Purple_Yam_Flour_(Dioscorea_alata_L.)_Processing_Effect_on_Anthocyanin_and_Antioxidant_Capacity_in_Traditional_Cake_Bolu_Cukke_Making_.pdf

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Purple Yam Flour (*Dioscorea alata* L.) Processing Effect on Anthocyanin and Antioxidant Capacity in Traditional Cake "Bolu Cukke" Making

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Abstract. Purple yam (*Dioscorea alata* L) is a food that has the potential as a source of natural antioxidants, because of the anthocyanin component. Anthocyanin can be damaged from high temperatures (heating) during processing and manufacturing processed products. The purpose of this study was to analyze the content of anthocyanin compounds and the antioxidant activity in purple yam flour before and after processing. The determination of anthocyanin test was done by using pH spectrophotometry method and DPPH method for antioxidant test. The main analysis parameters wereanthocyanin content and antioxidant activity. The results showed that the anthocyanin content in the processing of purple yam to flour and sponge cake was decreased. The highest anthocyanin content of 38.12 mg/ 100g is found in purple yam and the lowest is 2.99 mg/100 g in cake "bolu cukke" with 10 grams of purple yam flour. The highest antioxidant activity was 79.08% in purple yam and the lowest was 22.64% in cake bolu cukke with purple yam gram 10 gram addition. The decrease in antioxidant activity is directly proportional to the decrease in anthocyanin levels.

1. Introduction

Indonesia is a tropical country, therefore Indonesia is rich in biodiversity. One of the many crops produced is tubers such as purple yam. This plant grows well from the lowlands to an altitude of 800 m above sea level, but can also grow at an altitude of 2700 m above sea level [2]. In the dry season purple uwi bulbs experience a period of rest. To avoid damage easily, purple yam bulbs are stored in a dry place. Towards the rainy season this tuber will sprout. Bulbs that have sprouted are used as seeds. Harvesting can be done after 7-9 months after planting, marked by yellowing of the leaves, which means the tubers are ripe [9].

Purple yam are one of the varieties of tubers that have the potential as a source of local food ingredients that contain carbohydrates, proteins, fats, fiber, vitamins, minerals, and contain antioxidants [10]. Purple yam plants grow in the Soppeng area, but the people do not use these plants, even though purples can be processed into flour to extend shelf life and can be used as an alternative to reduce wheat flour in meeting consumer needs. The advantages of this processed flour can be seen from its form, among others, easily stored ingredients, small volume, easy to transport, and can be used for various processed food products [17]. Another interesting thing from the Dioscorea plant is that it contains anthocyanin compounds and antioxidant activity.

According to [5], the purple color found in local varieties of tuber indicates that there is an anthocyanin which is an antioxidant and can counteract free radicals in the body. Anthocyanin content

has colored compounds which are mostly red, blue and purple. Strong purple color shows anthocyanin levels and has high antioxidant activity [14]. Antioxidants are compounds that serve as a neutralizing increase in free radicals, protecting cells from the toxic effects produced and contributing to disease prevention. Anthocyanin acts as an antioxidant that can counteract free radicals so as to prevent aging, cancer and other degenerative diseases. Anthocyanin content also functions as antimutagenic, antocarcinogenic and can reduce blood sugar levels and antihypertension [13]. Changes in the content of anthocyanin levels and antioxidant activity in purple yam, purple yam flour and cukke sponge products made from purple yam flour during processing will occur. So this research was carried out by analyzing the anthocyanin compound content and activity on purple yam bulbs, purple yam flour and cukke sponge products made from purple yam flour and it is hoped that this research could become information to the public about the benefits of anthocyanin compounds and antioxidant activity in purple yam.

2. Research Methodology

2.1. Tools

The tools used in this study are analytic scales, measuring cups, erlenmeyers, test tubes, vortices, propipets, measuring pipettes, measuring cups, wathman filter no. 42 and UV-Vis Genesys 20 spectrophotometers, and cuvettes**.**

2.2. Ingredients

The ingredients used are uwi tuber, uwi tuber flour, cukke sponge products made from purple yam flour, 98% methanol and 96% ethanol, 0.2 mM DPPH solution, acetate buffer, potassium chloride (pH 1), buffer sodium acetate (pH 4.5) and aluminum foil.

2.3. Research Procedure

The initial stage of preparation of samples, namely purple yam obtained from Soppeng district, South Sulawesi, then cleaned with running water to remove the sticky soil. Then the purple yam is peeled to separate the tuber meat and skin. Furthermore, anthocyanin levels and antioxidant activity were tested. Furthermore, the process of making purple uwi flour begins with purple yam washing from the soil and other impurities, then theprocess is carried out *blanching* by soaking it in hot water at 80°C for 1 minute until the entire purple yam is submerged in water, then anthocyanin levels and antioxidant activity are carried out. Then stripping purple yam skin using a knife. The next stage is slicing with a *slicer* with a thickness of ± 1-2 mm, then the tubers are soaked in 5% salt solution for 2 hours, then anthocyanin levels and antioxidant activity are tested. Then washing with running water was carried out, then anthocyanin levels and antioxidant activity were tested. Then drying with a *cabinet dryer* at 60°C for 6-8 hours, then testing anthocyanin levels and antioxidant activity. Then the dried uwi was crushed with a *grinder* and sieved with 80 mesh size and tested for anthocyanin levels and antioxidant activity. How to make cukke sponge by using purple yam flour, flour and rice flour, first of all is purple yam flour, flour and mixed rice flour according to the treatment then roasted. Then the eggs and brown sugar are stirred until blended. Then added tbm, and baking soda. After thickening, the mixture of purple yam flour, flour and roasted rice flour was added, little by little. Then added cooking oil and stirred again until smooth. After that, prepare the cake mold "cukke sponge" then spread the cooking oil into the cake mold. Then put the mixture into the mold and then baked until cooked. Furthermore, anthocyanin levels and antioxidant activity were tested**.**

2.3.1. Anthocyanin Extraction [3]

Samples of purple yam, purple yam flour and cukke sponge 'made from purple yam flour, weighed 1 g then put into a test tube. In the test tube a 1 ml acetate buffer was added, then the purple yam was incubated at 40°C for 1 hour with a shaking of 170 rpm using a centrifuge. After the education is complete, into the tube is added 10 mL of acidified 70% ethanol (pH 3.5). The tube is then inserted

into the waterbath at 80^{0}C for 1 hour. After the incubation in the water bath is complete, the tube is centrifuged so that the extract and residue are separated. Anthocyanin extract is separated from the residue by decantir. Anthocyanin extracts are stored in tubes that have been coated with aluminum.

2.3.2. Determination of Total Anthocyanin Concentration Using Differential pH Method of Spectrophotometry

Determination of total anthocyanin content by differential pH method [8]. The sample was dissolved in two different buffer solutions, 1 ml the sample was diluted with potassium chloride buffer (pH 1) until the volume was 10 ml, and the sample was diluted with sodium acetate buffer (pH 4.5). Then it was allowed to stand for 15 minutes, then the absorbance measurements were carried out using spectrophotometry. Absorbance measurements are carried out using each wavelength read at a length of 516 and 700 nm.

$$\text{antosianin content (mg/L)} = \frac{A \; x \; MW \; x \; DF \; x \; 1000}{\varepsilon \; x \; L}$$

Where:
A = Absorbance [A516 - A700] pH 1 - [A516 - A700] pH 4.5,
ε = Koefisien ekstingsi molar extension (Cyanidin-3-glycoside: 26900 L / mol cm)
L = width of cuvette (1 cm)
MW = molecular weight of cyaniding-3-glycoside 448.8 g / mol,
DF = factor of dilution.

2.3.3. Measurement of Antioxidant Activity with DPPH Method

As much as 1 ml the extract of the sample was dissolved in 98% ethanol as much as 5 ml and then vortexed until homogeneous. Then it was centrifuged at 4000 rpm for 10 minutes, then the supernatant was pipetted as much as 4 ml, then 1 ml of DPPH 0,2 mM was added. After that, leave it in a dark place for 30 minutes. Then absorbance is measured with a wavelength of 517 nm. The amount of the percent (%) value of antioxidant activity can be calculated using the equation:

$$A = \frac{(\textit{Absorbansi blanko} - \textit{absorbansi sampel})}{\textbf{absorbansi blanko}} \text{ x } 100\%$$

Where:
Akt. antioxidant: The amount of the percentage (%) antioxidant activity
Abs / Absorbance: Absorption value (a) blank and sample

3. Results and Discussion

The results of anthocyanin analysis on the purple yam during the sowing process to become cukke sponge cake ranged between 2.99 - 38.12 mg / 100g. Figure 01 shows that the lowest anthocyanin level in cukke sponge cake treatment with the addition of 10 grams of purple tuber flour is 2.99 mg / 100 g. While the highest anthocyanin content is found in purple yam with a yield of 38.12 mg / 100g. The results of the variance analysis showed that the purple yam processing during the tasting process to become a cukke sponge cake had a significant effect on the level of 5%, so that further testing was carried out. Duncan's test results showed that the purple yam treatment had a significant effect on drying treatment, flour, and the addition of purple yam flour 10, 20 and 30 grams. But thetreatment *blanching* and washingdoes not have a real effect.

The total anthocyanin content obtained in purple yam is 38.12 mg / 100g. After processing into flour, there is a decrease in anthocyanin levels. The anthocyanin content with treatment *blanching* decreased anthocyanin levels, ie 36.73 mg / 100g. The decrease in anthocyanin levels that occur occurs because in theprocess *blanching* can damage the anthocyanin caused by contact with heating and moisture, which can affect the damage to anthocyanins caused by enzymatic damage and heating

treatment resulting in anthocyanin degradation. This is in accordance with [11] reduced anthocyanin levels due to the presence of two, namely the steam process (heating with water vapor), anthocyanins damaged by enzymatic damage and heating treatment.

Table 1. Total anthocyanin content and antioxidant activity in purple uwi during processing into flour and used as substitute for making sponge cake

Ingredients and processing	Anthocyanin content of mg / 100 g	Antioxidant Activity %
Purple yam	38.12	79.08
Blanching	36.73	61.75
Washing	32.63	40.75
Drying	29.29	32.16
Flour	27.27	30.01
Cukke sponge cake + 10 gram purple yam flour	2.99	22.64
Cukke sponge cake + 20 grams of purple yam flour	8.04	24.06
Cukke sponge cake + 20 grams of purple yam flour	20.71	26.9

3.1. *Anthocyanin Content*

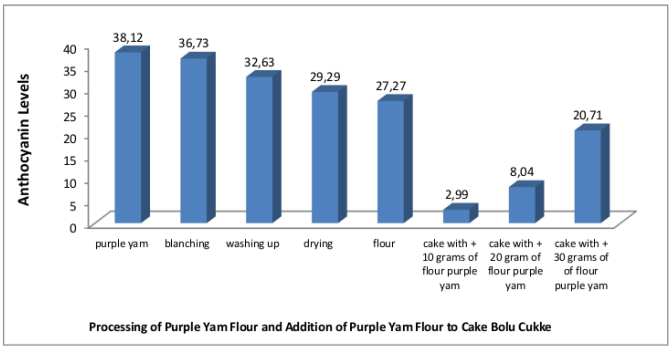

Figure 1. Total content anthocyanin and in purple yam during processing into flour and cukke sponge cake.

Washing treatment also decreased anthocyanin levels, where after purple yam was *blanched* then purple yam was washed. This washing process has experienced a decrease in anthocainin levels of 32.63 mg / 100g. The loss of anthocyanin is caused by the dissolution of anthocyanin compounds in the immersion of purples yam slices before drying, because anthocyanins are soluble in water. This is consistent with [16], who stated that anthocyanins are a group of pigments that cause reddish color, located in cell fluids that are soluble in water.

Drying treatment also decreased anthocyanin levels by treatment after purple yam washing, then drying was done using a dryer cabinet. After testing anthocyanin levels in this treatment, anthocyanin levels were produced which were 29.29 mg / 100 g. The decrease in anthocyanin levels in this

treatment is due to the drying process of anthocyanin pigments which is easily damaged because anthocyanins are not stable at high temperatures. In making purple yam flour, drying is carried out at a temperature of 60^0C and requires a long time and contact with oxygen which can cause anthocyanin oxidation. High heat causes the anthocyanins contained in the material to be damaged, but this is also affected by the heating temperature, heating time, and the size of the treated material. This is consistent with [20], on high heating, the stability and resistance of anthocyanin dyes changes and results in anthocyanin damage. This is also confirmed by [6] anthocyanins begin to experience damage above 60˚C. Drying is carried out at a temperature of 60˚C but requires a long time and contact with oxygen which causes anthocyanin oxidation. The decrease in anthocyanin in purple yam flour produced is 27.27 mg / 100g. The loss of anthocyanin because it has been treated with repeated heating and washing, because anthocyanins are heat-stable and water-soluble anthocyanins. This is in accordance with [21], which states that the color of a product is determined based on the natural pigments present in food ingredients, besides the presence of heating factors can reduce the content of natural pigments contained in food.

3.2. *Antioxidant Activity*

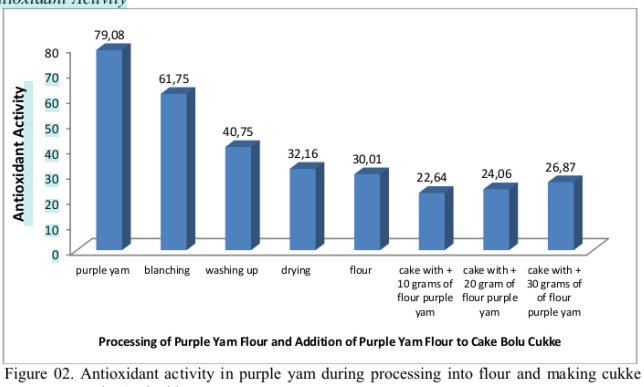

Figure 02. Antioxidant activity in purple yam during processing into flour and making cukke sponge cake Antioxidant

Reduced levels of anthocyanin in the cukke sponge cake treatment with the addition of purple yam flour 10 grams, 20 grams and 30 grams, due to theprocess *blanching* and drying before making flour, thus damaging the purple yam color of anthocyanin content and influencing purple yam flour is produced and ultimately affects purple yam flour. The decrease in the stability of anthocyanins is also caused by the added sugar which is brown sugar which affects the color of the resulting cukke sponge turning brownish. In addition, from several types of sugar that have been tested (sucrose, fructose, glucose, and xylose) which apparently can increase anthocyanin degradation with a mechanism of formation to form polymer pigments and browning and due to the different levels of purple uwi flour substitution that produce different levels of anthocyanin. The higher the substitution of purple yam flour, the higher the anthocyanin content produced. And the roasting temperature used can increase anthocyanin degradation. This is in accordance with [1], which states that the color of the cake turns brown can be caused by sugar. Sugar can reduce anthocyan stability. In addition, from several types of sugar that have been tested (sucrose, fructose, glucose, and xylose) it was found to increase the

degradation of anthocyanins by a mechanism of formation to form polymer pigments and browning. This also occurs in research that has been carried out by [7] that the variation of the substitution of purple sweet potato flour in the manufacture of syringes can affect anthocyanin levels. Anthocyanin increased in keu syringe by 6.25466 mg compared to control (wheat flour). Besides that, there was also a study conducted by [4] that the variation of mixing flour and brown rice flour in the manufacture of steamed sponge increased compared to control (100 percent flour) could affect the levels of anthocyanin in the steamed sponge produced.

Antioxidant activity in purple yam and during the siege process to become cukke sponge cake ranged between 22.64 - 79.08%. Figure 02 shows that antioxidant activity decreases during the siege process to become a cukke sponge cake, the highest antioxidant activity is obtained in purple yam treatment which is 78.08% and the lowest in cukke sponge cake treatment with 10 gram purple uwi flour substitution of 22.64% . The results of the variance analysis showed that the purple yam processing during the tasting process to become a cukke sponge cake had a significant effect on the level of 5% on the content of the purple yam antioxidant activity during the siege process to become a cukke sponge cake so that further testing was carried out. Duncan's test results showed that the purple yam treatment had a significant effect on washing, flour and cukke sponge cake treatment with the addition of purple yam flour 10, 20 and 30 grams. But the blaching and washing treatment has no real effect.

Antioxidant activity experienced a different decline after undergoing the siege process to become a keuku cukke. Figure 02 shows that the highest to lowest antioxidant activity in the order is purple yam treatment, *blanching*, washing, drying, purple uwi flour, cukke sponge cake with 30 grams of purple yam flour substitution, cukke sponge cake with 20 grams of yam purple flour substitution and finally cukke sponge cake with 10 grams of purple flour flour. This is due to the process of making purple uwi flour through a process of *blanching* and drying, which causes a decrease in antioxidant compounds found in purple uwi flour, because the antioxidant component is not heat resistant. The difference in antioxidant activity produced is due to the resulting anthocyanin levels. Where anthocyanin levels are directly proportional to antioxidant activity. This is consistent with [18], which states that the decrease in antioxidant activity is directly proportional to the decrease in total phenolic and anthocyanin levels and the process of processed products. This is also confirmed by [15], which states that phenolic and anthocyanin compounds are closely related to the ability of ingredients as a source of antioxidants.

4. Conclusion

The anthocyanin content in the processing of yam purple becomes flour and sponge cake has decreased. The highest anthocyanin content of 38.12 mg / 100 g is found in purple yam and the lowest is 2.99 mg / 100 g in cukke sponge cake with 10 grams of purple yam flour. The highest antioxidant activity was 79.08% in purple yam and the lowest was 22.64% in cukke sponge cake with purple gram 10 gram addition. The decrease in antioxidant activity is directly proportional to the decrease in anthocyanin levels.

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