Advances in Engineering Research, volume 194
5th International Conference on Food, Agriculture and Natural Resources (FANRes 2019)

The Use of Fishing Tuna Flour Fortification Modified Tapioca Starch in Emergency Food Product

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ABSTRACT
Starch is used as a thickener and stabilizer in food. Natural starch causes several problems related to retrogradation, low stability, and low paste resistance. This is the reason for starch modification. When chemically modifying starch with ginger oil, a cross-linking bond will create, which is the formation of covalent bond that strengthen the existing hydrogen bond. The formation of the cross-linking could influence swelling power and solubility of starch. The aims of the research are to find out the influence of weight comparison between tapioca starch, water and ginger oil volume on swelling power, cross linking level and solubility and to find out the influence of the proportion of skipjack tuna flour fortification modified tapioca starch on chemical properties of emergency foods product. The nutrition value of water level is 3.97%, ash level is 2.69%, fat is 12.95%, protein is 15.45%, total carbohydrate is 64.94% and the energy value per product is 203.85kkal/100 g.
Keywords*: tapioca starch, starch modification, cross-linking agent, emergency food*

I. INTRODUCTION

The utilization of cassava in North Maluku is fairly high. It can be seen from the harvest area and crops production according to Regency/City especially cassava with area of 11.770 Ha and average production of 34.621 ton/year and mostly are direct consumed by the community [6]. Cassava production in Indonesia in 2008 has reached 21.593.053 ton [5]. The price of cassava is Rp. 460/kg. Due to the high production and low price, cassava has good prospect as the raw material for the production of native starches in big scale [15].

One of materials in the production of starch is cassava that grows well in Indonesia. Starch is a polysaccharide resulted from the synthesis of green plant through photosynthesis. Starch has granulated crystal form and insoluble in water in room temperature with size and form that depends on the type of plant. Starch is used as thickener and stabilizer in food. Native starch causes some problems related to retrogradation, low stabilization, and low paste resistance.

Ginger contains gingerol, which is a phenolic compound causing the occurrence of cross-linking that influence molecule bonds of starch and in turn, it will result in better starch with swelling power value, solubility and cross-linking.

Starch that chemically modified with ginger oil will form cross-linking bond, which is a covalent bond that strengthen the existing hydrogen bond. The occurrence of cross-linking influences the thickness, gelatinization time and swelling power. The problem is that how the relationship between the comparison of weight between tapioca starch and ginger oil and the comparison between water weight and starch on the change of starch characteristics (swelling power, solubility and cross-linking level).

II. MATERIAL AND METHOD

Materials used for the research was cassava obtained from BPTP North Maluku. The cassava, then, processed into tapioca starch in traditional way and was compared to starch obtained from supermarket at Ternate.

The experiment arrangement was conducted using factorial completely randomized design. Every treatment parameter was replicate 3 times. Data analysis was conducted using analysis of variance and average value test was used least significant difference method with level of 5 percent and linear model of mathematic.

The research was aimed to study the influence of comparison between starch weight and ginger oil volume on the quality of modified tapioca starch (swelling power and solubility). The research was done in two steps. First, the production of modified tapioca starch by using natural cross-link agent, which is ginger rhizome oil.

Initial weight of tapioca starch: 300 g
Reaction temperature: 30 ^{0}C
Parameter used to analyze modified tapioca starch was swelling power [9]. Swelling power was calculated using the following formula:

$$Swelling\ power = \frac{Paste\ dry\ weight}{Weight\ of\ dry\ starch\ sample}\% \quad (1)$$

Second: The production of emergency food products using skipjack tuna flour proportion modified tapioca starch

Experiment

At start, tapioca starch with certain weight was mixed with water and ginger oil at certain volume in a breaker glass. They were mixed in certain speed for 30 minutes at temperature of 30 ^{0}C. The mixture was then dehydrated at temperature of 50 ^{0}C for 24 hours. The resulted starch was grinded to obtain soft powder starch and it was called modified starch.

The next step was the use of tapioca starch with the addition of skipjack tuna flour in the production of food emergency products.

III. RESULTS AND DISCUSSION

The modification process used was cross-linking process using ginger oil. The cross-linking process strengthened starch molecule bonds; therefore, it resulted in starch with swelling power, solubility and higher cross-linking level compare to native starch [4].

It is known that the smaller the comparison between starch weight and water, the starch will be evenly disperse into the water; therefore, it will be easier for starch to react with gingerol and in turn, it will result in starch with bigger swelling power. The result can be seen in Table 1.

Table 1. Swelling Power Value Of Tapioca Starch Using Native Agent Cross Link

Treatment Weight Comparison starch: water	Volume of Ginger oil (ml)				
	0.1	**0.2**	**0.3**	**0.4**	**0.5**
300 : 300	15.0	15.5	9.5	8.0	7.9
300 : 400	9.2	19.6	8.8	8.5	8.2
300 : 500	8.2	14.9	12.3	9.4	9.9

Table 1 shows that modified starch indicates higher swelling power than that of native starch (9.7). Swelling power is highly influenced by inter-molecules bond of starch composer molecules. The penetration of ginger oil and water into starch molecule will dilute the bond; therefore, the swelling power of starch is higher than that of native starch [1]. In addition, observation on the change on physical properties indicated that modification on native starch was influenced by the active component of ginger oil that forms cross-linking [4]. Using Flohry-Rehner formula and optimization with laboratory mathematic the cross link-value of modified starch was obtained.

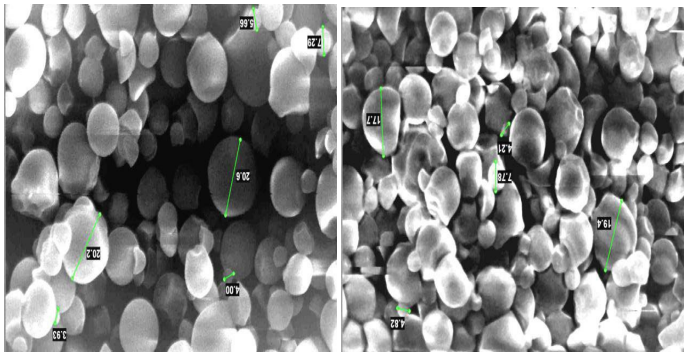
In this research, swelling power analysis was conducted using Leach Method (1959). Kaimuna Method was used for solubility and Flory-Rehner optimization approach was used for cross-linking analysis.

Result of SEM of Modified Starch

In order to find out the differences on shape and size of modified starch granule, SEM (Scanning Electron Micrograph) was used. Result of SEM of native starch and modified starch is displayed in the following figure.

Fig. 1 shows that modified starch has starch granule size that bigger than native starch with small difference. To support the result of SEM, further analysis is needed to clarify the difference between native starch and modified starch.

The highest solubility value was gain in the comparison between starch weight, water and ginger oil volume of 300:300:0.3. The smaller the comparison between starch weight and water, the smaller is the concentration of ginger oil dispersed; therefore, the reaction is not running well [10]. If the comparison between starch weight and water is bigger, ginger oil will have difficulty to disperse into the mixture thus the reaction is not running well [2].



(A) **(B)**

Figure 1. Result of SEM of starch granule from (A) Native Starch and (B) Modified Starch

The comparison between starch weight and water influences the solubility value. The smaller the comparison then it will even [3]. This will cause starch that react to gingerol will be bigger and in turn, the solubility of starch tends to decrease [9].

Emergency Food Products

Emergency foods in form of food bars have various advantages such as they have low *aw* value that means longer storage time than semi-wet product with higher aw. Besides the advantage, food bars have dry texture causing thirsty if consume without water and they are easier to absorb vapor in the air thus the products will be moist and not crunchy. Therefore, food bars package should be specific to maintain the quality and their nature of having longer storage time [12]. The nutrition value of emergency foods produced with modified tapioca starch with native agent cross link method and the addition of skipjack tuna fish flour can be seen in Table 2.

Table 2. Nutrition value of emergency food

Parameter	**Value**
Water level (%)	3.97
Ash level (%)	2.69
Fat (%)	12.95
Protein (%)	15.45
Total Carbohydrate (%)	64.94
Energy per product	203.85 kcal/100 g

One of form of dry processed emergency food with potential to be developed is energy bars snack bars. Snack bars are cookies with specific formula that will not cause thirsty and have high protein content with bar form that easy to consume during eating time. Energy bars have high content of macronutrient, protein, fat and carbohydrate thus they are able to fulfill daily energy need. Energy bars are diet supplement often consumed by athletes and people with high physical activities to maintain the sufficiency of their energy. In addition, the bar shape of energy bars

make them easier to be made, package and distribute due to their strong texture and to be handled at the storage than round or cylinder shape.

Formula bars are similar to formula cookies. However, cookies have maximum protein content of 6% (SNI, 1992) [7] whereas protein at bars is 10-15% according [11]. Bars have a balance content of macronutrient protein, carbohydrate and fat and able to fulfill daily energy need. According to SNI 01-2973-1992 [7], cookies are one of biscuit made from soft dough with high fat level, relatively crunchy and if they are heated their cross-section have less solid texture.

There is no specific standard that regulate emergency food in form of bars. Therefore, emergency food standard refers [11], which is fat contribution is 35-45%, protein is 10-15%, and carbohydrate is 40-50% with energy value that fulfill daily energy need of 2100 kcal; whereas, microbiology test is based on Indonesian National Standard on cookies [8]. Emergency food products made, among others, are banana bars made from banana puree, flour and cassava flour conducted. Cookies made from green gram made, taffy made from sticky rice flour, green gram flour, protein isolate, and full cream made [13], and can product made from rice and chicken flavor.

Research on snack bars was ever conducted with raw material of sorghum flour, corn flour and tofu waste flour and with raw material of foxtail millet flour and tofu whey. Those researches can be used as comparison to the research [14].

IV. CONCLUSIONS

The lower the comparison between starch and water, the higher are the swelling power and solubility values. The bigger the volume of ginger oil, the higher is the swelling power and solubility. Starch modification using ginger oil results in modified starch with the highest swelling power of 19.60 with comparison of starch: water: ginger oil is 300:400:0.2. The influence of modified tapioca starch proportion with fish flour fortification on chemical properties of emergency food products are water level of 3.97%, ash level of 2.69%, fat level of 12.95%, protein level of 15.45% and total carbohydrate of 64.94%. The energy value per product is 203.85 kcal/100 g.

ACKNOWLEDGMENT

The authors want to say thank you to BPTP of North Maluku Province as the raw material supplier that has developed local variety of cassava of Tidore; Directorate General of DIKTI who has given the authors a grant to conduct research and Laboratory of THP of Faculty of Agriculture, Unkhair that facilitate the research.

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