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ANALOG RICE WITH THE RAW MATERIAL CASSAVA AND ENRICHED OF SEAWEED

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ABSTRACT

Analog rice is one of the staplefood made from cassava and enriched of seaweed. The purpose in this research to find the best formulation of cassava and seaweed, in analog rice result of rich fiber. The formulation of cassava consist of A1 = fresh cassava and A2 = cassava powder, but seaweed formulation consist of B1 = 5% (w/w); B2 = 10% (w/w) and B3 = 15% (w/w). The parameters tested were yield, water absorption, moisture content and crude fiber. The results showed the best formulation was A2B3 (cassava flour with 15% seaweed addition). Characteristics of product analog rice were86±0,50% of yield, water absorption 140,02±0,98% , moisture content15,01±0,15% and crude fiber 15,17±0,93% , white color, with uniformity of granules for a length of 3 - 10 mm, and a diameter of about 3 mm. The fiber in analog rice was very good for health and can be used as fibrous functional food.

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INTRODUCTION

Rice is the staplefood of the people of Indonesia. Even some regions in Eastern Indonesia which previously had non-rice staplefood, have now used rice as their staplefood. The development of science and technology currently shows a variety of artificial rice that can be made from various non-rice raw materials, including cassava. Cassava is a staplefood in several regions in Indonesia. Cassava is a source of carbohydrates, has a higher calcium, vitamin C and vitamin A content compared to rice. as a source of fiber, cassava can reduce the risk of stroke, heart disease, colon cancer and help control diabetes (Gestarini, et al. 2015; Anonymous, 2014). Besides cassava, seaweed of includes fiber-rich food which needs in making analog rice. This is intended to improve dietary lack of fiber and prevent the above degenerative diseases that are increasing. The principal components of the edible seaweed are carbohydrate. But only a small portion of carbohydrates can be absorbed in human digestion (difficult to digest), because this carbohydrate content consists mainly of gumi compounds (Winarno, 1990 ; Chapman, 1970). In Astawan et al. (2004), mentioning *Eucheuma cottonii* as a carrageenan producer has a total food fiber content of 78.94%, dw. Whereas according to Ristanti (2003), total food fiber *Eucheuma cottonii* of 83.2% consisted of insoluble food fiber content of 52.4% and soluble food fiber of 30.8%.

In Santoso (2011), said food fiber is able to absorb water and bind glucose, thereby reducing the availability of glucose. This situation can reduce the increase in blood glucose and keep it under control.

In Indonesia the consumption of seaweed is still quite low. Of the total production of 1.7 million tons / year of wet seaweed, 85 percent of them are exported to various countries. 15% of seaweed that is not exported is consumed by the community, so the level of seaweed consumption is around 1.2 kg of wet seaweed / cap / year or less than 0.2 kg (dw). In comparison, Japanese people consume seaweed every year no less than 1.6 kg / cap (dw) (Fleurence, 1999).

Several studies on alternative rice processing that have been carried out and used as references in this study include Fitriyanto and Putra (2013) about the characterization of artificial rice from a mixture of sago flour and green bean flour. Agusman et al. (2014), about the use of *Eucheuma cottoni* flour and mocaf flour in the processing of rice analog. Franciska et al. (2015) regarding the making and physical characteristics of rice analog to the raw material of cassava flour enriched with tuna fish protein. Jannah et al. (2015) about making and testing the physical characteristics of analog rice made from cassava flour enriched with shrimp protein. The development of artificial rice is one approach to increase the potential of local tubers in meeting the imbalance between rice production and consumption.

This research aims to obtain the best formulations of cassava and seaweed in analog rice resultof fiber rich.

METHODS

Material and Tools

The material used were cassava and seaweed esspecially *Eucheuma cottonii*. The tools used were scales, knives, pan, grated, filter cloth, molen, and drying oven.

Stage of Research

This research consists of several stages, namely (1) the stage of analog rice formulation, (2) the analysis phase, and (3) data processing.

Formulation Stage

This analog rice formulation is made using raw materials of fresh cassava (63.9% moisture content) and cassava flour (14.58% moisture content). Whereas seaweed with a concentration of 5%, 10% and 15% (b/b) with the treatment as follows: A = Cassava, consist of A1 = Fresh cassava, is the result of grated cassava, squeezed using filter cloth to reduce the water content and A2 = Flour Cassava, is the result of squeezed cassava is dried and sifted so the homogen. B = Concentration of seaweed, consists of: B1 = seaweed 5% (b/b), B2 = seaweed 10% (b/b) and B3 = seaweed 15% (b/b).

The Process of Making Analog Rice

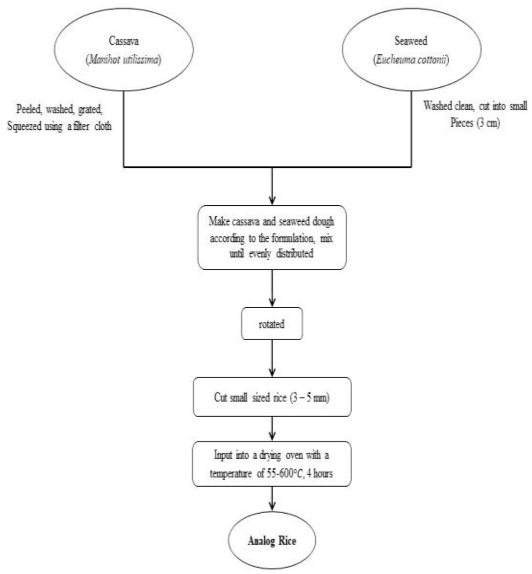

Figure 1. Procedure for Making Analog Rice

Stages Analysis

Analysis of the analog rice, include:

- Yield
  The yield is calculated based on the percentage comparison of final weight and initial weight..
- Water Absorption
  A number of samples were weighed heavily, then dipped in warm water for 2 minutes, removed and

drained, then the sample was weighed again (Francisca et al. 2015).

Water absorption is determined by the equation:

$$\text{Water Absorption (\%)} = \frac{B - A}{A} \times 100\%$$

Where: A = Weight of the sample before dipping

B = Weight of sample after dipping

- Moisture content and crude fiber

For testing moisture content and crude fiber, refer to SNI 01-2891-1992. The observation of color and granular homogenize is done visually.

RESULTS AND DISCUSSION

The analog rice test results from each treatment of the test parameters analyzed, can be seen in table 1.

Table 1. Analog Rice Test Results.

Treatment	Test Parameters (%)			
	Yield	Water Absorption	Moisture content	Crude fiber
A1B1	68±0,50	107,14±0,98	14,45±0,65	12,65±0,78
A1B2	72±1,00	114,28±0,92	14,77±0,03	14,03±0,21
A1B3	76±0,50	120,78±1,82	17,74±0,76	16,73±0,30
A2B1	78±1,50	123,18±0,88	13,78±0,82	12,60±0,55
A2B2	82±1,50	127,06±0,10	14,23±0,25	13,25±0,20
A2B3	86±0,50	140,02±0,98	15,01±0,15	15,17±0,93

Yield

Measurement of the yield of a product is intended to find out the amount of weight of the final product obtained from the initial amount of weight used, usually expressed in percent. In analog rice processing heavy losses occur from the initial stages of the process to the final stages of the process. The results of variance analysis showed the treatment of cassava (A) and the treatment of seaweed concentration (B) which affected the yield of analogue rice.

The average analog rice yield from this study can be seen in table 1 and figure 2.

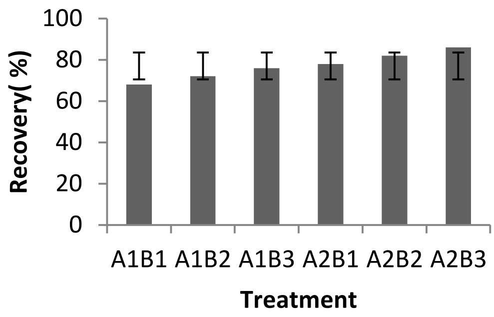

Figure 2. Yield of Analog Rice.

The lowest yield of 68±0,50% was obtained from the A1B1 treatment of fresh cassava with the addition of 5% seaweed. That means there is a heavy loss of 32%. This weight loss is caused by the cassava used is fresh cassava which has a high moiture content of 63.09%. That besides, heavy losses can occur at each stage of the processing process starting from the process of dissolution, the squeeze process to the drying process while the highest yield of 86±0,50% is obtained from the A2B3 treatment, namely cassava flour with the addition of 15% seaweed. The high yield of this treatment because the cassavaused is cassava flour with moisture content of 14.58%, lowest than fresh cassava. Concentration of the addition of seaweed affects the yield produced. However, this result is lower when compared to research from Agusman et al. (2014), making analog rice from seaweed flour and mocaf flour, getting a yield of around 98 - 100%. The addition of seaweed flour affects the increase in yield obtained. Furthermore, it is said that carrageenan in seaweed flour serves as a stabilizer and binder which unites other components to prevent loss during the process of making rice. On the contrary, the yield obtained in this study is still greater than that of Gideon et al. (2012), making analog rice based on *goroho* banana flour, with yields ranging from 23.18 - 31.11%. The research of Hidayat et al. (2013), making analog rice using *lindur* flour with the addition of sago flour and chitosan obtained a yield of 81.94%.

Water Absorption

The results of variance analysis showed the treatment of cassava (A) and the treatment of seaweed concentration (B) and treatment interactions (AB) had a very significant effect on the absorbency of water produced. Water absorption of analog rice products analyzed in this study can be seen in table 1 and figure 3.

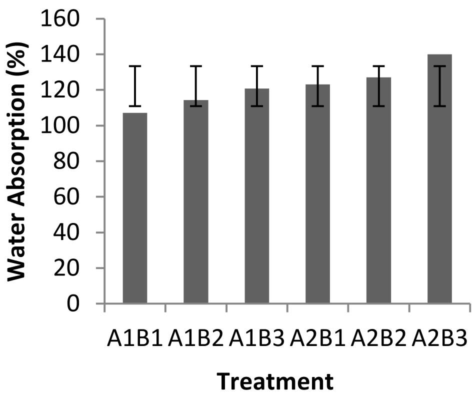

Figure 3. Water Absorption of Analog Rice.

The lowest absorption of water is 107.14±0,98%, obtained from the treatment of A1B1, which is fresh cassava with the addition of 5% seaweed. The highest absorbency is 140.02±0,98%, obtained from the A2B3 treatment, namely cassava flour with the addition of 15% seaweed. When compared to the water absorption results of the research conducted by Dinarki et al. (2014) in the manufacture of analog rice based on cocoyam taro flour and *onggok* flour, it ranged from 58.22 - 94.25%, this result was much smaller than this study. This is due to the use of seaweed in the process of making analog rice. In Anggadiredja, et al. (2006), seaweed produces hydrocolloid compounds. Hydrocolloid compounds are generally built by long chain polysaccharide compounds and are hydrophilic (like water), thus the water absorbency obtained is quite high. Furthermore, the results of Gideon, et al.(2012), making analog rice made from *goroho* bananas with carboxymethyl cellulose (CMC) binder, showed water absorption of 198 - 221%. It is said that the main function of CMC is to bind water and is useful for getting the right thickness. Furthermore, the research conducted by Oktaviani, 2012, Processing of artificial rice with the treatment of cassava flour *Bimo* and tapioca flour with the addition of soybeans, obtained water absorption capacity of 115-226%. It is said that food with high starch content will be easier to absorb water due to the availability of amylopectin which is reactive to water molecules, so that the amount of water absorbed into food is increasing (Herper, 1981 in Oktaviani, 2012). In the study of Franciska et al. (2015), using cassava flour and fish protein, water absorption was obtained from 206.6 - 267.9%. Water absorption is the ability of a material to absorb or bind water. Water absorption can be influenced by the composition of starch found in food is quite high so that the greater the starch content in food ingredients the greater the absorption of water (Herawati and Widowati, 2009). The greater the value of water absorption, the greater the amount of water needed to cook rice.

Moisture

The results of variance analysis showed the treatment of cassava (A), seaweed concentration (B) and interactions (AB) had a very significant effect on the water content produced. The moisture content of a product greatly affects the quality and durability or shelf life of the product. The moisture content of analog rice products analyzed in this study can be seen in table 1 and figure 4.

The highest moisture content is 17.74±0,76%, obtained from the treatment A1B3, which is fresh cassava with the addition of 15% seaweed. The lowest water content is 13.78±0,82%, obtained from the A2B1 treatment, namely cassava flour with the addition of 5% seaweed. This result shows that the concentration of seaweed added to analog rice also influences the water content obtained. Based on the Indonesian National Standard (2008), the moisture content requirements of rice are 14-15%. Thus the moisture content obtained in this study generally met the requirements except treatment A1B3 (fresh cassava with the addition of 15% seaweed).

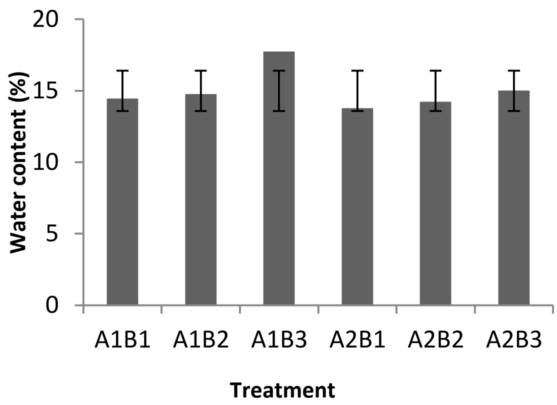

Figure 4. Moisture Value of Analog Rice.

As a comparison shown the moisture content of some research has been done such as research of Dinarki, et al.(2014), analog rice moisture content made from taro and *onggok* flour, amounting to 9.72-15.39. Furthermore, analog rice made from seaweed flour and mocaf flour moisture content was 8.44 - 8.88%.(Agusmanet.al.2014). Wahjuningsih and Susanti (2017), showing the analog rice moisture content the best made from mocaf flour, arrowroot flour and red bean flour is 12,19%±0,08. The results of the study by Budijanto and Yuliyanti (2012) using sorghum flour showing moisture content was 10.58%. While the analog rice moisture content made from cassava flour enriched with shrimp protein, by Jannah et al.(2015), amounted 9.07 - 14.01%.. Santoso et al. (2013), said the moisture content of analog rice grains was influenced by making process, including water use, steaming and drying . Winarno (1990) said, the moisture content of a material is very important in relation to the durability of the material. The lower the moisture content the more durable the material. Generally the moisture content of the above research were quite low, so that the analog rice products produced have a longer shelf life.

Crude Fiber

The results of analysis of variance showed the treatment of cassava (A) and the treatment of seaweed concentration (B) had a significant effect, while the treatment interaction (AB) had no effect on the crude fiber produced. The highest crude fiber is 16.73±0,30%, obtained from the treatment A1B3, which is fresh cassava with the addition of 15% seaweed. The lowest crude fiber is 12.60±0,55%, obtained from the A2B1 treatment, namely cassava flour with the addition of 5% seaweed (Figure 5). This result shows that the concentration of seaweed added in analog rice also influences the crude fiber content obtained.

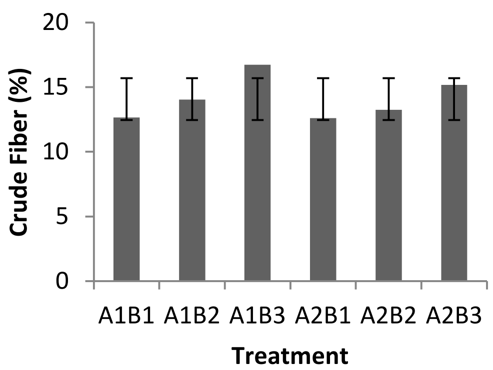

Figure 5. Crude Fiber Value of Analog Rice

Crude fiber intake is between 4 and 8 g/day in Britain. But in the United States intakes of about 8 to 11 g/day (Chummings,1973). Furthermore, dietary fiber intakes very difficult to estimate because tables of the composition of food either do not give fiber content but use the crude fibre value. Variation within the community probably occurs as high crude fiber intakes are found in vegetarians, 12 – 24 g/day crude fiber. Especially those living in religious communities, 22 – 35 g/day crude fiber). In Madhuet. al. (2017), according to Institute Of Medicine people of different ages and sex should intake prescribed amount of crude fiber daily for the respective food stuff consumed. A wealth of scientific evidence demonstrates that adequate crude fiber intake has a number of health benefits, including maintenance of healthy laxation and the reduced risk of cardiovascular disease and cancer etc.

Ristanti (2003) states that *Eucheuma cottonii* seaweed has a total fiber content of 83.2% (dw), insoluble food fiber 52.4% and soluble food fiber 30.8%. While the content of raw fiber of fresh cassava is around 2.5% (Agro Innovation, 2011). Ebook-pangan (2006), crude fiber must be distinguished from dietary fiber. Crude fiber is commonly used in the proximate analysis of food ingredients and is a part of food that cannot be hydrolyzed by chemicals used to determine the levels of crude fiber namely sulfuric acid (1.25% H_2SO_4) and sodium hydroxide (1.25% NaOH). While food fiber is a part of food that cannot be hydrolyzed by digestive enzymes. Furthermore Wimvy (2010), states that crude fiber is very important in assessing the quality of food ingredients because this number is an index and determines the nutritional value of these foods. Food fiber is not the same as crude fiber. But the level of crude fiber in a food can be used as an index of dietary fiber content, because generally in crude fiber is found as much as 0.2 - 0.5 parts of dietary fiber. Furthermore, said fiber will bind bile acids when they arrive in the digestive tract and are removed from the body in the form of feces. To replace the missing bile acid, cholesterol in the body will be overhauled, so that the more fiber the more bile acids are removed, the more cholesterol is released from the body, so cholesterol levels in the body will decrease. Other fats and sterols will also be removed from the body. So that these fibers can prevent the re-absorption of bile acids, cholesterol and fat. Thus the fiber has the function of blocking the absorption of fats and carbohydrates in the body. Whereas in Setiawati et al. (2015), Fiber is a non-nutritional substance, there are two types of fiber, namely dietary fiber and crude fiber. Foods that contain a lot of crude fiber have a higher digestibility.

Visual Observation of Analog Rice

Observation of color and uniformity of grain from analog rice is done visually. Where the color of rice produced is white. This is because the cassava used is white cassava so that it affects the analog rice products produced. While the uniformity of granules is long, ranging from 3-10 mm with a diameter of about 3 mm (Figure 6). This grain of rice is quite large compared to rice grain. This is because the mold used for granulating rice is meat molten and cutting is done manually.

Figure 6. Analog rice products made from cassava with the addition of seaweed.

ACKNOWLEDGEMENT

Based on the results of the research obtained as mentioned above, it can be concluded that:

- The best formulation of cassava and seaweed in making analog rice is A2B3 (cassava flour with the addition of 15% seaweed).
- Characteristics of analog rice produced from treatment A2B3 are 86% yield, water absorption 140.02%, water content 15.01% and crude fiber 15.17% or 3.04 - 7.59% fiber food, white, with uniformity of granules for lengths of 3-10 mm, and diameters of around 3 mm.
- Based on the above characteristics, especially food fiber, the analog rice produced can be called a source of fiber and even high in fiber, so it is very good for health and can be used as fibrous functional food.

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