Seaweed Fortification on Crispy Enbal as Local Food of Kei Islands

Ismael Marasabessy¹, Fien Sudirjo¹

¹Fisheries Processing Technology Study Program, Tual State Fisheries Polytechnic, Indonesia
Langgur-Sathean Road Km.6, Southeast Maluku, 97611, Maluku, Indonesia
Email: Ismael_mabes@yahoo.com

Abstract. One of health problems phenomenon in Indonesia and the world is increasing the degenerative disease because human's bad habits of eating that having less fiber. Source of fiber which is relatively abundant in eastern Indonesia is seaweed that is very precise to fortified on local food that aims to be more nutritious and economically valuable. The purpose of this study is to got appropriate seaweed fortification technique to produce Seaweed Crispy Enbal (SCE) as typical food from Kei islands that rich in fiber and preferred by consumers. The research was done in two stages. The first stage is to analyze quality of fiber and HCN content of seaweed and enbal flour as SCE raw material, and the two-stage is fortified fiber to enbal lempeng using two types of raw materials, namely pulp seaweed and flour seaweed. The results showed that the fiber content of seaweed Eucheuma cottonii and flour enbal respectively 7.01% and 4%, while HCN content less than 3 mg/kg. Fortification techniques using pulp seaweed better than others. It is because pulp seaweed produces seaweed crispy enbal with high value of sensory (really like) with having fiber content is 7.48%.

1. Introduction
The world in the last decade is haunted by the phenomenon of health problems, especially the increasing degenerative diseases, as a result of external and internal factors of the body. External factors are people's eating habits that are currently inclined to eat fast food that is high in fat but low in fiber. The internal factor is the inability of the body to regenerate cells normally also triggered by an imbalance of nutrient intake, especially food fiber. Research in the last three decades showed that fiber contributes a significant role in the prevention of degenerative diseases, but awareness about the importance of food fiber in Indonesian society lacks [8], especially for urban communities surrounded by low-nutrient foods. One source of food fiber that is very potential and easy to obtain is seaweed.

Traditionally seaweed has long been used as food and medicine because it is rich in minerals, macro elements, and other micro elements. Some types of seaweed contain important minerals that are used for body metabolism such as iodine, calcium, selenium, and fiber [2].

Southeast Maluku community or better known as the Kei community has a special local food called enbal that is local food made from cassava / toxic cassava (Manihot sp.) that high in cyanide acid. As a special local food, enbal is consumed by all levels of society. This food is served in a variety of ways that is fry without oil called fried enbal, fry mixture spread into a pan called enbal bubuhuk and baked called enbal bubes (porno). Crispy enbal is one of the diversified results that recently glow produced
as typical of local souvenirs and quite interested in local communities and from outside Kei. Factors that affect the quality of crispy enbal are material formulas, drying techniques and baked techniques.

The Seaweed production in Kei Islands in the last 5 years is quite high and continues to increase [3]. This condition causes the supply of fiber derived from seaweed is large enough. Fiber is very important in the process of digesting food for the body. Lack of fiber can cause constipation, apenaistis, alverculity, hemorrhoids, diabetes mellitus, coronary heart disease and kidney stones [10].

For the utilization of seaweed can be more maximal as a source of fiber, and on the other hand, there is improvement of local food quality it is necessary to product diversify by fortifying the seaweed into enbal and make it more acceptable to the public communities as a unique snack by Kei Islands. The purpose of this study is to obtain the proper seaweed fortification technique to produce a rich in fiber Seaweed Crispy Enbal (SCE) and preferably.

2. Methodology

2.1. Material
The main ingredients for Seaweed Crispy Enbal (SCE) are Eucheuma cottonii cultivated (60 days age) that has been dried and high HCN cassava (Manihot sp.) 11 month age and additional ingredients include chicken eggs, butter, sugar, vanilla and milk powder.

Seaweed cultivation materials include nylon ropes of 5 and 3mm diameters, fiber ball float as the main float and plastic bottle float as float ropes (where seaweed binders). Seaweed seeds used are a type of Eucheuma cottonii 1 month age with weight 150 grams/seedlings.

2.2. Research Methods
This research consists of two stages. The first stage is done seaweed cultivation with longline method for 60 days, then analyzed fiber quality. Besides that, analyzed fiber content and HCN content of enbal flour (cassava flour) which will be used as raw material of Seaweed Crispy Enbal. The second stage is fortification of seaweed on the enbal lempeng using two types of raw materials namely seaweed pulp and seaweed flour, then analyze organoleptic and chemical qualities.

2.3. Seaweed Cultivation
Seaweed seeds used are good quality green thallus parts with length 10-15 cm, initial biomass 150 g, using longline method. There are 3 long lines (as replicates) are used to tie the seeds to the length of one long line 10m. The harvest is done when the seaweed is 60 days. The distance between the long line is 120 cm and the spacing between seedling is 30cm. At each corner and the center of the rope is put in the main float and the ballast. Seeds of Eucheuma cottonii are always kept under water. Every time the harvest, seaweed is analyzed fiber quality.

2.4. Making of Seaweed Pulp and Seaweed Flour
Seaweed pulp is made by dry seaweed soaked for 2 days until the fish is lost, then blend until it becomes mush. As for the seaweed flour is made by cutting dried seaweed size 0.5 - 1 cm and ground until smooth. Further sieved using 80 mesh sieve to produce smooth and clean seaweed flour.

2.5. Making Enbal Flour
Enbal (high cassava HCN content) peeled and washed with clean water, then grated and washed again. Further squeezed until the water content decreases. The enbal is milled and dried, then sieved using 80 mesh sieve to obtain white and clean enbal flour.

2.6. Fortification of Pulp Seaweed Into Enbal (Cassava)
Fortification of seaweed pulp is done by as much as 15% of seaweed pulp is mixed into the dough until homogeneous then spread to the plate enbal. It is then stored a night in the refrigerator and baked in the oven until cooked. For fortification with seaweed flour, which is as much as 15% seaweed flour mixed with enbal flour in the mold then baked and dried. The next process is the same as the previous
treatment of the spread dough, let stand in the refrigerator, and baked. Organoleptic qualities, fiber content and HCN. Seaweed Crispy Enbal used to determine the best treatment.

2.7. Research Design and Data Analysis
This study is an experimental study using Completely Randomized Design (CRD) with three replications. The variant analysis was performed on proximate and fiber data at 95% confidence level. Advanced test using Duncan's Multiple Range Test (DMRT) if there is a difference. Organoleptic data were analyzed descriptively.

3. Results and Discussion

3.1. Quality of Seaweed Fiber and Enbal Flour
The results showed the fiber content of seaweed is harvested 60 days and enbal flour respectively 7.01% and 4%, while the very low levels of HCN which is below 3mg / kg (Table 1) Eucheuma cottonii seaweed are cultivated in Dunwahan village Southeast Maluku has a high enough fiber content at 60 days of harvest time. This condition is possible due to the establishment of marine polysaccharides still occur continually. Eucheuma cottonii seaweed is containing polysaccharide in large quantities and is the structure of cell walls of seaweed that could potentially generate high fiber. According to [9, 5], the fiber is composed of three main factions namely structural polysaccharides (composed of cellulose, hemicellulose and pectin), nonstructural polysaccharides (lignin), and non-structural polysaccharides (gum, carrageenan and seaweed), if compared with other researches such as [1] where seaweed is harvested 45 days age has fiber content 0.9% and research [12] where seaweed is harvested 50 days age fiber content reaches 3%, then the quality of Eucheuma cottonii seaweed fiber produced high enough.

For HCN content of cassava enbal flour very small at less than 3 mg/kg and still below standard cassava flour qualities (ISO 1992), which is a maximum of 40 mg/kg and mocaf flour a maximum of 10 mg/kg so that no toxic effects on crispy enbal. The low levels of HCN due to repeated water washing treatments are then followed by extortion and curing causing more HCN to dissolve. [10], stated that HCN in food could be reduced in several ways, including soaking in water because HCN is a water-soluble compound. This is research reinforced by the results of [7] which showed the treatment cassava immersion in water for 24 hours can reduce levels of HCN to 90.10%. The value of seaweed fiber content of Eucheuma cottonii and HCN of Enbal (cassava) as shown in Table 1.

Table 1. Result of seaweed fiber content analysis of Eucheuma cottonii and HCN level of Enbal (cassava)

| Raw material         | Fiber (%) | HCN (mg/kg) |
|----------------------|-----------|-------------|
| Seaweed              | 7.01      | undetection |
| Enbal flour (cassava flour) | 4         | < 3         |

3.2. Quality of Crispy Seaweed

3.2.1. Organoleptic Quality of SCE. Level of panelist acceptance of seaweed fortified enbal with two types of raw materials so that the analyzed parameters are organoleptic quality and fiber and HCN SCE level.

The result of the organoleptic test (Figure 1) shows that the average value of organoleptic SCE fortified by seaweed pulp is preferred (value 4.08) compared to fortification treatment using seaweed flour (value 3.78). This is alleged because the seaweed pulp with wet conditions more absorbed into the enbal at the time of stand-in for a night.

All values of organoleptic parameters are above 4 (very like), except the value of fortification treatment appearance using seaweed flour which got value 2.60 (value under 3 as panelist acceptance
limit). The low value of the treatment appearance is due to the resulting SCE is slightly darker color with slightly rougher surface than the fortification treatment using seaweed pulp.

![Figure 1. Graph of organoleptic value of SCE fortified by seaweed](image)

**Description:** A1 = Fortification using seaweed grass  
A2 = Fortification using seaweed flour

Fortification using seaweed flour mixed with enbal flour produces dry "enbal lempeng". The dough used to coat the fortification of the fortified plate contains low moisture content when heated the heat penetration to the center of the product becomes slower so that the SCE surface becomes more rapidly darker (Fig. 2). Baking time is longer about 20 minutes.

![Figure 2. SCE that is fortified](image)

**Description:** (a) seaweed pulp, (b) seaweed flour, and (c) that are not fortified

The condition is different from fortification using seaweed pulp. The process of wet seaweed blender added water causes the seaweed dough to be slightly liquid with a rather high water content. When heating (baking) in the oven, the SCE surface color change rate is hampered by surface water content. The slightly liquid dough makes the wet plate envelope, which causes heat penetration rather quickly to enter the center of the product so that the maturation rate is faster (about 7-10 minutes) and more evenly distributed.

SCE water content before baking is very important. According to [4], a mechanism that occurs when hot air with low moisture content is exhaled in wet food causes water to exist on the surface of the evaporated material. First of all the vapor is water on the surface of the material, then followed by water on the inside of the material. If the water on the surface of the product is low, while the texture is somewhat dense, the heat propagation to the center of the product becomes longer, while the surface is slightly dry causing the surface to rapidly turn darker.

### 3.2.2. Quality of Fiber and HCN SCE

Levels of fiber SCE fortified with seaweed flour slightly higher than that fortified seaweed pulp, that is each for fortification using seaweed grains 7.48% while using seaweed powder 7.77% fiber content (Table 2), but statistically, both values Is not different (sig> 0.05). When compared to the fiber content of both the above fortification treatment was much
higher than the unfortified plate enbal. This condition indicates that the goal of fortification of seaweed to increase fiber in SCE is achieved. The results of this study are in line with the research of [6] by fortifying the seaweed powder in cookies to produce higher fiber values. While the nutritional and proximate value others tend to be the same and not statistically different.

The HCN concentration contained in SCE on the two treatments is very small that is <3 mg/kg still below [11] which is maximum 40mg / kg, so it does not give toxic effect on SCE. The low levels of HCN due to repeated water washing treatments cause most of the HCN to dissolve.

| Fortification Treatment | Fiber level (%) | HCN Level (mg/kg) |
|-------------------------|----------------|------------------|
| Seaweed pulp            | 7.48           | < 3              |
| Seaweed flour           | 7.77           | < 3              |

4. Conclusion
Seaweed fiber content is harvested 60 days and enbal flour respectively 7.01% and 4%, while the HCN content is very low that is below 3mg / kg. Organoleptically, the SCE fortified technique using seaweed pulp is preferred because it results in higher texture and visibility values. Cadillary SCE fortified pulp and seaweed flour are not statistically significant.

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