Characterization flour of two seaweeds (Gracilaria spp. and Kappaphycus alvarezii) for reducing consumption of wheat flour in Indonesia

A Munandar1*, D Surilayani1, S Haryati1, M H Sumantri2, R P Aditia1, and G Pratama1

1 Fisheries Department, Faculty of Agriculture, Sultan Ageng Tirtayasa University, Jl. Raya Jakarta km. 04 Pakupatan, Serang City, Banten Province, Indonesia.
2 Graduate of Fisheries Department, Faculty of Agriculture, Sultan Ageng Tirtayasa University, Jl. Raya Jakarta km. 04 Pakupatan, Serang City, Banten Province, Indonesia.

*Corresponding author: aris.munandar@untirta.ac.id

Abstract. Dependence on wheat flour in Indonesia can be reduced by looking for substitute ingredients which had high nutritional value, one of which was seaweeds. The objective of this research was to determine the characteristics of flour of two seaweeds (Gracilaria spp. and Kappaphycus alvarezii). Seaweed flours have produced using a hammer mill. The comparative of characteristics on two seaweed flours with proximate composition, crude fiber, and L* parameter. The proximate content of seaweed flours from Gracilaria spp. and K. alvarezii were moisture 11.83% and 17.56%, ash 15.08% and 16.90%, fat 0.32% and 0.13%, and protein 8.77% and 4.07%, respectively. The value of crude fiber and L* parameter in seaweed flour K. alvarezii (5.43% and 80.50%) were higher than Gracilaria spp. (4.77% and 49.90%). The best of seaweed flour was Gracilaria spp. flour, because of the content almost similar to wheat flour.

Keywords: Seaweed flour, Gracilaria spp., Kappaphycus alvarezii

1. Introduction

In Indonesia, consumption of wheat flour is increasing every year. In 2013, its needs reached 5,351 million or increased by around 4.06% compared to 2012 [1]. One of the causes of the increasing need for wheat flour is the increasing number of food products that use wheat flour as the main basic ingredient. Indonesia is the second-largest wheat importing country in the world after Egypt with an average import volume of over 5 million tons per year. In 2013/2014, the volume of Indonesia's wheat imports reached 7,392 million and increased in 2014/2015 by 7.7 million. The increase in imports was due to the lack of domestic production [2].

Dependence on wheat flour in Indonesia must be reduced by finding substitution materials that have high nutritional value. One of the substitution materials that can be used mainly for making meal was seaweed [3]. Seaweed is an important commodity in Indonesia so it can be optimized into seaweed flour. Seaweed contains carbohydrates (sugar or vegetable gum), protein, less fat, and ash which are mostly sodium and potassium salt compounds [4]. Seaweed that can be used were Gracilaria spp. and K. alvarezii [5].
K. alvarezii was included in seaweed which has commercial value and export commodity. This type of seaweed is one of carragenophytes which is carrageenan-producing seaweed. The processed products from K. alvarezii are widely used as emulsifiers, gel formers, stabilizers, and thickeners [6]. Gracilaria spp. produce agar which can form a gel so that it can function as a gelling agent and also as a thickener and stabilizer [7]. Therefore, we desire to attempt the characteristics of flour of two seaweeds (Gracilaria spp. and K. alvarezii).

2. Material & Methods
2.1 Preparation of materials
The seaweed of Gracilaria spp. and K. alvarezii were collected from Lontar Beach in July 2016. The areas were in Serang, Banten, Indonesia. In general, the process of making flour includes cleaning and washing, soaking, reducing the size, drying, grinding and sifting. Seaweed flours have produced using a hammer mill [4].

2.2 Analysis of sample
The comparative of characteristics on two seaweed flours with proximate composition, crude fiber, and L* parameter. Proximate and crude fiber measurement used the concept of AOAC [8]. Measurement of the L* parameter using a whiteness meter. The sample was put into the tool, at the place provided for the sample [4].

3. Result & Discussion
3.1 L* parameter
The color produced in seaweed flour was influenced by the quality of raw materials. Gracilaria spp. was blackish green so that the color of seaweed flour was less than the maximum. Because there are still impurities in the raw material and contain color pigments. It was different from K. alvarezii which has a white color so that the value was higher when compared to Gracilaria spp. Red seaweed has a phycobiliprotein pigment consisting of red phycoerythrin and blue phycocyanin [9]. In this condition, this seaweed can make pigment adjustments to the lighting quality so that it can cause various colors on the thallus. The colors formed include dark red, pink, blond, brown, yellow and green [7].

3.2 Crude fiber
The crude fiber content of Gracilaria spp. and K. alvarezii were 4.77% and 5.43%, respectively. It was closely related to the content of polysaccharides. Polysaccharides are composed of hydrocolloids making up cell walls and intercellular space-filling materials including carrageenan and agar [3]. The content of carrageenan and agar in seaweed plays a role as does gluten. The function of gluten as a form of skeletal structure in food dough [4]. Carrageenan and agar can also function to form gels in food [10]. Therefore, seaweed flour can be used as an alternative to wheat flour substitution.

3.3 Proximate composition
The proximate content of seaweed flours from Gracilaria spp. and Kappaphycus alvarezii were moisture 11.83% and 17.56%, ash 15.08% and 16.90%, fat 0.32% and 0.13%, and protein 8.77% and 4.07%, respectively. High mineral salts in seaweed raw materials will make water levels high. The surface of the seaweed has white salt crystals. The presence of hygroscopic salt crystals can result in increased water content of seaweed during storage. Carrageenan is hydrophilic so it was easy to absorb and dissolve in water [9]. Carrageenan was stored the longer the more water vapor is absorbed. The content of water content in seaweed flour affects shelf life. The higher the water content of seaweed flour, the more susceptible to microbes during storage [4].

Seaweed protein levels are different from one area to another because it was influenced by the habitat and type of seaweed itself. Gracilaria spp has a higher protein content when compared with K. alvarezii in several studies. Because the content of phycobiliprotein in Gracilaria spp was higher than K. alvarezii
fat and ash in both seaweed there was no significant difference. The proximate content has shown in Table 1.

| Parameter          | Seaweed flour |          |
|--------------------|---------------|----------|
|                    | Gracilaria spp. | K. alvarezii |
| L* parameter (%)   | 49.90         | 80.50    |
| Crude fiber (%)    | 4.77 ± 0.54   | 5.43 ± 0.47 |
| Moisture (%)       | 11.83 ± 0.18  | 17.56 ± 0.15 |
| Ash (%)            | 15.08 ± 0.48  | 16.90 ± 0.11 |
| Fat (%)            | 0.32 ± 0.25   | 0.13 ± 0.01  |
| Protein (%)        | 8.77 ± 0.20   | 4.07 ± 0.12  |

4. Conclusion
The best of seaweed flour was Gracilaria spp. flour, because of the content almost similar to wheat flour, but the color was not good.

5. References
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