

SEAWEED AS MICRONUTRIENTS INGREDIENT FOR FOOD SUPPLEMENT

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ABSTRACT

In some part of Indonesia seaweed has been used as vegetables dish. The most important component of seaweed is iodine and iron. *Gracillariasp* is one species of seaweed that can be used as a source of the micronutrients such as iron, iodine and calcium. Iron Deficiency Anemia and Iodine Deficiency Disorder can cause several diseases also known low haemoglobin level and iodine level in the blood. This preparation of *Gracillariasp* could supplement micronutrients in the diet. This study was to develop appropriate local technology of *Gracillariasp* contained as an ingredient in the making of food supplement for improvement of micronutrients intake. The experimental study uses optimum formulated composition from seaweed. Based on the practical in the area (Bali), the formula of seaweed composed of seaweed of *Gracillaria* with additional of 20 % salty fish extract, 5 % dextrin. The seaweed contains high of carbohydrate, iodine, calcium and iron but low in protein and lipid. Appropriate technology of dried seaweed supplement could be prepared at home. These seaweed supplements could be advocated in rural area level or posyandu for combating under nutrition status of the children. The formula of direct seaweed inclusion in the supplement is preferred due to green colour and acceptable taste compared to dried seaweed. The serving size of 25 g of this product could cover children's need about 23 % in iodine, 100 % in iron and 22-35 % in calcium.

Keywords: seaweed, *Gracillariasp*, iodine, iron, food supplement

INTRODUCTION

Malnutrition is still cause of death of nearly half of the children in developing countries. The main nutrition problems are protein energy malnutrition (PEM), vitamin A deficiency (VAD), iron deficiency anemia (IDA) and iodine deficiency disorder (IDD). The interaction of micronutrient deficiency is related to nutritional status due to metabolism of protein and energy less efficient and therefore clinical signs are detected. Micro nutrient include vitamin A, iron and iodine must be available in daily intake of food consumption to combat nutritional problems (Hidayati *et al.* 2010; NIHRD 2008).

It has been known that macro-algae is one of marine plant rich in pigment and also micronutrient content. In some part of Indonesia, especially Bali, seaweeds of *Gracillaria* and *Caulerpa* have been consumed as vegetable (salad of seaweed) made of *Bulunghijau* (*Gracillariasp*) and *Bulungbunih* (cauliflower). These seaweeds of *Gracillaria* is generally known as producer of agarophyte as primary metabolism and extraction of this seaweed in the condition of acids or bases, marketed in various forms, for example, agar-agar powder, paper and agar-agar bars and processed into various forms of snacks (cake), pudding, jelly, and supplementary materials used in the pharmaceutical industry. Gelatin content is relatively high

and consumed as a functional food. Through a certain process of gelatin also produced into media for use in the laboratory as a medium for bacterial culture or tissue culture (Komari *et al.* 1997; Rasyid 2004).

Bulunghijau (*Gracillariasp*) is one species of seaweed that can be used as source of the mineral include iodine, iron and carotene. Carotene had been used as vitamin A sources supplemented into noodle, since carotene can be converted becomes vitamin A (Retinol). Iodine and iron are the most important component of seaweed could be used as food supplements for improve intake of Iron and iodine.

Present nutrition intervention inform of supplements were iron, iodine and vitamin A capsules in high doses to improve nutritional status of the target subjects given for 6 months or 2 years. In traditional technology, the empowerment of people to use traditional seaweed for micronutrient intake can be formulated into daily food consumed by target subjects. This food enriched with micronutrient would be beneficial for appropriate technology of community in house fortification.

The role of community is important for successful of this program. Community may have active role in improving nutrient intake of the family by program in house fortification such as micronutrient fortification in main dishes during consumption. The local technology must be rich in micronutrients content and also ease to prepared and improve stored time (Lamid *et al.* 1999).

The product available at the present was in form of sheet or dried product with specific taste. In Indonesia such as Bali, seaweed is consumed with salted fishy taste as snack or to be eaten side dishes of rice (Dawezsky *et al.* 2007). Bulung hijau (*Gracilaria sp*) used in this study can be prepared into food supplement or formula of fortification of micro nutrient. This product must be dried so that can be distributed whole year, and keep the micronutrient available in high concentration by formulated with dextrin. The formula is developed into thin sheet or dried granule that soft and eatable as side dishes.

MATERIALS AND METHODS

1. Materials

The materials that used in this research were :Bulunghijau(*Gracillariasp*)were collected from Bali. Salty fish extract that used in this research was collected from the craftsman maker boiled fish at Bogor-Indonesia, and Dextrin Powder as fillers.

2. Methods

2.1 Seaweed supplement preparation

Formulation of seaweeds into nutrient supplements for fortification in house hold level based on dried powder. The seaweed of Bulunghijau (*Gracilariasp*) were taken from Bali with salty fish extract and this special taste would be considered into product development. First, bulunghijau (*Gracillariasp*) were thoroughly cleaned with running water to remove foreign materials such as epiphytes, sands, and shells. Then the seaweed was cleaned with boiling

water to remove particles or mucous attaching in the surface of the leaves. There were two seaweed formulations in this study:

- a. The cleaned seaweeds were blended until obtained a very small particle and mixed with 10 % dextrin (w/w) and 20 % (w/v) salty fish extract. Then the mixture was mixed well and dried with oven at 60° C temperature until dry completely.
- b. The cleaned seaweeds were blended until obtained a very small particle, then it was dried and mixed with 10 % (w/w) dextrin and 20 % (w/v) salty fish extract. Then it was stirred well and dried with oven at 60° C temperature, until dry completely.

2.2 Proximate analysis

The proximate chemical composition (protein, carbohydrate, crude lipid, fiber, ash and moisture content) of the seaweed was determined according to the ASEAN Food standard method. Protein content was analyzed by the Kjeldahl method. A conversion factor of 6.25 has been used to convert total nitrogen content into crude protein. Carbohydrate content was determined as the weight difference using crude protein, lipid, fibre, moisture and ash content data. Crude lipid of the seaweed was extracted from seaweed powder in a Soxhlet extractor with petroleum ether. After ensuring complete extraction of crude lipid, petroleum ether was evaporated and the residue was dried to a constant weight at 105°C. To determine the fibre content of seaweed 2 g samples were boiled with diluted H₂SO₄ (0.3 N). Then the mixture of sample and H₂SO₄ was filtered and washed with 200 ml boiling distilled water and NaOH (0.5 N). After washing by boiling distilled water and acetone the residue was re-extracted and dried at 105°C to constant weight. The moisture content was determined by drying the seaweed samples in an oven at 120°C until a constant weight was obtained and the ash content was estimated by heating the seaweeds in a muffle furnace at 550°C for 4 h (ASEAN FOODS 2011).

2.3 Minerals Analysis

The minerals (Ca, Fe and Na) content of samples was analyzed by atomic absorption spectrophotometer (AAS), except iodine used spectrophotometer.

2.4 Calcium, Iron, Sodium determined using AAS:

a. Calcium Analysis Procedure :

Samples were prepared by dry ashing and the mineral was diluted in Nitric acid 1N with 1 % w/v LaCl₃ solution to make a final concentration of 0.1 % w/v LaCl₃. Calcium content was measured by injection to AAS with wavelength 422.7 nm. The content could be calculated with the standard

b. Iron Analysis Procedure :

The iron from dry ash was diluted with Nitric Acid 1 into 100 ml. The aliquot was read at AAS with wavelength 248.3 nm.

c. Sodium Analysis Procedure :

The ash of sample was diluted with Nitric acid 1N and add CsCl₂ solution to an aliquot portion to make a final dilution of 1 % w/v CsCl₂ prior to the analysis. The aliquot was then determinatitto AAS with wavelength 330,4 nm (ASEAN FOODS 2011)

2.5 Iodine determination used spectrophotometer:

Sample was taken for 2 gram in crucible and digested with 2 ml solution of NaOH 2 % and KNO₃ 1 % in 105°C for 24 hours and then another wet ashes in muffle. The ashes was then diluted in 50 ml. Sample was taken 3 ml and added with arsenic acid 2 ml and allow for 15 minutes and color development is after added with 1 ml Ce(SO₄).4H₂O and its absorbance was measured at 415 nm. The calculation was using calibration standard on iodine 100 ppm using the same solution as sample (ASEAN FOODS 2011).

RESULTS AND DISCUSSION

Raw seaweed was green and having fishy odour. The chemical composition of the product can be shown in Table 1 and Table 2. Table 1 showed that raw seaweed content of high carbohydrate and micro nutrient but low in protein and lipid content. This seaweeds *Gracillariasp* contains 162 Kcal energy, very low protein (0,8g/100g), lipid (0,5g/100g), and high in micro minerals such as Calcium, iron and iodine (Table 1)



Figure 1. Raw Seaweed

Table 1. Composition of Raw Seaweed in 100 g samples

Composition	Raw seaweed
Energy(Kcal)	162
Protein (g)	0.8
Lipid (g)	0.5
Carbohydrate (g)	38.6
Moisture (g)	55.0
Ash (g)	5.1
Iodine (mg)	0,52
Calcium (mg)	435
Iron (mg)	49.7
Sodium (mg)	13.0

From fresh seaweed, the calculated dried powder of seaweeds in dry basis contains iodine of 1,15mg/100g or 0,29mg/25g dry basis, iron 110,4 mg/100g or 27,6 mg/25g dry basis and calcium of 966,6 mg/100g or 241.6mg/25g dry basis. Dextrin in this formula to improve the stability of nutrients in seaweed, improve its texture and the salty fish extract to improve acceptability due to special flavor and taste the product. This picture below that shown the pictures of product of seaweed in this study. In picture 2, shown the product made from dry seaweed having dark green powder caused hot temperature of the oven. The dried seaweed made difficult to mix with dextrin making the seaweed sheet not smooth powder. While in the picture 3 shown the product that made from raw seaweed is looked fresh green; the dextrin mixed well with the seaweed.



a. b

Figure 2. Products (a) made from dryseaweed (b) Product made direct from raw seaweed

Table 2. The Calculated Composition of Seaweed Supplementin 25 g/serving

Composition	Food supplements
Energy (Kcal)	76.28
Protein (g)	0.32
Lipid (g)	0.2
Carbohydrate (g)	18.3
Moisture (g)	0.1
Ash (g)	5.1
Iodine (mg)	0.21
Calcium (mg)	174
Iron (mg)	17.8
Sodium (mg)	5.2

Table 2 showed the calculated composition of seaweed product. It is showed that the composition nutrient of this product had high carbohydrate and micro nutrient but low in protein and lipid. The increase in carbohydrate content of this product is due to addition of dextrin. While sodium content increase, since the product is added by salty fish extract. The micronutrient compositions of seaweed supplements were iron 17,8 mg/25g dry basis, iodine 0,21 mg/25g dary basis and calcium of 174 mg/25g dry basis. This recovered micronutrients

compared to Table 1 were lower than calculated figures. This may be due to the effect of addition of dextrin.

Based on Recommended Dietary Intake (RDI), the compare of children's daily requirement of micro nutrient with the seaweed product were 25 g of this product could be supply the intake of children's requirement for 23 % in iodine, for 100 % in iron and for 22-35 % in calcium.

The formula of this supplement was made from raw seaweed and results in more attractive supplement therefore the nutrient content of product was calculated. Applied technology of this supplement can be adapted in household level (Figure 3).

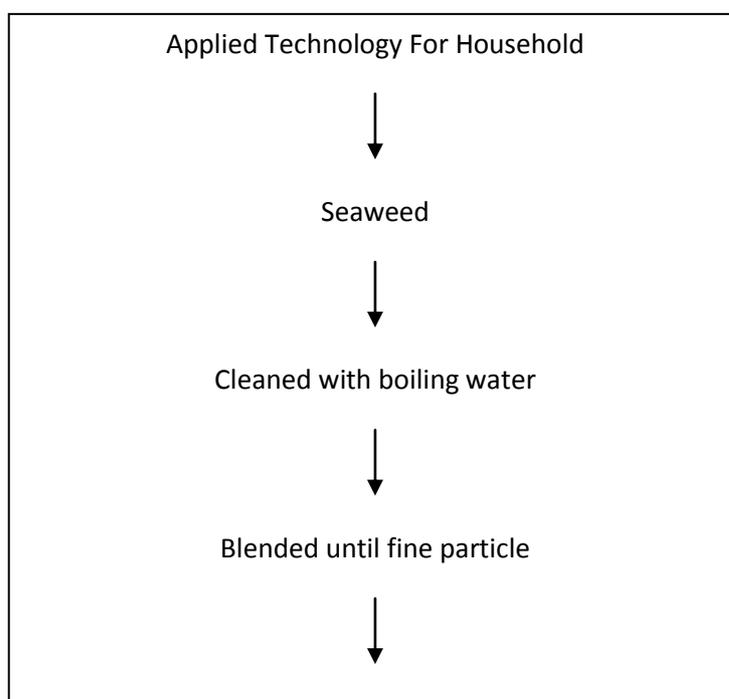


Figure 3. Applied Technology of Household Level Adapted

CONCLUSION

The dried seaweed formula can be useful in fortification of rice at point of consumption or in-house fortification.

The seaweed product developed in this study can be prepared in household level. The seaweed product could be used as food supplement or fortification formula content micronutrients especially for children. Further research could be prepared to measure effectively of the supplement.

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