown that extracted seaweed alginates aid weight loss but with negative side effects. This will be the first research using whole seaweed as a food ingredient in obesity and weight management.

Seagreens® Pilot Study design Stage 2

Aim: To establish the effect of a Seagreens product on nutrient uptake and subsequent human appetite/feeding behaviour



- Hall A. C., et al. Pilot study design for obesity research using Seagreens® in overweight male subjects. Sheffield Hallam University, 2009.

Obesity Research 2009 - 2011

Seagreens® obesity research 2009 - 2011

"The Seagreens® Ascophyllum enriched bread, contained 4.5 grams MORE dietary fibre per 100g than the wholemeal control bread, and in seaweed it is soluble fibre. Even more interesting, subjects who consumed the seaweed enriched bread experienced an involuntary REDUCTION (16.4%) in energy intake in the 24-hour period after consumption."

- Hall A. C., Fairclough A. C., Mahadeva K., Paxman J. R., 2011. Ascophyllum enriched bread reduces subsequent energy intake in overweight males. Journal of Appetite.

Seagreens® obesity research 2009-2011

Fibre composition of Seagreens® species compared to whole foods

Food type	Total fibre	Soluble fibre	Insoluble fibre	Carbohydrates
Seaweed (g/100g wet weight)*				
Ascophyllum nodosum	8.8	7.5	1.3	13.1
Whole food (g/100g weight)†				
Brown rice	3.8			81.3
Prunes	2.4			19.7
Porridge	0.8			9.0
Lentils green/brown	8.9			48.8
Cabbage	2.9			4.1
Carrots	2.6			7.9
Apples	2.0			11.8
Bananas	3.1			23.2

*Values for seaweeds from the Institut de Phytonutrition (2004).[15]
†Values for whole foods from McCance et al. (1993).[15]

Seagreens® obesity research 2009 - 2011

Conclusion

This study has shown for the first time that the incorporation of *A. nodosum* into bread significantly reduces energy intake at a subsequent test meal. No significant differences were seen in AUC glycaemia or cholestrolaemia which suggests that neither delayed gastric emptying nor nutrient encapsulation occurred. There were also no significant differences in AUC hunger or fullness. Further investigation of potential mechanisms of action is warranted.

This study was an acute feeding trial. Incorporating *A. nodosum* into a long term, appropriately powered, free living intervention study involving the substitution of "normal" bread for *A. nodosum* enriched bread, would help to establish the potential for seaweed enriched bread to reduce habitual energy intake longitudinally, with potential to favourably affect BMI or body composition.

Published in the peer-reviewed Journal of Appetite, 2011.

"Breakfasting on a slice of bread baked with ground up seaweed rather than salt, could help burn more calories than half an hour on a treadmill"

– The Daily Telegraph, 2012

Seagreens® obesity research 2009-2011

Key Findings

Overweight males ate a breakfast of scrambled eggs on Seagreens enriched toast. They consumed 179 less calories per day. 100 less calories is sufficient to achieve ***weight loss - with no adverse effect on nutrient uptake.***

Seagreens at 4% per 400 gram bread mix, replaced 100% of normal salt, yet ***none of the men could tell the difference against ordinary toast.***

Additional benefits in: ***cardiovascular health, diabetes, blood / liver mineralisation, and detoxification.***

Results were better than previous research using alginate extracted from the same seaweed species, even when conducted by the same researchers. Research won the 2010 Alpro Foundation Award.

Key Nutrient Groups

Polysaccharides
Soluble fibre slows gastric emptying, aids digestion, releases nutrients.

Phenols
Naturally inhibit starch digestive enzymes, slowing release of sugars to the blood (similar to eating low Glycemic Index foods like wholefood brown rice).

Nutrient density
Seagreens® is a 'complete' food, reducing food craving (the opposite of fast foods).

Seagreens® obesity research 2009 - 2011

Appetite 58 (2012) 379–386

Contents lists available at SciVerse ScienceDirect

Appetite

journal homepage: www.elsevier.com/locate/appet

Research Report

Ascophyllum nodosum enriched bread reduces subsequent energy intake with no effect on post-prandial glucose and cholesterol in healthy, overweight males. A pilot study ☆

A.C. Hall [a,*], A.C. Fairclough [a], K. Mahadevan [a,b], J.R. Paxman [a]

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ABSTRACT

It is well recognised that the consumption of seaweed isolates (such as alginate) successfully reduce energy intake and modulate glycaemic and cholesterolaemic responses. However, to date, the effect of adding whole seaweed to bread has not been widely investigated. Hence, this study aims to investigate the acceptability of *Ascophyllum nodosum* enriched bread as part of a meal, and measure its effect on energy intake and nutrient absorption in overweight, healthy males to see if it has a similar impact. Results from the acceptability study, (79 untrained sensory panellists) indicated that it is acceptable to eed (*A. nodosum*) into a staple food such as bread at concentrations of up to 4% per l loaf. A single blind cross over trial ($n = 12$ males, aged 40.1 ± 12.5 years; BMI was used to compare energy intake and nutrient uptake after a breakfast meal using ad (4% *A. nodosum*) against the control bread (0% *A. nodosum*). Consumption of the breakfast led to a significant reduction (16.4%) in energy intake at a test meal 4 h later. een treatment arms for area under the curve, peak values, and time of peak for blood esterol were not significant. Further investigation of potential mechanisms of action is

☆ *Acknowledgements:* This work was supported by Seagreens® and the Seaweed Health Foundation. With thanks to Dr. Iain Brownlee for his critical review of the manuscript, Chris Trueman for sample manufacture and Paul Ash for his technical assistance.

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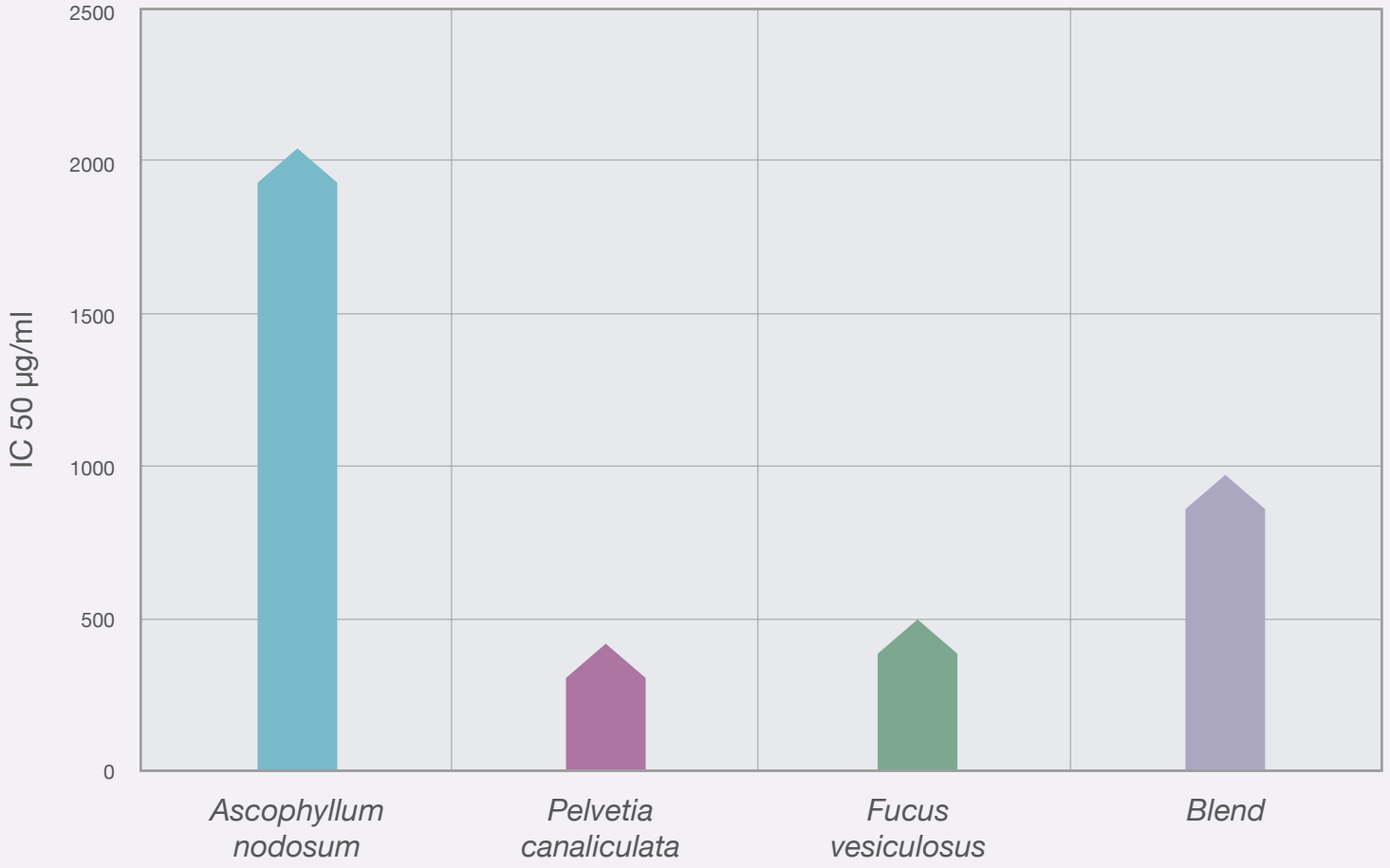
Diabetes & Antioxidant Research 2010- 2012

Diabetes research 2009 - 2011



Inhibition of digestive enzymes – significant differences between species – Nutrition studies at Sheffield Hallam, Glasgow and Newcastle Universities, UK

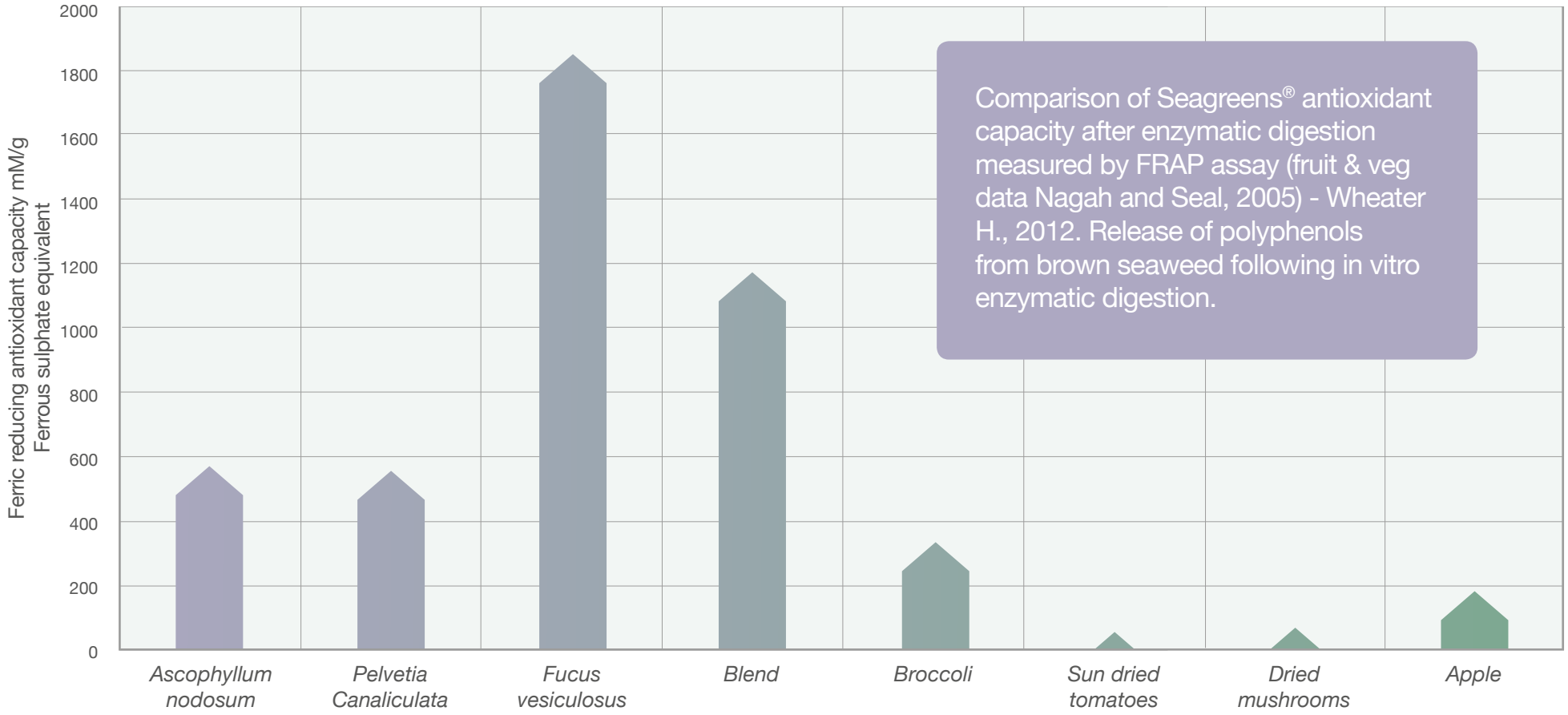
Inhibition of lipase and amylase in digestion prolongs breakdown of polysaccharides, slowing the release of sugars to the blood.

Seagreens® may lower glycaemic index of foods as an ingredient.

Potential for the management of obesity and diabetes.

Possible advantages over a common drug Acarbose®.

Antioxidant studies – capacity and behaviour 2012



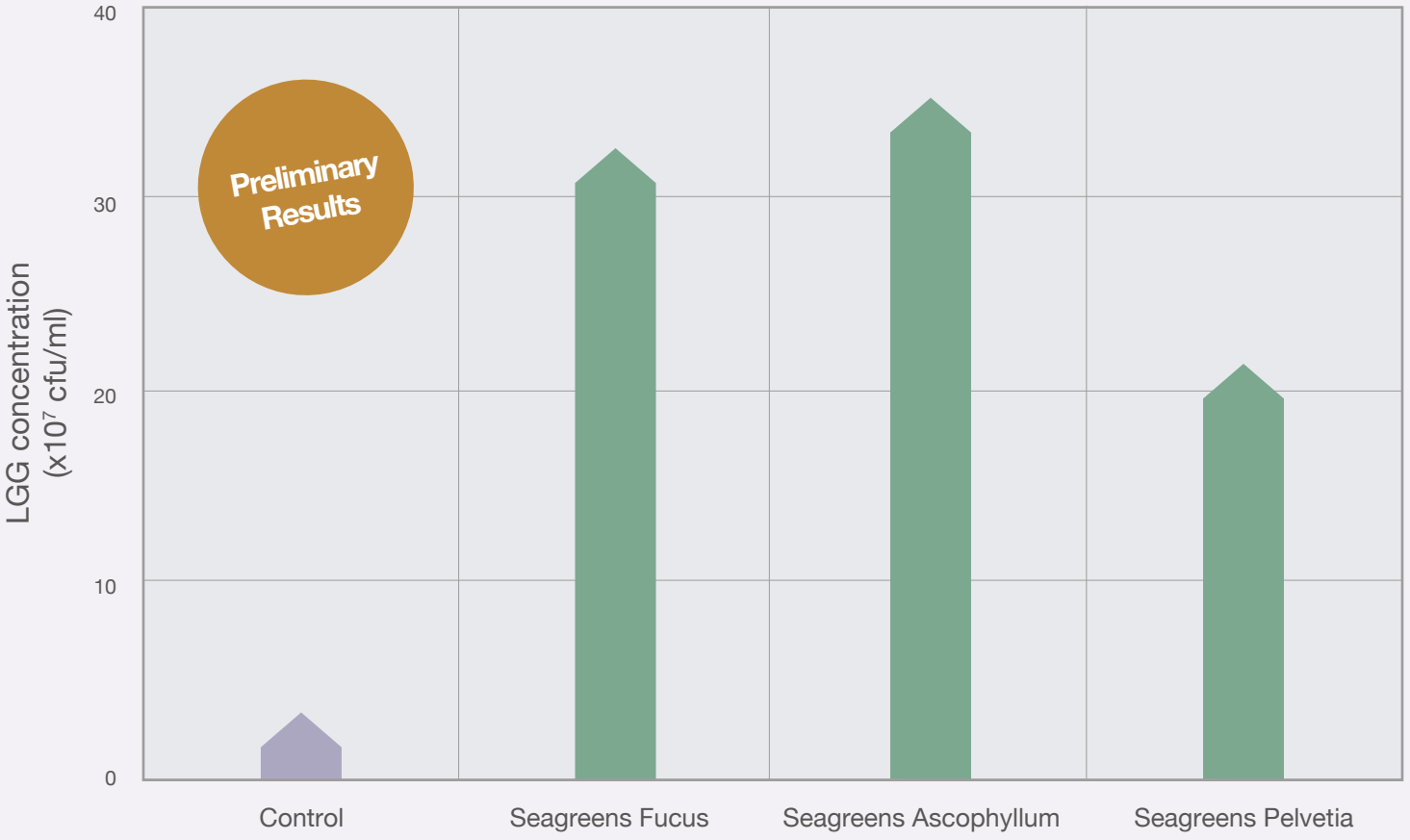
Significant in vitro evidence as potential agents in prevention and treatment of diabetes and obesity. Rich sources of polyphenols, could be more effective radical scavengers than green tea. High antioxidant capacity survived initial digestion, could protect against oxidative damage in the gut. Antioxidant studies - capacity and behaviour 2012

Seagreens® infused makes an outstanding antioxidant tea or tonic

Prebiotic and Digestive Research 2012 - 2013

Prebiotic and digestive studies

Use of wholefood Seagreens species as effective prebiotics; demonstrated with Lactobacillus (LGG)



Increased good bacteria *(Lactobacilli)*. Reduced bad bacteria *(E. coli)*. Probable reduced oxidative stress from improved balance nitric oxide and reactive oxygen species (ROS). Supports results in livestock (e.g.. improved digestion and feed utilisation in dairy cows).

Nutrition studies at Sheffield Hallam, Glasgow and Newcastle universities

- Lyons V. Seagreens® as a potential prebiotic and the role of probiotic bacteria in the production of nitric oxide in macrophages. MSc Thesis, Teeside University, 2012

Thyroid Iodine Research 2013 - 2014

Joint research with Napiers, a Seagreens® Brand Partner

British Journal of Nutrition, page 1 of 9

doi:10.1017/S0007114514001573

Low-level seaweed supplementation improves iodine status in iodine-insufficient women

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(Submitted 4 March 2014 – Final revision received 23 May 2014 – Accepted 27 May 2014)

Abstract

Iodine insufficiency is now a prominent issue in the UK and other European countries due to low intakes of dairy products and seafood (especially where iodine fortification is not in place). In the present study, we tested a commercially available encapsulated edible seaweed (Napiers Hebridean Seagreens® *Ascophyllum nodosum* species) for its acceptability to consumers and iodine bioavailability and investigated the impact of a 2-week daily seaweed supplementation on iodine concentrations and thyroid function. Healthy non-pregnant women of childbearing age, self-reporting low dairy product and seafood consumption, with no history of thyroid or gastrointestinal disease were recruited. Seaweed iodine (712 μg, in 1 g seaweed) was modestly bioavailable at 33 (interquartile range (IQR) 28–46) % of the ingested iodine dose compared with 59 (IQR 46–74) % of iodine from the KI supplement (*n* 22). After supplement ingestion (2 weeks, 0·5 g seaweed daily, *n* 42), urinary iodine excretion increased from 78 (IQR 39–114) to 140 (IQR 103–195) μg/l ($P<0·001$). The concentrations of thyroid-stimulating hormone increased from 1·5 (IQR 1·2–2·2) to 2·1 (IQR 1·3–2·9) mIU/l ($P<0·001$), with two participants having concentrations exceeding the normal range after supplement ingestion (but normal free thyroxine concentrations). There was no change in the concentrations of other thyroid hormones after supplement ingestion. The seaweed was palatable and acceptable to consumers as a whole food or as a food ingredient and effective as a source of iodine in an iodine-insufficient population. In conclusion, seaweed inclusion in staple foods would serve as an alternative to fortification of salt or other foods with KI.

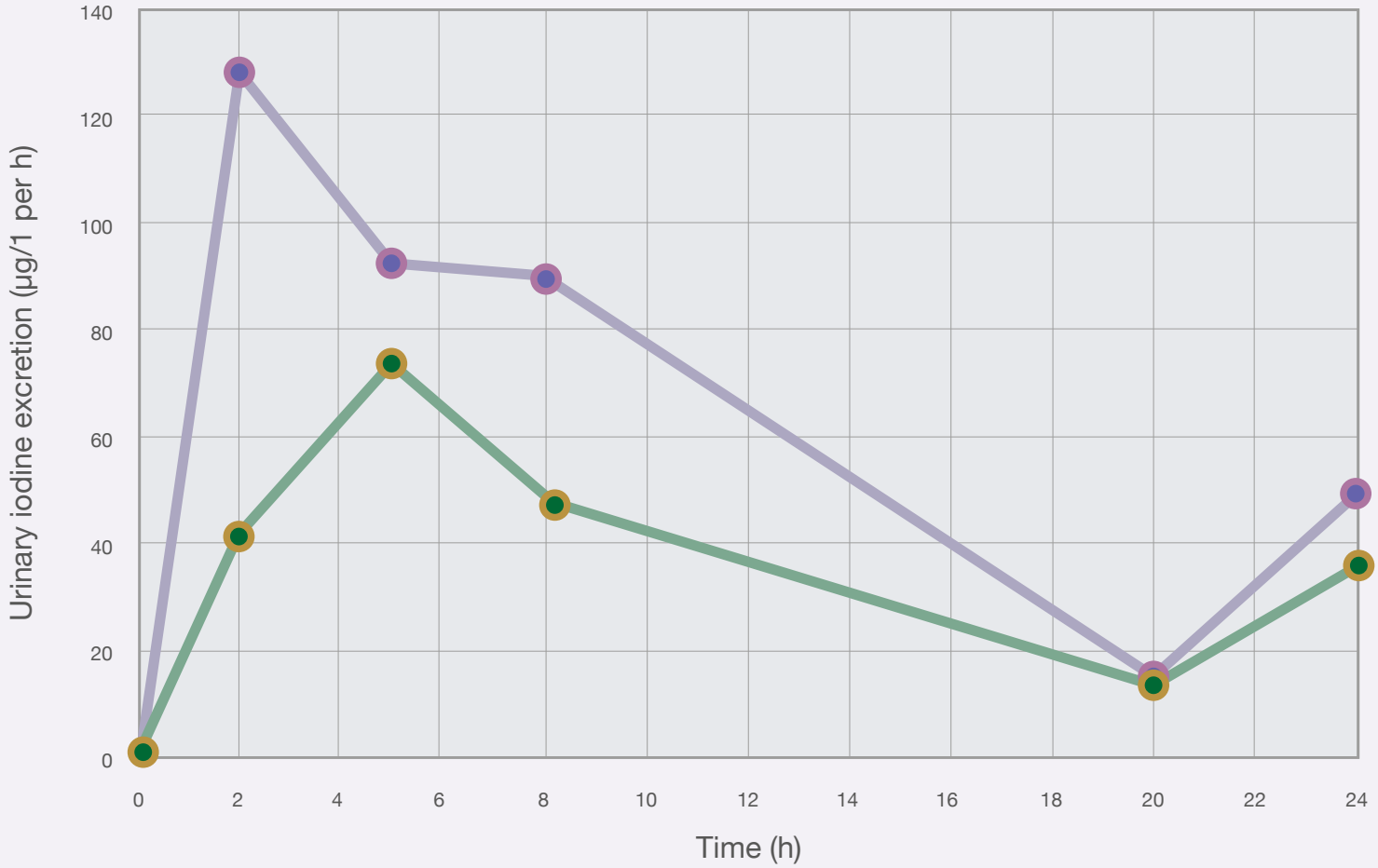
Key words: Iodine: Women: Seaweeds: *Ascophyllum nodosum*: Bioavailability: Thyroid function: Childbearing age

British Journal of Nutrition

Around 70% of UK women and school aged girls are iodine deficient

Table 1: Source of Iodine:	
Soil	
$NaIO_3$	Sodium iodine
$NaIO_4$	Sodium periodate
Seaweed/micro algae	
KI	Potassium iodide
NaI	Sodium iodide
I_2	Iodine
I	Iodide
Seawater	
I	Iodide

Uniquely proven vegetable source of iodine with broad nutritional benefits



Urinary iodine excretion over 24h after the ingestion of a dose of 712 µg of iodine from potassium iodide (●) or Napiers Hebridean Seagreens® *Ascophyllum Nodosum* (●).

Steady prolonged uptake of Seagreens® iodine is much healthier than the rapid uptake and decline of manufactured potassium iodide, a commonly used iodine supplement in salt.

As little as 65mg Seagreens® per day contributes to health

Key Findings

- Asymptomatic young women in the UK with low dietary seafood and dairy, display marked iodine deficiency.
- Seagreens® boosts iodine intake by 60% with no adverse affect on thyroid hormones or function (500mg Seagreens Ascophyllum Fine Granules per day). About 33% absorbed.
- Seagreens iodine uptake limited in the first gastric and intestinal phases of digestion. Colonic fermentation shown to free iodine from the seaweed matrix in the intestine.
- Upper tolerable limits for daily iodine intake EU 600µg, USA 1100µg.
- Iodine contributes to the normal production of thyroid hormones, normal thyroid function, nervous system and cognitive function, the normal growth of children, normal energy-yielding metabolism, and the maintenance of normal skin.

- Combet et al., 2014. Low level seaweed supplementation improves iodine status in iodine-insufficient women. British Journal of Nutrition.

Conclusions

Seagreens® is a nutrient dense, mineral rich, natural whole food ingredient, which in the daily diet, can deliver iodine sufficiency with no adverse effect on thyroid function, reduce the glycaemic response to carbohydrate load, reduce hunger via lowered gastric emptying with a positive effect on nutrition, and in the digestion is an effective prebiotic, and a high antioxidant free radical scavenger. It is a comprehensive source of nutrition which may help to ameliorate numerous risk factors associated with diabetes, obesity, endothelial dysfunction, hypertension and cardiovascular disease.

Useful applications (example) - all special diets

- Diets that avoid grains, meat, or dairy products
- In thyroid, hormonal and metabolic disorders
- Cardiovascular salt reduction and replacement
- Detoxification, obesity and weight management
- Allergen free and substance sensitivity
- Pregnancy, lactation, recuperation
- Old age, dementia, convalescence, cancer

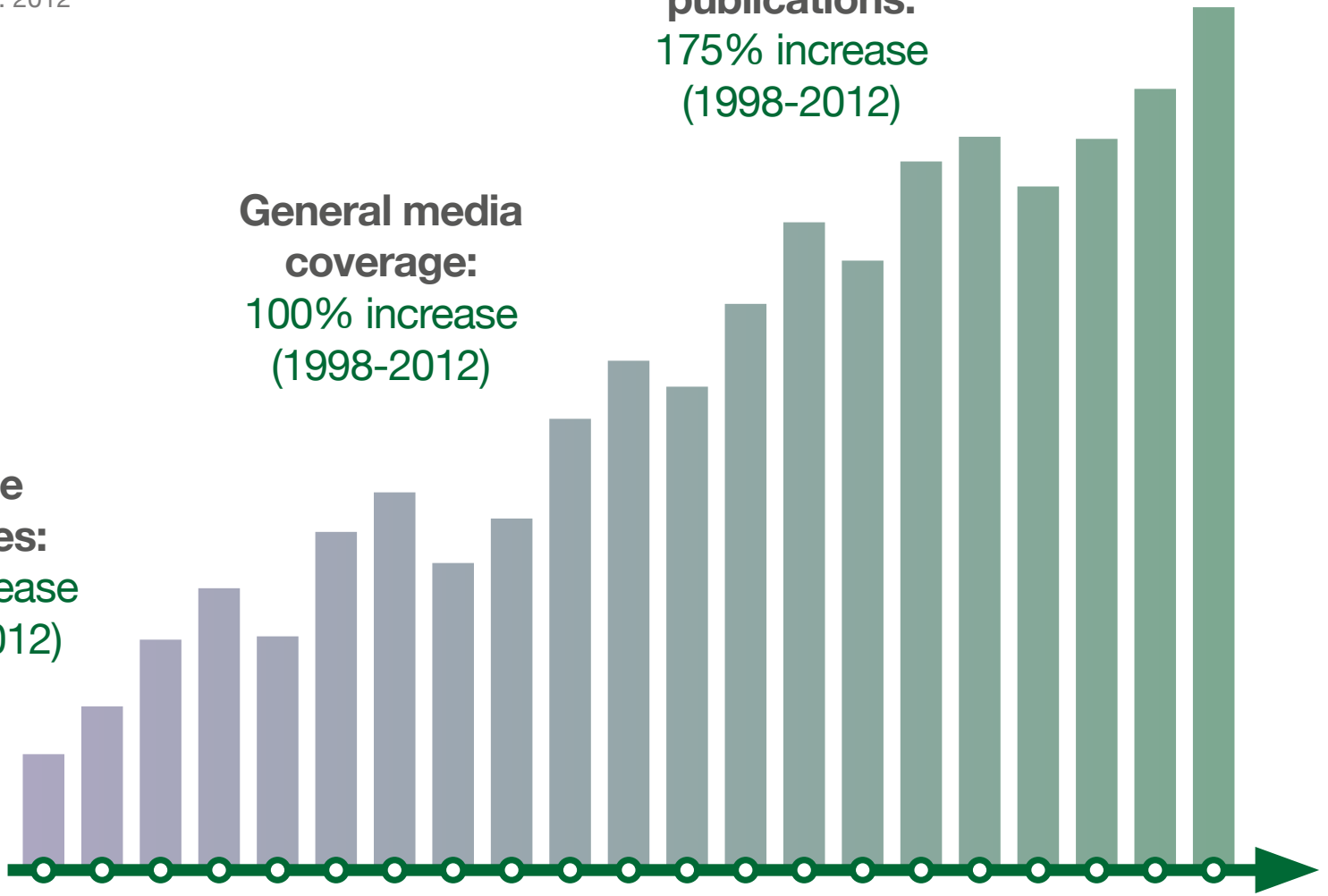
Seaweed market trends 1998-2012

1. Web of Science, Jan. 2012
2. Lexis Nexis, Jan. 2012
3. Google Trends, Jan. 2012

Scientific publications:
175% increase
(1998-2012)

General media coverage:
100% increase
(1998-2012)

Google searches:
60% increase
(2004-2012)



No other seaweeds deliver the Seagreens® quality assurance

Ascophyllum nodosum, *Chondrus crispus, Colpomenia sinuosa, Ecklonia bicyclis, Ecklonia cava, Enteromorpha compressa, Enteromorpha intestinalis,* ***Fucus serratus*** *and* ***vesiculosus***, *Gelidium sesquipidale, Gloiopeltis furcata, Gracilaria changii, Gracilaria corticata, Gracilaria salicornia, Gracilaria vermiculophylla, Himanthalia elongata, Hizikia fusiformis, Hypnea charades, Hypnea valentiae, Kappaphycus alvarezii, Laminaria digitata, Laminaria hyperborea, Laminaria japonica, Mastocarpus stellatus, Palmaria palmata,* ***Pelvetia canaliculata***, *Porphyra haitanesis, Porphyra tenera, Porphyra umbilicalis, Sargassum fusiforme, Sargassum ilicifolium, Sargassum marginatum, Turbinaria conoides, Ulva Pertusa, Ulva lactuca, Undaria pinnifitada.*

Of some 35 species identified in the latest international review of seaweed research for food and health*, only 4 species provide a certified nutritional profile, free of harmful allergens and contaminants , and are fully compliant with international food regulations, have track records over two decades in food and therapeutic use supported by independent applied scientific research, and are readily available internationally as food and nutrition supplement ingredients.

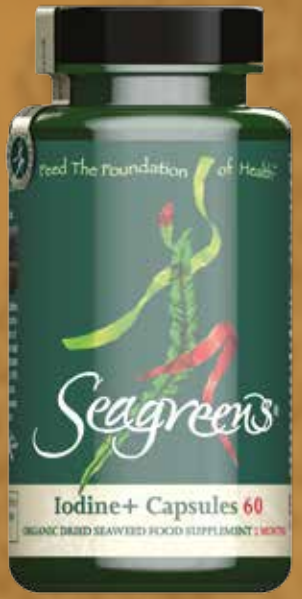
*Cornish M. L., Critchley A. T., and Mouritsen O. G., 2015. A role for dietary macroalgae in the amelioration of certain risk factors associated with cardiovascular disease. Phycologia, Volume 54 (6), 649-666

Using Seagreens® everyday

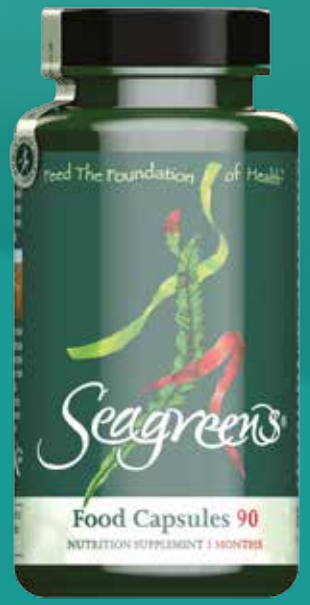
Seagreens®
Food Capsules
60 & 180 size
– a comprehensive dietary foundation from a special blend of 3 Wrack species

Seagreens®
Food Granules
& Capsules
– the granules work well in smoothies

Seagreens®
Iodine+ Capsules
– higher iodine 350µg in a one-a-day capsule for insufficiency



Seagreens®
Food Capsules 90
– one-a-day capsule with the complete nutrient balance but only 190µg iodine



Seagreens®
Salad & Condiment
– Pelvetia Large Pieces 50g jar

Soaked 5 mins in cold water, on penne with a pesto sauce ...

Seagreens®
Culinary Ingredient –
Ascophyllum Medium
Granules 200g jar

Seagreens®
Culinary Ingredient
– Ascophyllum
Medium Granules
200g jar

Brings out the flavour of
a pea and mint soup ...

Seagreens®
Culinary Ingredient
– Ascophyllum
Medium Granules
200g jar

Surprisingly good in
yoghurt ...

Making dishes at home

Seagreens®
Culinary Ingredient
– Ascophyllum
Medium Granules
200g jar

A teaspoon of Seagreens® 'Culinary Ingredient'. Add 3 times as much cold water.

Recipe © Thorkil Degn Johansson 2015

Seagreens®
Culinary Ingredient –
Ascophyllum Medium Granules 200g jar

6 minutes later all the water is absorbed. Mix well with saliva and later the digestive juices in the stomach. The real goodness begins…

Recipe © Thorkil Degn Johansson 2015

Seagreens®
Culinary Ingredient
– Ascophyllum
Medium Granules
200g jar

After soaking the Culinary Ingredient, blend with a little ghee and finely chopped garlic to make this nourishing recipe.

Recipe © Thorkil Degn Johansson 2015

Seagreens®
Culinary Ingredient
– Ascophyllum
Medium Granules
200g jar

Beef tartare on rye bread with raw egg, capers, garlic, sea buckthorn, and Thorkil's special 'Ascoghee'.

Recipe © Thorkil Degn Johansson 2015

To purchase a copy of Thorkil's Seagreens recipes please email post@seaweedhealthfoundation.org.uk

A growing range of products containing Seagreens

Sea Greens & Grain Broth by Sainsbury's

A typical salt replacement application

Clearspring oatcakes

Duchy biscuits

Saladworx salad dressings

Pukka organic bionutrients

Viridian Nutrition

Both brands use Seagreens in a number of products

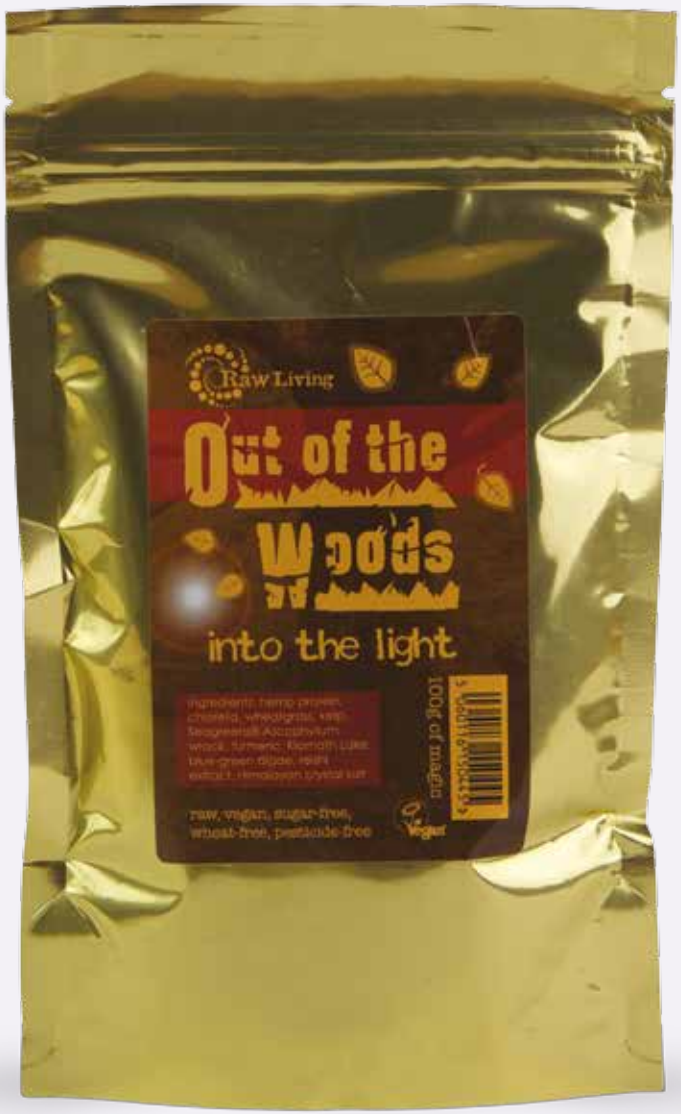
Bart sea salt & seaweed condiment

Napiers thyroid iodine capsules

Nosh raw smoothies

Artisan Bread Organic

Out of the Woods raw superfood powder blends




Seagreens® supports the
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