Characteristic of banana flour produced from the variety of "Raja Lawe" and "Raja Labu"

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Abstract. Banana variety of "Raja Lawe" and "Raja Labu" are found mostly in Banjarnegara, Central Java. To extend the shelf-life of these bananas, it is necessary to apply an appropriate technology. One of the alternatives is processing of bananas into flour. This study aims to determine the effect of blanching and immersion in several types of solutions on the sensory and physicochemical characteristics of "Raja Lawe" and "Raja Labu" banana flour. This study used an experimental method with a randomized block design. The factors consisted of banana variety ("Raja Lawe" (A1) and Banana variety "Raja Labu" (A2)), blanching effect (non-blanching (B0) and blanching (B1)), and the soaking solutions (sodium chloride (C1), sodium meta-bisulfite (C2), citric acid (C3), and water (C4)). The result of this research shows that in addition to the fresh consumption of the banana fruit “Raja Lawe” and “Raja Labu”, both bananas could be utilized as an intermediate product such as flour. Treatments of blanching and soaking in the solution could improve the quality of the banana flour made from the “Raja Lawe” and “Raja Labu”. The banana flour last longer and may reach broader market that increase the economic value of the fruits.

1. Introduction

Banana (*Musa parasidiaca*) is one of the important fruit commodities in Indonesia. This refers to the large harvested area and banana production that tend to increase year by year. Apart from the large area of harvest and banana production, Indonesia is also one of the primary centers for banana diversity. More than 200 types of bananas exist in Indonesia, which provides opportunities for the use and commercialization of bananas according to consumer needs. Banana fruits can be found in all of 34 provinces in Indonesia [1]. It is an advantage for Indonesia as a potency to become a main producer of banana. A professional management should be conducted during cultivation to have high quality of the product because pre-harvest treatments affect the quality of products [2].

Banana fruit is an agricultural commodity which is perishable. Generally, the banana is consumed fresh and few of them are processed info food products. Due to the inherent characteristic, the shelf life of bananas is short, so it is necessary to use appropriate technology to maintain the quality. Moreover, process of bananas into food products is one of the alternatives to prolong the shelf life. One of these preparations is the processing of bananas into flour [3]. Flour as an intermediate product from raw material as one of the alternatives solution for guarantee the availability throughout the year. Previous research reported advantages of flour as an intermediate product [4].

Banana flour is the result of grinding dried banana fruit. Banana flour has several advantages over fresh bananas and other processed bananas, such as: longer shelf life, economical value, can be processed into various kinds of food products (cookies, cakes, bread, biscuits, noodles and complementary foods of breast feeding) and larger marketing or distribution area. Banana flour can be formulated into several forms of processed cake, and is easy to digest so it is safe for consumption by the elderly and children [5]. According to Cheok et al. [3], banana flour is one of the recommended alternative forms of semi-finished products, because it is more resistant during storage, easy to mix (made composites), enriched with nutrients (fortified), shaped, and faster cooked according to the demands of modern life. Banana flour has a distinctive taste and smell so that it can be used in the processing of various types of food that use flour (rice flour, wheat flour etc.) in it. In this case banana flour replaces part or all of the other flour. Raw banana flour is more common than ripe banana flour. The advantages of raw or green banana flour include high content of resistant starch and dietary fiber which is beneficial for human health [5].

Banana flour is a prospective intermediate product as a local food development that is rich in carbohydrates. Apart from starch, banana flour is also rich in dietary fiber which is a functional food. Functional food is defined as food that can benefit one or more of the target functions in the body as well as nutrients that can strengthen the body's defense mechanism and reduce the risk of disease [6].

Banana flour has easy digestibility and is suitable for use as food for babies, food for the sick and the elderly. Several studies have been conducted to improve the nutritional properties of a food product by supplementation of banana flour. Previous research reported that green banana flour has the potential for improving the quality of the products, such as a source of fiber. Banana flour was used as a substitution on bread making [5]. Moreover, Ovando-Martinez et al. [7] reported that pasta products containing banana starch exhibit low levels of enzymatic hydrolysis of carbohydrates and they can help expand the range of low glycemic index foods available to consumers.

In the process of making banana flour, several treatments are applied to maintain the quality, particularly color. The pretreatments that are common during production of banana flour are blanching, controlled-drying, and soaking in the solution. Raw material, peeled bananas are soaked in a various solution to maintain the bright color, solution used for soaking such as citric acid [5,6,8], water [9] or salt solution [3]. The purpose of using soaking solutions during food preparation is to control enzymatic and non-enzymatic browning reactions, inhibit microbial growth.

$CaCO_3$ is still widely used in traditional processing, and is widely available on the market. Some fruit are immersed in the solutions of limestone or calcium carbonate as a soaking material to maintain the quality. The purpose of immersion is to strengthen fruit tissue and is an inexpensive source of calcium. The use of calcium carbonate as a soaking material in bananas is expected to improve the quality of banana flour. The purpose of this study was to determine the characteristics of the banana of “Raja Lawe” and “Raja Labu”, as well as to evaluate the effect of blanching and immersion in the solutions on the characteristics of the flour produced from the banana of “Raja Lawe” and “Raja Labu”.

2. Materials and methods

Green (unripe) bananas from two types of cultivars, “Raja Lawe” and “Raja Labu” were used in this study. The fresh fruit were obtained from the farmers in Banjarnegara Regency Central Java. The characteristic of the fruit, including content of moisture, fat, vitamin C, starch, and pH were determined. Moreover, the other fruits were prepared for producing the flour according to the treatments. The treatments applied to the banana fruit of “Raja Lawe” (A1) and “Raja Labu” (A2) were: blanching (without blanching/B1 and steam blanching for 5 min/B2) and soaking with solution for soaking (sodium chloride/C1, sodium metabisulfite/C2, citric acid/C3 and water/C4). Before the flour production, the characteristic of the banana were determined. There were three times for harvesting the banana from the farmers, at each batch there were three replications for the measurement.

The flour was produced according to this procedure: the banana fruits were treated by blanching with the peel for 5 min or without blanching process, afterward the banana were peeled and sliced for about 1 cm thickness and soaked in the provided solutions (sodium chloride/C1 or sodium metabisulfite/C2 or

citric acid/C3 or water/C4). The slices were dried in the cabinet dryer at 50°C for 24 hours. The final stage was the flouring process using a grinder to produce banana flour and sieving using an 80 mesh sieve. There were three times production of flour that will be analyzed for their characteristic.

The flour were analyzed to know the characteristic. The physicochemical variables observed included yield of flour, moisture content, starch content, viscosity and brightness. Yield of flour was calculated by comparing the weight of flour and the weight of banana as raw material for producing flour. Moisture content was determined by gravimetric method, using an oven for the drying. Brightness was measured using color-reader and the result was L-value [10]. The viscometer was used to determine the viscosity of the flour, the mixture consist of 50 g of the banana flour in 300 ml water. The chemical analysis were conducted 3 replications and in each replication there were 2 repetitions. The data obtained from this study were analyzed by variance analysis (F test) and if the result of the analysis showed a significant effect, then continued with Duncan's Multiple Rank Test (DMRT).

3. Results and discussion

The characteristic of the banana "Raja Lawe" and "Raja Labu" is presented in the Table 1.

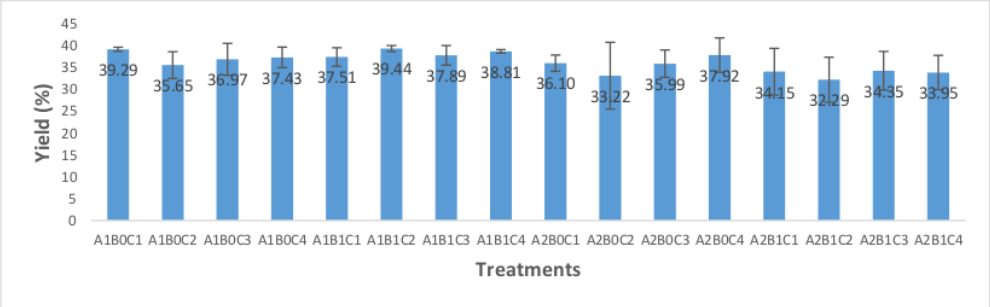
Table 1. The characteristic of the banana "Raja Lawe" and "Raja Labu"

No	Parameter	Content	
		"Raja Lawe"	**"Raja Labu"**
1	Moisture (%)	61.23	60.64
2	Vitamin C (mg/100 g)	1.91	4.07
3	Reducing sugar (%)	1.17	1.30
4	Fat (%)	0.37	0.33
5	Starch (%)	0.97	1.14
6	pH	6.0	6.33
7	Total soluble solid (Brix)	6.93	5.73

The size of the banana "Raja Lawe" and "Raja Labu" are different, therefore they are easily recognized by their size. Both bananas have the same shape but the banana "Raja Lawe" is long and "Raja Labu" is short. Banana "Raja Lawe" is mainly utilized as raw material for processing, such as: banana chips. It is not common for fresh consumption. Meanwhile, banana "Raja Labu" commonly prepared as fresh fruit. The Table 1 shows the content in the banana "Raja Lawe" and "Raja Labu". The inherent characteristic of the banana "Raja Lawe" and "Raja Labu" are different and this factors will influence the processed product from these banana. Moisture content of both banana were 61.23% and 60.64%, respectively. Both bananas had moisture content about 60-61% that means they have high content of dry matter. High dry matter content is expected for agricultural commodities as raw material for processing, including for flour production to have high yield. The result in the present research according to Marta et al. [9] who concluded that different varieties of the banana will have their own characteristic.

3.1. Yield of flour

The results of the analysis of variety showed that blanching (B) and soaking material (C) did not have a significant effect on the yield of "Raja Lawe" banana flour and "Raja Labu" banana flour. The average yields of "Raja Lawe" banana flour and "Raja Labu" banana flour are presented in Figure 1. "Raja Lawe" banana flour had a higher yield than "Raja Labu". The yield of "Raja Lawe" banana flour ranged from 35.65% - 39.49% with an average of 37.87%. While the yield of "Raja Labu" banana flour was in the range of 32.29% - 37.94% with an average of 34.75%. "Raja Lawe" and "Raja Labu" are plantain types. The plantain banana group has a higher yield, because this type has more starch and has a greater total dissolved solids.

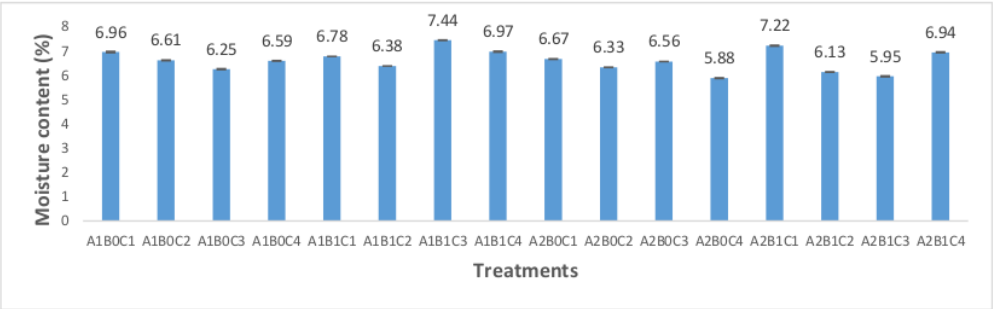


A1: banana flour made from "Raja Lawe"; A2: banana flour made from "Raja Labu"; B1: without blanching; B2: steam blanching for 5 min; C1: sodium chloride; C2: sodium metabisulfite; C3: citric acid; C4: water

Figure 1. Yield of the flour made from banana "Raja Lawe" and "Raja Labu"

3.2.Moisture content

The moisture content of "Raja Lawe" banana flour was in the range of 6.25% - 7.44% with an average of 6.75% (Figure 2). While the rate of "Raja Labu" banana flour water was in the range of 5.88% - 7.22% with an average of 6.46% (Figure 2). Referring to the National Standard of Indonesia for banana flour (SNI 01-3841-1995), the results of both bananas in this research is still in the classification of the grade B. In the grade B, maximal of moisture content for banana flour is 12%. Moreover, additional treatments are required to reduce the moisture content of the flour in order these flour classified as grade A. In the grade A, maximal of moisture content of the banana flour is 5%. Alternatives for the treatment is drying for longer time. However, another consideration regarding the discoloration must be calculated. The expected result of the flour is low moisture content with relatively bright color. The low moisture content is required to extend the shelf life and give a positive effect on the food product. Moreover, the previous research that produced the flour from banana "Kapas", "Kepok", "Ambon" and "Nangka" reported that the moisture content range from 6.92% to 9.0 % [9].



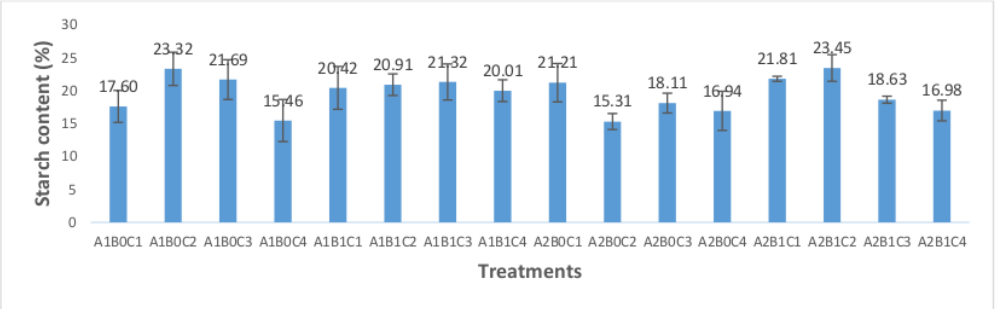
A1: banana flour made from "Raja Lawe"; A2: banana flour made from "Raja Labu"; B1: without blanching; B2: steam blanching for 5 min; C1: sodium chloride; C2: sodium metabisulfite; C3: citric acid; C4: water

Figure 2. Moisture content of the flour made from banana "Raja Lawe" and "Raja Labu"

3.3.Starch content

Starch content is one of the important properties of the flour because it contributes on determining the quality of food products. Figure 3 shows that the starch content of the flours ranged between 15.31% and 23.32%. In the National Standard of Indonesia for banana flour (SNI 01-3841-1995) there is no regulation regarding the minimal content of the starch. Starch content of the flour is mainly influenced of the inherent characteristic of the raw material. Based on the properties of the bananas, the starch content of "Raja Lawe" and "Raja Labu" are 0.97% and 1.14%, respectively. In addition, the banana

flour also contains mineral and other microelements that good for health. It will become a consideration of the customer for buying the food products. Particularly, starch content will influence the pasting properties. Previous research reported that the different banana varieties will produce different functional properties of the flour (swelling volume, solubility, water absorption and syneresis) [9]. Moreover, the addition of the banana flour also influence the characteristic of the bread as reported by Juarez-Garcia et al. [5].

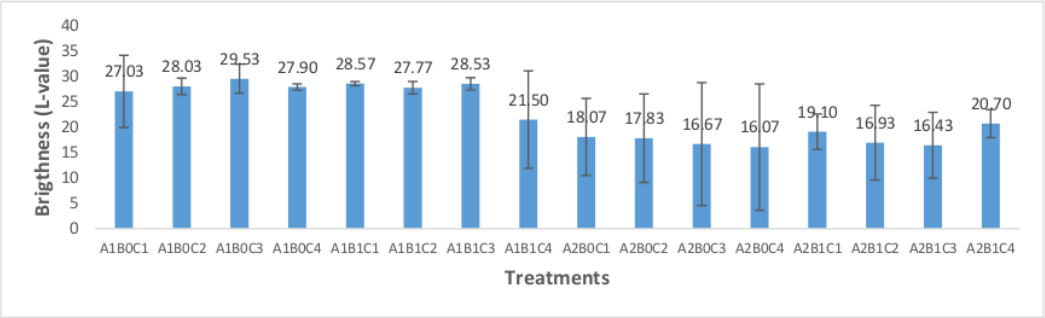


A1: banana flour made from "Raja Lawe"; A2: banana flour made from "Raja Labu"; B1: without blanching; B2: steam blanching for 5 min; C1: sodium chloride; C2: sodium metabisulfite; C3: citric acid; C4: water

Figure 3. Starch content of the flour made from banana "Raja Lawe" and "Raja Labu"

3.4.Brightness

The higher the brightness value is, the better performance of the flour to give a good effect on the food product. Figure 4 shows that the average of the flour made from "Raja Lawe" was higher than the flour made from "Raja Labu". The higher L-value means the flour is brighter than others. The result of brightness of the flour is depend on the raw material, the flesh of the banana fruit "Raja Lawe" relatively white to light yellow, whereas the flesh of the banana fruit of "Raja Labu" is tend to yellow color. Moreover, the oxidation after peeling also plays an important role for discoloration. During the preparation of the flour production, there was a drying process that will also contribute on the browning effect if there is no an appropriate temperature and duration of applying the drying. Comparing to the previous research, these result are relatively low because Marta et al. [9] reported that the flour from banana "Kapas", "Kepok", "Ambon" and "Nangka" have the L-value more than 77. Moreover, Savlak et al. [8] also presented that the L-value of the banana flour is higher than 80.

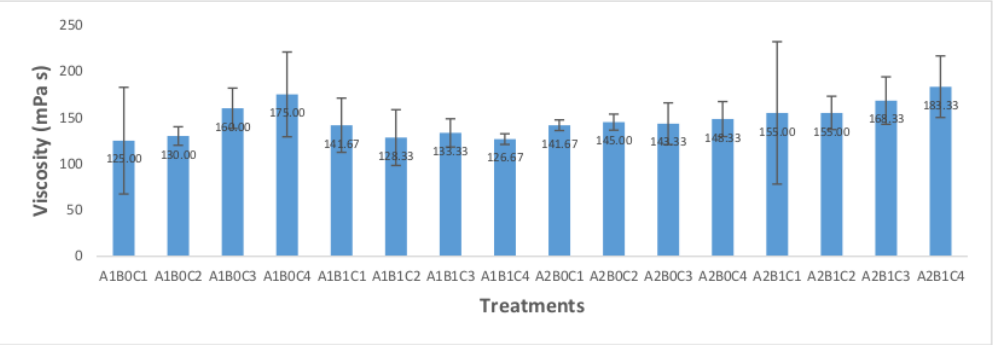


A1: banana flour made from "Raja Lawe"; A2: banana flour made from "Raja Labu"; B1: without blanching; B2: steam blanching for 5 min; C1: sodium chloride; C2: sodium metabisulfite; C3: citric acid; C4: water

Figure 4. Brightness of the flour made from banana "Raja Lawe" and "Raja Labu"

3.5. Viscosity

Since the banana flour will be utilized as a main material or as a substitution for producing food products, viscosity properties of the flour is important to be determined in order to apply an appropriate treatments during processing. Banana flour can be used as material for many food products, such as: brownies, cookies, cake, biscuits, porridge etc. Figure 5 presents the viscosity of the banana flour made from "Raja Lawe" ranged from 125 mPA.s to 175 mPa.s, while the viscosity of the banana flour made from "Raja Labu" ranged from 141.67 mPa.s to 183.33 mPa.s. This information could be as a consideration for utilizing these flour as a material for producing food products [5].



A1: banana flour made from "Raja Lawe"; A2: banana flour made from "Raja Labu"; B1: without blanching; B2: steam blanching for 5 min; C1: sodium chloride; C2: sodium metabisulfite; C3: citric acid; C4: water

Figure 5. Viscosity of the flour made from banana "Raja Lawe" and "Raja Labu"

Referring to the National Standard of Indonesia for banana flour (SNI 01-3841-1995), that the banana flour must be free from the contaminant of heavy metal and microorganism to ensure the quality of the flour. Therefore, further analysis is required to evaluate the contaminant in the flour produced form the banana of "Raja Lawe" and "Raja Labu". Moreover, in this research there is a treatment using the metabisulfite as the soaking solution, it could be an alternative as the soaking solution to minimize the browning and maintain the color. However, based on National Standard of Indonesia for banana flour (SNI 01-3841-1995), the banana flour of grade A must be free from the sulfite and the grade B required that maximum content of sulfite is 1 mg/kg.

4. Conclusion

The result of this research shows that in addition to the fresh consumption of the banana fruit "Raja Lawe" and "Raja Labu", both bananas could be utilized as an intermediate product such as flour. The flour can be used as main material or substitution of producing food products. The banana flour will last longer and may reach broader market that increase the economic value of the fruits. Treatments of blanching and soaking in the solution could improve the quality of the banana flour made from the "Raja Lawe" and "Raja Labu".

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