SEAWEED & Co.

Iodine White Paper

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Table of Contents

Abstract

Iodine is an essential micronutrient, required for thyroid function, which impacts on numerous developments in the body.

Globally, Iodine Deficiency Disorder is one of the biggest public health issues. The UK is one of the most iodine-deficient countries in the World, being one of only two high income countries on a recent list.

With limited iodine from land plants, the main food contributors of iodine in the UK are seafood, dairy and seaweeds.

This white paper highlights how seaweeds, of the right species, with appropriate sustainability, safety and quality assurances, is a good and natural solution to addressing iodine deficiency disorders.

Seaweeds, in a dried and milled form, are straightforward to include in food, beverage and nutritional supplement products, and with multiple benefits beyond iodine alone.

Introduction to Iodine

Iodine is one of the essential elements required for normal human growth and development. The body needs iodine to make thyroid hormones. These hormones control the body's metabolism and many other important functions. Getting enough iodine is important for everyone, especially infants and women who are pregnant. As the body does not make iodine, it is an essential part of the diet[i].

There is limited iodine in topsoil, especially where there is regularly leaching from rain and flooding, and where intensive agriculture has not replenished iodine. This leads to few land plants with iodine content, and the iodine availability in land plants being geographically limited[ii].

Iodine Deficiency

Iodine Deficiency Disorder (IDD) issues are one of the biggest worldwide public health problems of today. Their effect is hidden and profoundly affects the quality of human life[ii].

Whilst coastal locations are richer in marine-derived iodine, and seaweeds and seafood can be excellent sources, living on the coast does not guarantee iodine sufficiency. Significant pockets of iodine deficiency have been reported from coastal regions in different parts of the world[iii].

In the 1990s, 1.6 billion people, that was 28.9% of the earth's population, were at risk of iodine deficiency[iii], and which is a situation that has not improved. About 50% of Europe remains mildly iodine deficient, and iodine intakes in other industrialised countries, including the United States and Australia, have fallen in recent years[iv].

The total number of older adults at risk for development of hypothyroidism, which can be caused through iodine deficiency, steadily increases with age. It has been estimated that there were almost a quarter million individuals with hypothyroidism resulting from treatment of Grave's disease in the United States alone in 1980, with a considerably larger number at risk[v]. Hypothyroidism is invariably listed as one of the causes of potentially reversible dementia in older adults[vi]. Hypothyroidism may lead to irreversible mental deficiency in the newborn, and early treatment can prevent this outcome[vii,viii].

Impacts of iodine deficiency linked to the functioning of the thyroid may include brain development and cognitive health, the functioning of the metabolism, skin conditions, and certain cancers.

The shocking statistics for the UK is that the country "now ranks seventh among the ten most iodine-deficient nations in the world, one of only two high income countries on the list" according to a 2016 new alert from the Iodine Global Network, reporting from the highly regarded medical journal The Lancet.[ix]

Four groups that may be at risk of low iodine status in the UK include:

1. Teenage girls - Mean iodine intakes of girls aged 11-18 years are not meeting the RNI[x] and this group may be at risk of low iodine status. It is critical for women of child bearing age to have sufficient iodine intakes, as inadequate iodine intake during pregnancy can impair fetal development
2. Dairy avoiders - Reducing and removing dairy products from the diet is a growing trend in the UK. Individuals that have lower urinary iodine concentrations are also low dairy consumers[xi]. Mean daily consumption of liquid cows' milk fell from 136g in 1997 to just 110g in 2008-11 for girls aged 11-18 years[x].
3. Vegans - the exclusion of dairy products and fish from their diets, puts vegans at serious risk of inadequate iodine status[xii]. A study of 39 "healthy" British vegan volunteers showed this group had a median UIE of 20.1 µg/L; which, according to WHO criteria, is indicative of severe iodine deficiency[xiii].
4. Sufferers of milk allergy, lactose intolerance, fish allergy or ethnic minority groups that do not consume milk and milk products may also be at risk[xiv].

According to WHO, the recommended dietary allowance of iodine is 50 µg/day from 0 to 6 months, 90 µg/day from 6 months to 6 years, 120 µg/day from 7 to 10 years, 150 µg/day during adolescence and adulthood, and 200–300 µg/day during pregnancy and lactation[xv].

The UK Reference Nutrient Intake (RNI) for iodine is 140 µg per day for adults (including pregnant and lactating women), and between 50 µg and 140 µg per day for children, depending on their age. The advice from the Committee on the Medical Aspects of Food Policy (COMA) that pregnant and lactating women do not need increased intakes of iodine compared to normal adults was based on the assumption that women entered pregnancy with adequate thyroid status and iodine stores. However, dietary intake data from the National Diet and Nutrition Survey (NDNS) indicate that approximately a fifth of non-pregnant girls aged 11-18 years in the general population are at risk of low iodine intakes[x].

The best sources of iodine can be found in seaweeds, seafood, and some amounts in milk, eggs and fortified foods. But not all iodine sources are made equal.

Seaweed as a safe, natural and vegan source

The use of iodised salt in the food industry is compulsory in 18 out of 43 countries in the WHO European Region[xvi]. In the US, iodised salt and seafood are the major dietary sources of iodine. The UK has no current salt iodination programme.

The iodine used for iodised salt is an artificial source of iodine, which, whilst effective to a significant extent, has been shown to be less desirable as compared to natural sources of iodine.

These natural sources of iodine can be limited, with the primary sources of an adult's daily intake[xvii] being fish and fish products (11%), beer and lager (11%), cereal and cereal products (10%), eggs and egg dishes (6%), milk and dairy foods providing (33%).

Seaweed is known particularly to be a good natural source of iodine. Even living in a coastal location can improve iodine intake and associated health, as compared to those that live in non-coastal locations. A two-decade study, published in the Irish Medical Journal[xviii], explored the health of people around coastal areas as compared to non-coastal. It found that there are physiological health benefits of seaweed from breathing in the iodine emitted from the seaweeds.

However, it is important to recognise that with around 10,000 species of seaweed globally, there is much diversity, and different seaweeds have vastly differing levels of iodine. Therefore, the seaweed species should be understood, as well as the source and processing of any seaweed product you may use. This

level of knowledge should extend also to general quality and nutrition of all seaweed ingredients and products, and should be properly reported by suppliers and finished products where appropriate[xix].

The differences in naturally occurring iodine and artificial iodine used in some supplements and in iodised salt can be profound. A study published in the British Journal of Nutrition[xx] demonstrated that iodine intake from an artificial source of potassium iodide was highly bioavailable, but quickly excreted, whereas the iodine intake from seaweed was slower to release, with excretion over a longer period. This indicates that iodine from seaweed may be a more effective source of iodine to give a more controlled and consistent release to the body as compared to artificial sources, which may shock the system with high levels of iodine and then be excreted within hours.

Figure 1: Urinary iodine excretion comparison between sources of iodine: potassium iodide (red line) and Hebridean Ascophyllum Seaweed (used for PureSea®) (green line)[xx]

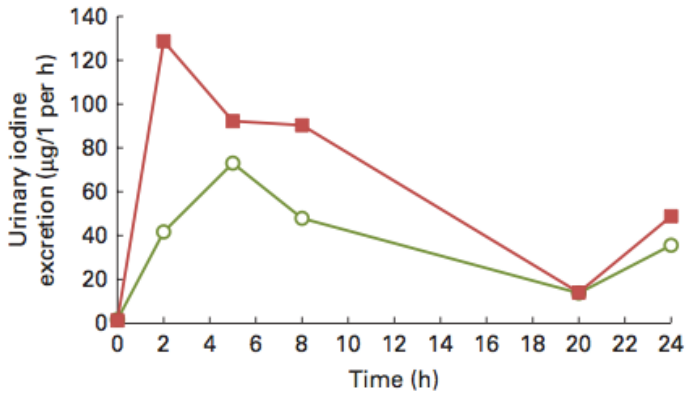

Figure 1 displays the urinary iodine excretion over 24hrs from this study[xx]. The women in the study had the same intake of iodine - either as potassium iodide (red line), or the PureSea® seaweed species (green line) and it is clear that the excretion was lower with the seaweed meaning that more was retained in the body over a longer period.

The study concluded:

"We found a difference in the amounts of iodine excreted between those with either sufficient or insufficient iodine intake, as described previously[xxi]. This is consistent with the generally held view that most of the iodine will be excreted in urine if iodine stores are replete. In vitro digestion confirmed the limited release of iodine from the seaweed matrix in the first gastric and intestinal phases of simulated digestion. We found that colonic fermentation of seaweed is important to free iodine from the seaweed matrix, with the mechanism being reliant on the fermentation of the polysaccharide matrix[xxii] or metabolism of organic iodine[xxiii]. Therefore, the seaweed matrix may delay iodine absorption (compared with KI), with iodine being released from the food over a longer period."

This conclusion may explain reports of highly excessive iodine intake from eating relatively large quantities of seaweed by Japanese fishermen, but with only few cases with any issues of mild effects of iodine excess. This was reported in the UK Department of Health's Report on Health and Social Subjects: Dietary Reference Values for Food Energy and Nutrients for the United Kingdom[xxiv], which states, to summarise, that intakes of up to 5000 mcg per day (i.e. over 7 grams of *Ascophyllum* seaweed) has shown only few cases with any issues of mild effects.

In cases where seaweed has been linked with thyroid problems, such as the 6 - 12% of Japanese fishermen who have goitre, it has been found that their intakes are 10 - 20 mg/d (10,000 - 20,000 mcg) of iodine (i.e. 14 - 28.5g of Ascophyllum). To put this in further context, a capsule of Ascophyllum seaweed would be

typically 0.5g, and thus require 28 to 57 capsules per day to be consumed.

This is not to say some people are not iodine sensitive, but that a natural source may be a safer source than artificial sources for this small proportion of a population.

The UK Report's chapter on iodine states the following:

"Guidance on Intakes: High iodine intakes can cause toxic modular goitre and hyperthyroidism. Few cases of toxicity have been reported in people with intakes of less than 5000 mcg/d although transient mild effects have been demonstrated in previously deficient individuals receiving only 150 - 200 mcg/d.

Normal subjects with intake of 1,000 - 2,000 mcg/d showed an increased iodine concentration in the thyroid gland, but no other changes.

An intake of 10 - 20 mg/d (iodine not seaweed) in Japanese fishermen resulted in an incidence of iodine goitre in 6 - 12%. There appears to be a weak relationship between consistently high iodine intakes and thyroid cancer. The placenta is permeable to iodine and the foetus is more susceptible to iodine–induced hyperthyroidism than the adult. Transient hyperthyroidism has been reported in neonates following high iodine exposure in the mother, particularly in areas of iodine deficiency. Because there remains a small number of elderly people in the UK who may be sensitive to high intakes, the Panel recommend that the safe upper limit on intakes of 17 mcg/kg be retained, or not more than 1,000 mcg/day."

A subsequent review by the Expert Group on Vitamins and Minerals (EGVM) concluded that iodine intakes of 940 µg/day would not be expected to have any significant adverse effects in adults (who had not been iodine deficient)[xxv].

Benefit from seaweed in your products

The right supply of seaweed is critical, and in a form that makes it easy and convenient to use.

Seaweed & Co.'s PureSea® range of naturally innovative seaweed ingredients are from pristine waters in the Scottish Outer Hebrides, with unique and high quality processing (International Patent Pending), full and transparent traceability, and with world-experts on hand to advise.

As displayed in Figure 2, the PureSea® ingredients are supplied in a dried and milled format, and so is easy and convenient to use in capsules, green/superfood blends, foods, beverages, and a wide range of functional food applications. With a variety of different formats and flavours, the PureSea® range is highly versatile:

- **PureSea® Natural**: Organic Hebridean Ascophyllum Seaweed
- **PureSea® Smoked**: Naturally Oak Smoked Organic Hebridean Seaweed
- **PureSea® Protect**: Microencapsulated Hebridean Seaweed, with no flavour and soluble in water

Figure 2: Image of the PureSea® range

For more details on the range, please see: www.seaweedandco.com/puresea

Figure 3 demonstrates the gram-for-gram comparison with other known sources of minerals, highlighting how the PureSea® ingredients are ideal to complement green blends, and boost the overall nutrition of finished products and functional foods. In products such as smoothies and green blends, a small addition as little as 100mg can enable EU Approved Health Claims as a good source of iodine.

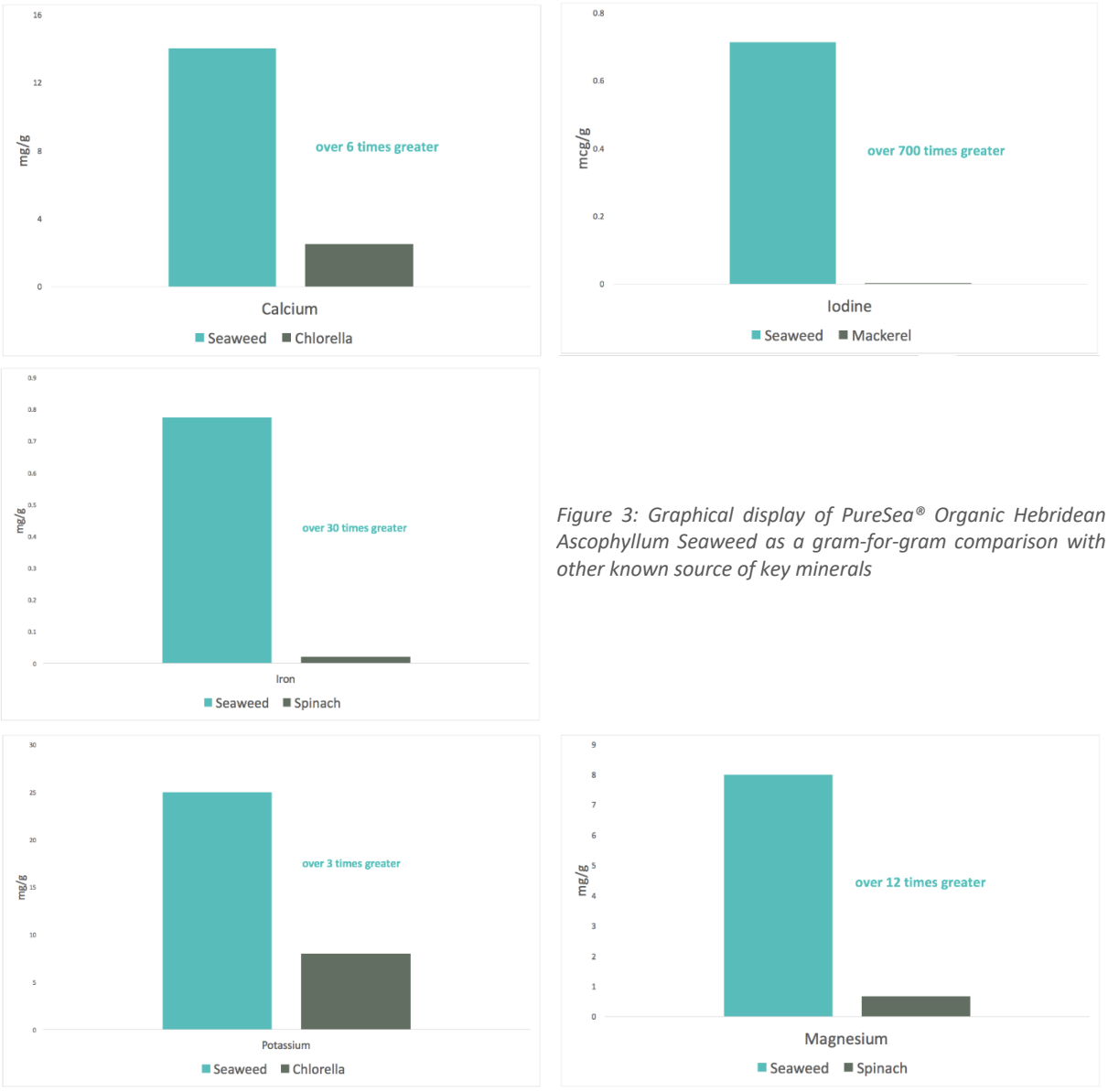

Figure 3: Graphical display of PureSea® Organic Hebridean Ascophyllum Seaweed as a gram-for-gram comparison with other known source of key minerals

Conclusion

The issues of iodine deficiency globally are clear, being labelled as one of the biggest worldwide public health problems of today. Finding solutions, from safe and natural sources must be achieved.

With the proper source, species, and quality assurances, seaweeds offer an extremely viable, sustainable and under-utilised source of iodine in the daily diet through food ingredients and nutritional supplementation.

About the Authors

Craig Rose PhD is Managing Director of Seaweed & Co. He is actively involved in numerous research projects with Universities in the UK, is guest member of staff at Newcastle University, where has supervised a PhD and other seaweed research projects. He sits on the Applied Algae Group of the British Phycological Society, and is on the management group of the Scottish Seaweed Industry Association.

Seaweed & Co. advise on, supply and accredit seaweed, using patent pending technologies and techniques to produce their PureSea® range of seaweed ingredients. Their Organic, Vegan, Allergen Free and Kosher certified PureSea® seaweeds are supplied into the food, health and nutrition markets. Their seaweeds are sustainably wild harvested in pristine waters, naturally rich in iodine, uniquely DNA Authenticated for world-class analytical traceability, extensively batch tested, and accredited for safety and quality.

Philippa Wallis is an independent nutrition consultant. Highly respected in her field of nutrition, having worked as Company Nutritionist for Mitchells and Butlers; a pub and restaurant chain with over 1,600 outlets and turnover of around £2billion. Philippa has previously worked with Innocent Drinks and Sainsbury's. Her experience includes defining and delivering nutrition strategy, providing nutritional information for menus and advising on menu claims, working throughout the supply chain. She has supported development chefs on the creation of healthier options for menus, and delivered commitments to the Government Food Responsibility Deal food pledges. She is involved in various working groups and external forums.

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