GADUNG TUBER (*Dioscoreae hispida* Dennst) AS POTENTIAL SOURCE OF STAPLE FOOD SUPPORTING FOOD DIVERSIFICATION

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***Abstract*— ABSTARCT**

Gadung tuber (*Dioscoreae hispida* Dennt), Indonesian called "umbi gadung", is one of the potential sources of staple foods in supporting food diversification. Gadung tuber contains carbohydrate of 29.7g in every 100 g of material. It also contains 3.2 g of protein, vitamin C, vitamin B and other minerals. The purpose of this paper is to present how to eliminate dioscorine and cyanide acid and to process some food diversification of gadung tubers. The innovation technology of post-harvest handling to eliminate dioscorine and cyanide acid content can be done by immersing and washing them in salt water or blanching. Gadung tubers of 2 mm slice immersed in salt water of 8% and 7.5% decrease cyanide acid content of 5.45 ppm; while shreded gadung tubers immerse in salt water of 7.5% for 72 hours can reduce cyanide acid content of 18.75 ppm.
Gadung tubers can be processed to be stapple food such as flour, flake. Flour of gadung tubers combined with wheat flour or starch can be processed to become snack food such as cake, sponge cakes. Research conclude that gadung tubers is safety for consumption by immersing in salt solution of 7.5% to 8% for 72 hours to eliminate dioscorine and cyanide acid content. Combination of 60% and 50% of gadung flour can be used to make good cake and sponge cake.

Keywords— **Gadung tubers, food diversification, staple food, flour, snack.**

I. INTRODUCTION

Gadung tuber (*Dioscoreae hispida* Dennst), known as Umbi Gadung in Indonesia, is one of the most economically important yam species which serves as a staple food in the tropical countries (Udensi et al, 2008). *D. hispida* is commonly found in secondary forests and grows under shaded area or near streams (Nashriyah et al, 2010). It is a creeper plant that can grow in any type of soil and very potential to be developed for the cultivation and its use.
Gadung tuber (*Dioscoreae hispida* Dennst) is a wild tuber plant which grows in a tropical regions. Gadung tuber-shaped pole, between 5-20 cm long, bulbous and various shapes, oval, triangular, round, yellowish-brown or greyish skin as can be seen in figure 1. The inside is yellowish-brown or greenish, the thickness of the skin between 0.15 cm to 0, 3 cm. Meat yellowish white bulb, diameter between 10 cm to 15 cm (Tajuddin et al, 2013).

Figure 1 Gadung tuber (*Dioscoreae hispida* Dennst)

Gadung tuber is harvested as a good starch since it has a good carbohydrate sources. Gadung tuber contains carbohydrates, protein, crude fibre, ash content, dioscorine and fat. Every 100

grams of gadung tuber, the highest nutrient content is carbohydrate with 18% and 0.16% fat as the lowest nutrition content. Meanwhile, the toxic compound, dioscorine, is 0.41% as a dry basis as can be seen at Table 1 (Health Department of Indonesia, 1981).

Table 1. Nutrient Content in every 100 grams of Gadung tuber (Health Department of Indonesia, 1981)

Nutrition	Percentage
Calorie (cal)	101,00
Water	78,00
Carbohydrate	18,00
Protein	1,81
Crude fibre	0,93
Ash content	0,69
Dioscorine	0,41 (dry basis)
Fat	0.16

The utilization of gadung tuber as a source of carbohydrate is one alternative to increase the diversification of food by utilizing local food which is abundant in Jambi province. Moreover, this plant also has essential dietary nutrient source as it exhibits nutritional superiority (Kumoro, et al, 2015). This property is related to the presence of resistant starch which plays role in creating a slow digestion in human gastrointestinal tract, resulting in slow absorption of glucose (Kumoro et al, 2011). This tuber has a digestive property which can reduce the risk of obesity, diabetes and other related diseases (Aprianita et al, 2009). However, some studies discovered that this tuber contains some toxic compounds which gives serious health complications, such as cyanide acid and dioscorin. Dioscorin, the poisonous alkaloids in gadung tubers, and cyanide acid caused *D. hispida* considered as underutilized species (Kumoro et al, 2015). Despite the toxic compound found in tuber, several steps can be taken to eliminate this compound. Local people undertake pretreatments like peeling, followed by leaching of the sliced tubers in running water, overnight, washing and drying (Kumoro et al, 2015). After eliminate the toxic compound, gadung tuber can be consumed directly and utilized as staple foods, cookies or cakes.

II. Material and Methods

2.1 Free Toxic of Gadung Tuber

Post-harvest handling is important to eliminate the toxin of gadung tuber before consumption. There are several ways to eliminate the toxin, such as using ash or lime and processing with salt. The use of ash or lime is enable to accelerate the removal of cyanide acid. The skin of clean tuber is peeled and the tuber is trampled until the poison taken out. It is given ballast to keep the tuber depressed. The mixture of tuber with ash or lime should be dried under the sun. Dried-tube is cleaned by the immersion of water for 2 days. The bulbs are finally ready to use.

Another way to eliminate the toxic compound is the processing with salt. It can be done by using layered salt and stirring the salt. Peeled tuber is sliced and put into bamboo basket coated with salt layer by layer. The bamboo basket is given ballast and immersed for a week. Finally, the tuber free from toxin is the one which is not salty and contain a clear water. The tube can also be put into a basket, added with salt and stir it. Let the tuber in the basket for one night. Finally, the tuber is washed with water until no salty taste. The soak from tuber should be removed and dried under the sun.

The handling of the gadung bulbs by the method can reduce cyanide acid in gadung approximately 1-10 mg in every kilogram of processed gung. Furthermore, it was also reported that the immersion of gadung tube with a thickness of 2 mm in a salt solution of 8% was able to decrease cyanide acid levels up to 5.45 ppm (Pambayun, 2000). Moreover, another method that can be used to reduce the toxicity of gadung bulb is by extraction of microwaves (Micrwave Assited Extraction or MAE) which can extract dioskorin up to 71,36% (Tajuddin et al, 2013).

2.2. Gadung Flour Processing Technology

The process of making gadung tuber flour is quite simple and can be done either as a household scale or small industry scale. The most importantly, the process required pre-treatment to remove dioscorin and cyanide acid. The production of tuber flour typically involves the destruction or smoothing of the ingredients as well as drying up to a certain water content (Susila, 1999). Moreover, eliminating cyanide acid from tuber flour can be done by soaking the flour in 10% salt solution and processing it into powder form by oven drying at 60^{o}C.

Another toxic compound that should be eliminated is dioscorin. Dioscorin is soluble in water, alcohol, aceton and chloroform. This can be removed by using microwave assisted extraction (Kumoro et al, 2015). The *D. hispida* tuber flour (15 g to 30 g) was mixed with 300 ml aqueous ethanol of 75% to make up a desirable predetermined solvent. After extraction, the mixture was allowed to cool at room temperature using water bath. The solvents were completely removed and it will obtain dry extracts free from dioscorin (Kumoro et al, 2015).

2.3 Processing of Gadung Cake

After eliminating the toxin compound, gadung tuber is dried under the sun for several days until it really dry. Then, the tuber is mashed and filtered to eliminate the remain water. The best flour produced is white color flour powder. This flour can be stored for several months in room temperature.

Gadung flour can be utilized to be snacks like gadung stick, cookies and other spice ingredients. Moreover, gadung flour can be used as wheat flour substitution.

This experiment using completely randomize design by adding gadung flour with five different treatment described as follow. N_1 = 100% wheat flour, N_2 = 80% wheat flour: 20% gadung flour, N_3 = 70% wheat flour: 30% gadung flour, N_4 = 60% wheat flour:40% gadung flour and N_5 = 50% wheat flour : 50% gadung flour.

III. Result and Discussion

3.1 Gadung Flour Cyanide Free by Soaking the Tuber in Salt Solution (Hardjo, 2016)

Making cyanide free flour (safe consumption) can be done by soaking grated tubers in saline solution. The higher immersion time and concentration of salt solution, the lower cyanide, starch, and the fiber content. Moreover, the tiwul flour value of the gadung flour will decrease, while the water content, ash and color values tend to increase indicated by brighter color produced.

Immersion of 72 hours in 5% or 7.5% salt solution produces the safest flour to be consumed. This is because of its cyanide acid levels are well below the maximum according to SII. Flour made with a long immersion of 72 hours in a 5% salt solution has a higher starch content and taste better.

3.2 Gadung Flour

Susila *et al* suggests that by soaking 500 grams of gadung tuber for 12 hours in 10% salt solution and processing it into powder form by oven drying at 60°C can reduce cyanide acid by 33%. The cyanide acid can be decreased even more when the temperature is increased.

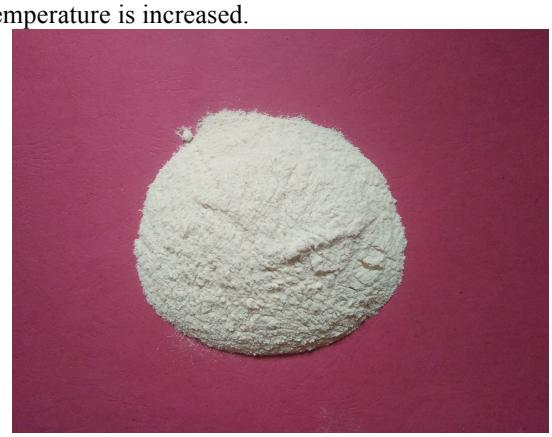

Figure 2. Gadung flour cyanide free

3.3 The processing of gadung cake

The Substitution of Wheat Flour to Gadung Flour to make cake (Renate, 2015)

This research aims to find out the quality of cake for 20%, 30%, 40% and 50% formulation of gadung flour, looked from taste, color, and texture (Renate, 2015).

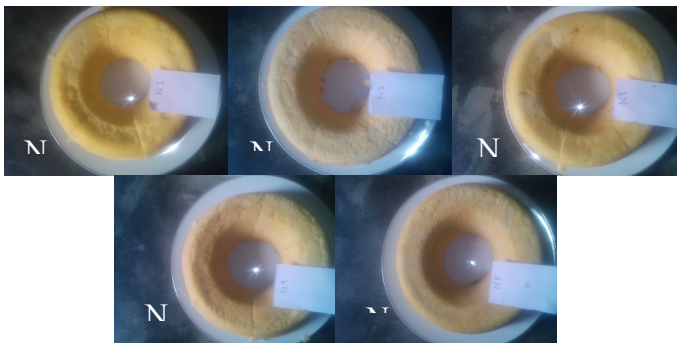

Figure 3. Gadung cake

This research is experimental type research with data collection method used is observation method. Sponge cake gadung from the aspect of flavor, color and texture has been tested by 25 trained panellists. The data collection instrument is a hedonic quality test sheet with 3 criteria; well, enough and less. Further analysis is using quantitative descriptive analysis. The results showed that the quality of sponge cake with 100% formulation obtained 89% taste percentage in good category, 84% color in good category and 55% texture in less category. Sponge cake quality with 75% formulation got percentage taste of 87% in good category, color of 88% in good category and texture equal to 76% in good category. Finally, sponge cake quality with 50% formulation got taste percentage 93% in good category, color 100% at good category and texture of 97% in either category.

3.4 Gadung Sponge Cake

This research aims to find out of quality sponge cake with 100%, 75% and 50% formulation of gadung flour, looked from taste, color, and texture (Sumiati et al, 2014).

Table 2. Organoleptic Analisis of Gadung Sponge Cake

Quality	Sponge cake (100% of gadung flour)		Sponge cake (75% of gadung flour)		Sponge cake (50% of gadung flour)	
	Result	Category	Result	Category	Result	Category
Taste	89%	Good	87%	Good	93%	Good
Color	84%	Good	88%	Good	100 %	Good
Texture	55%	Not Good	76%	Good	97%	Good

IV. Conclusion

Gadung tuber, the source of carbohydrate, can be used as a local food alternative of staple food. Some research indicated that: Immersion of 72 hours in 5% or 7.5% salt solution produces the safest flour to be consumed. Gadung flour processing by soaking into 10% salt solution and drying at 60 ^{o}C can reduce cyanide acid by 33%. The combination of 60% wheat flour : 40% gadung flour resulted in good taste, color and texture of gadung cake. In gadung sponge cake, the combination of 50% wheat flour : 50% gadung flour resulted in good taste, color and texture of 93% , 100% and 97% respectively.

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