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Breaking new ground in Food Quality

At the Royal Botanic Garden Edinburgh in 2016, Tarry Bolger, the Managing Director of BDA Certification at the time, inaugurated a new production standard for 'Nutritious Food Seaweed'. But the idea was born of necessity a quarter century ago.

International standards for food safety and against pesticides, still do not ensure the consumer even a minimum nutrient content. Seagreens Trust and the BDA are exploring new approaches to food quality.

SIMON RANGER, FOUNDER OF THE SEAGREENS® PROJECT

When a small group began the Seagreens® project, no European industry produced food ingredients from our native seaweeds. Yet as a sustainable natural source of every nutrient we need in our daily diet, seaweed is a food for our times without parallel.

The project today delivers significant amounts of seaweed into everyday food and health products, continuing to lay the foundations of a worthwhile new industry in the British Isles and elsewhere.

Our story has progressed along the western European coastline like the tide, in waves, its impulse both the logic of sourcing rare minerals and other nutrients from the ocean, and a sense that small steps, over time can achieve great things.

A European industry

At the turn of this century, traditional artisan producers, especially in Ireland, France and the Iberian Peninsula, still collected seaweed for food. Often an adjunct to farming or another occupation, they cut and dried the seaweed by hand. Many now sell it on the internet.

At the other end of the spectrum is large-scale factory production, for horticulture, animal feed, and the industrial extraction of seaweed alginates.

None of this focused on the extraordinary range and density of nutrients in our native seaweed species, which corresponds precisely to nutrition deficiencies in vast swathes of the population. This is what our project aimed to rectify. Even today, where seaweeds are most needed for their consummate nutrition, they are least known or understood as food ingredients.

A British Nutrition Foundation scientist observed in 2007 that "The healthiness of a food alone seems to be an important determinant of food choice for only a small sector of the population. For this reason, implicit improvements in the nutrient profiles of foods by the food industry are essential to have any substantial influence on public health"[1].

Most seaweed in the UK is imported from East Asia where it is farmed in huge quantities, with the result that 'seaweed' means *Hijiki, Wakame or Nori*, the dark sheets round sushi or sticks in miso soup, rather than our abundant but unfamiliar native species like *Ascophyllum, Fucus, Pelvetia and Palmaria* (Knotted Wrack, Bladder Wrack, Channelled Wrack and Dulse).

Getting these into the population diet in everyday foods, required a comprehensive study of how they could contribute to human health. The time and investment needed was far beyond the means of small artisan producers, or the concerns of industrial scale production.

Navigating the hurdles

The Seagreens® project aimed to get seaweed ingredients into a wide range of daily foods and drinks, whose taste and appearance may not change, but which would contain those 'implicit improvements in nutrient profile' which could reach large sections of the population.

We began a research programme in 2008 to study the whole composition of our seaweeds; clarify exactly how they could address our most ubiquitous health concerns; and ensure they would pass the most rigorous food safety audit.

In the market, by-products from industrial scale production limited seaweed to cheap 'kelp tablets', while dried seaweed from artisan producers and exotic imports restricted its culinary use to a tiny niche of enthusiasts for macrobiotic and oriental foods.

When we introduced seaweed food ingredients, underpinned by our research, it was unknown to most consumers and manufacturers. Even the burgeoning health and natural food stores, keen to promote organic and wild foods, wrestled with the idea of seaweed culinary ingredients and capsules as appealing sources of nutrition.

The final hurdle was ignorance of seaweed among the regulatory authorities. In the rare cases where seaweed is included at all, the regulations are inappropriate, and all of this still inhibits investment.

While there is no such thing as toxic seaweed if produced to a sufficient quality standard, some of our most nutritious species remain 'unauthorised', placing undue pressure on too few permitted species.

In the United States, where harvesting overcrowded a relatively

Simon Ranger and Geoff Hurst examining seaweed. Picture credit: Simon Ranger

small north Atlantic coastline, the Federal Government recently intervened, too late, to stop a few species being depleted and the marine environment disordered.

Nonetheless, by 2012, with positive results from our research and three remote harvesting locations in the British Isles and Nordic region – and a Crown Estate sustainability award – we launched the *Seaweed Health Foundation* at the Natural History Museum in London.

With other organisations, like the Royal Botanic Garden Edinburgh, we began a programme of public and professional education. We formalised the production methods which underpin the nutritional quality of our seaweed ingredients. UK Research Councils called Seagreens 'A Big Idea', among the most promising British research in the previous 5 years.

Healthcare professionals, manufacturers and consumers now recognise Seagreens as functional foods with known health benefits, stemming from their unusual prebiotic, mineral, fatty acid and dietary fibre nutrient groups.

In 2015 and 2017, the Seagreens studies were confirmed in two international reviews of seaweed nutrition research, published in a range of scientific journals.

The first review focused on how seaweed could help ameliorate the causes of degenerative conditions, like cardiovascular disease, obesity and diabetes, while the second focused on its potential benefits for brain health against cognitive impairment and dementia.[2, 3] By 2016, the Seaweed Health Foundation and BDA Certification were ready to announce the *Nutritious Food Seaweed* quality assurance scheme and standard.

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

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

Filling the gaps

All food products must comply with international food safety standards, and like Demeter for biodynamic farming, there are standards to address specific issues, from special needs diets to religious concerns.

But neither the production of wild seaweed, nor its composition, radically different to land grown foods, fit easily into the regulatory framework devised for conventional foods.

Given the special biochemistry of seaweed, its rapid deterioration once removed from the ocean, and its unfamiliar appearance and taste, no present standard differentiated between nutritious and denatured seaweed and could not reassure the consumer.

Seaweeds are remarkable not because they are the most appetizing food known to man – though ubiquitous in Japan, less than 2% in the traditional diet, equivalent to a few grams per person, a teaspoonful per day – but because, unlike land grown foods, they contain a little of every nutrient, many rare yet valuable. They fill the gaps in other foods, while also being unsuitable to replace them.

The tables illustrate differences between PUFAs (polyunsaturated fatty acids) in Knotted, Bladder and Channelled Wrack; how their minerals compare with common land grown foods; and how example nutrients have been improved by NFS certified production.

The singular point is that a very small amount of nutritious seaweed has a disproportionate effect in the daily diet. The entire progress of our project has pursued this founding goal of 'a gram of the best seaweed in the population daily diet'.

Nicolaus Remer's *The Laws of Life in Agriculture*, read in 2006, gave me one of those peculiar signposts which not only instructs, but at a profound level affirms one's sense of direction. Early German trials using Steiner's medicinal herbs in various feed regimes "even in minute quantities" (1g per animal per day, 10% of the preparation) produced remarkable improvements in the treated animals' chemical composition and behaviour.

Over the years we have shown the same scientifically in humans. At the end of 2020, our Director of Operations, Geoff Van Hurst,

Over the years, the collection of consistent, independent analytical data from each harvested batch, continues to guide production and improvements continue to be made.

Nutrient Data averages over 10 years from 2008-2018

	Specification	Measure	All *Ascophyllum* to 2016	All *Fucus vesiculosus*	All Scotland *Ascophyllum*	*Ascophyllum 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	-
Particle size	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	0.327	0.417	-	-
Cystine	TBA	g/kg	0.073	0.295	-	-
Cystathionine (free)	TBA	g/kg	-	-	-	-
Glutamic acid	TBA	g/kg	0.400	0.579	-	-
Glutamine (free)	TBA	g/kg	-	-	-	-
Glycine	TBA	g/kg	0.154	0.193	-	-

Nutrient improvements over 10 years

Vitamin C up a further 131%

Polyphenols up a further 6.5%

compared the nutritional quality of our seaweed in 2016 with the latest independent laboratory test results. *"Vitamin C in our Knotted Wrack has increased 1000% to 0.6 milligrams per gram. Polyphenols, that broader group of protective nutrients found especially in fruits, berries and seeds, by 54% to almost 40,000 micrograms per gram. Research shows this is higher than green tea, a common yardstick for antioxidant capacity. The corresponding increases in our Bladder Wrack, are 3000% to almost 0.2mg Vitamin C and 471% to 39,000µg polyphenols."*

The biodynamic approach

In drafting its vision in 2014, Demeter International considered the word 'culture' in Agri-Culture to be "not only about cultivating farming land, but really the development of humans and the earth. *We therefore conceive the term broader than we used to (so that) agriculture is seen as an essential foundation for social development and will gain in importance as it provides solutions for the burning issues of the present".*

As we carry this work outward, equally we need to understand what is meant by 'nutritious' and 'sustainable'. It is clear that the natural balance of nutrients in seaweed, and their relationship, is of greater value to the recipient organism than the nutrients alone. For example, it is not necessarily the case that 400mg of a mineral has greater value than 400µg, a thousandth of the amount.

It seems that a particular food or nutrient, no less than an individual life, can be imbued with greater vitality than others. There is the sense that in the human body, too little nutrition is better than too much – and so on.

As a result, issues arising from the introduction of seaweed to the human food chain – not just in food such as bread or cheese-making, but in animals, plants, soil, composting and seed preparation (in which we are now engaged) – deserve further scientific and spiritual research.

There is no systematic comparison of our own and seaweeds widely eaten in other countries, especially Japan, yet we have much to learn from their traditional practices such as fermentation and other means of processing.

The degree to which it is appropriate, or practicable, to bring seaweed within the scope of Demeter certification also remains to be explored.

To mark the 25th anniversary of our project, we have formed the Seagreens Trust, in which all our partners and customers may now involve themselves, hopefully to guide and pursue these worthwhile efforts far into the future.

PUFAs in three native wild Seagreens® seaweeds Ascophyllum, Fucus and Pelvetia. Nutritional information: Seagreens Trust 2012-2020 species comparative analysis.

(PUFA = polyunsaturated fatty acids)

PUFA	(mg/100g)	(mg/100g)	(mg/100g)
Total EPA + DHA Omega-3	78.310	111.950	270.650
Omega-3	169.100	252.900	687.900
Omega-6	512.900	579.650	2068.000
Omega-9	1245.000	1044.450	2783.300
Omega-3:Omega -6 ratio	0.606 (ratio)	0.416	0.416
Alpha-linolenic acid (ALA)	49.500	81.400	269.600
Eicosapentenoic acid (EPA) mg/100g	0.500	111.380	269.820
Docosapentaenoic (DPA)	0.400	0.785	0.2
Docosahexaenoic (DHA)	0.500	0.970	0.2

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