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Different Seaweeds Use for Iodine Deficiency Overcome

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ABSTRACT

Iodine deficiency is one of the three most common nutritional deficiencies worldwide and is a global public health problem that affects particularly the young children, pregnant women and elderly. The consequences of iodine deficiency disorder (IDD) include goiter and cretinism. The traditional consumption of iodine via supplemented salt should be monitored to reduce population sodium intake due to hypertension problems and the uncertain bioavailability of iodine in the supplemented salt. One approach for an effective and cost-efficient iodine supplementation is the use of seaweeds in food intake. Seaweeds, among all foods, are the most famous and reliable source of natural iodine. In this mini-review we pretend to explore the different uses of seaweeds to fill the iodine deficiency and improve life quality.

Abbreviations: T3: Triiodothyronine; T4: Thyroxine; WHO: World Health Organization; FAO: Food and Agriculture Organization; IDD: Iodine Deficiency Disorders

Introduction

Iodine is an essential mineral that is vital for the synthesis of thyroid hormones, triiodothyronine (T3) and thyroxine (T4), which play key roles in metabolism [1] including the increase of protein synthesis, improvement of metabolic activity promotion of growth and maintenance of normal brain function [2]. Iodine deficiency can cause among others per example, goiter, hypothyroidism, cretinism, deaf-mutism, mental retardation, congenital anomalies [3]. The most susceptible groups for iodine deficiency are young children, pregnant women and women that are breastfeeding, besides, in some situations, represents a significant hazard to national, social and economic development [4,5]. Based on the proportion of the population that presents urinary iodine <100µg/L (clinical analysis to estimate iodine concentration in the body), 2 billion of persons worldwide are at risk of insufficient iodine intake [5] and around one third of the world's population lives in areas where natural sources of iodine are low [4]. The World Health Organization (WHO) and UNICEF, recommended universal salt iodization, in 1993, recognizing the need to prevent the iodine deficiency disorders (IDD) [6]. Salt iodization has been implemented in more than 120 countries and could be a feasible option for preventing iodine deficiency on a global scale. In fact, many of these countries have successfully eliminated IDD or made a considerable progress in their control, principally as a result of salt iodization [4]. In 2003 the WHO and the Food and Agriculture Organization of the United Nations (FAO) recommended the reduction of salt intake and food content by less than 5g/day, ensuring the adequate salt iodization. Since 2010 this action was accelerated to reduce blood pressure and risk of cardiovascular disease in adults caused by excessive consumption of salt in the diet. The outcomes of salt consumption reduction might help re-emerge the iodine deficiency disorders in some countries [7].

The population diet improvement includes strategies as habits education, public health, dietary diversification, food fortification and supplementation [5]. An adequate diet should supply quantities of micronutrients, energy, protein, essential fat acids and other food constituents required for optimal health, including

iodine [5]. Many marine resources are known as functional foods [8]. Among those, the seaweeds highlights, since they are rich in unique bioactive compounds which are absent in terrestrial food sources [9]. These compounds include proteins rich in essential amino acids, polyphenols; PUFAs and polysaccharides, that can be used for mankind nutrition [9]. The seaweeds are also a rich source of several essential minerals, that includes, among others, iodine [8]. Some seaweeds have been regularly used for medical and food purposes for centuries in Japan, Korea and China [10]. In China, *Laminaria japonica*, is use as a dietary iodine supplement to prevent goiter. Also, *Laminaria digitata* is used as a supplement for myxedema and for goiter treatment [11]. There is a clear evidence that seaweeds consumption increases iodine levels in humans. The measurement of the serum levels of thyroid hormones in combination with well-defined ingestion rates of *Saccharina japonica*, showed that the urinary excretion of iodine increased [12]. A regular seaweeds ingestion can assure the iodine recommend daily intake, representing a food supplement that can improve the nutritive value of a healthy diet [10]. On the other hand, similar with other foods, excess of iodine can be harmful, since it can induce either to hyperthyroidism. The high levels of iodine in some brown macroalgae and their overconsumption could be unhealthy [12].

The iodine in edible plants is originate exclusively from the soil uptake and about 80% of iodine in the humans and animals derive from this kind of food [13]. Different approaches have been developed to guarantee a better iodine intake for man. Studies shown a significant improvement of iodine concentration in vegetables when they were cultivated using algae organic iodized fertilizer (*L. japonica*). So, the algae fertilization provides macro and micronutrients for biofortification, improving the soil edaphic properties [2]. Another approach to mitigate the iodine deficiency is the use of seaweeds in animal feed. Freshwater fishes feeding with *L. digitata* results in a significant increase of the animal's iodine content. Volunteers that fed on the fish, had their urine measured before and after the fish consumption, being the iodine content higher after the ingestion [14]. Growth of rainbow trout, with red seaweed *Gracilaria vermiculophylla* showed that iodine contents in the fish flesh doubles in relation to the control [15]. The feeding of hens with *Eucheuma spinosum* determines the significant increase of iodine concentration in its eggs. Iodine contents in urine also increased after these egg's consumption by 24 volunteers [16]. The lack of iodine is a global concern, and regionally as well. In 2012, Madeira Archipelago studies were carried out to assess the iodine content in 311 children aged between 6 and 12 years and with 196 pregnant women. The results showed that 68% of the children had iodine deficiency and 92% of the pregnant women had unsuitable values (<150μg/L) (17).

These results led to a university-enterprise partnership between University of Madeira (BG ISOPlexis) and UBQ II (Unidade de Bioquímica II), aiming to analyze the use of algae to mitigate this situation. Biochemical composition and antioxidant capacity of seven seaweeds were analyzed and showed that they were suitable to be label as functional foods production [18]. In this study one seaweed, *Asparagopsis taxiformis*, aroused interest due to their iodine values. A complementary study was done aiming to determine this algae potential as a source of iodine. The results demonstrated that *A. taxiformis* is a valuable source of bioactive compounds with a great potential to be use as a nutraceutical supplement [19]. Besides the importance of seaweeds consumption in the prevention of iodine deficient, they also demonstrate potential benefits for digestive health, weight management, and chronic disease prevention (cancer, cardiovascular diseases, diabetes and osteoporosis) [9]. The alternatives presented in this mini-review does not have the intention to substitute the salt iodization, on the contrary, comes to aggregate information and possible complement salt iodization programs. In countries were the salt supplemented with iodine is not mandatory, or the population has serious risk regarding salt-related diseases, seaweeds are an effective alternative for iodine supplementation.

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