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Physicochemical and sensory properties of cookies produced from the flour of banana variety of "Raja Lawe" and "Raja Labu"

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Abstract. Banana is one of the versatile fruit because not only can be freshly consumed but it can be utilized as raw material for food processing. In Indonesia, there are many varieties of Banana that cultivated throughout the country. Banana "Raja Lawe" and "Raja Labu" are some of them that commonly cultivated in Banjarnegara, Central Java. These bananas could be utilized for producing the flour that can be as a raw material for food products. This research aims to study the appropriate treatments for producing the cookies from the flour of banana "Raja Lawe" and "Raja Labu". The flour from the "Raja Lawe" and "Raja Labu" combined the different proportion of wheat flour, such as 20:80%, 40:60%, 60:40%, 80:20%, and 100: 0%. The properties of cookies observed were swelling potential, hardness, color parameter, moisture content, ash content, and sensory attributes. The result shows that the flour from banana of "Raja Lawe" and "Raja Labu" could be utilized as a raw material for cookies production. Due to the differences in the inherent characteristic, the cookies produced from both bananas have different properties. The differences are indicated in the result of the color and hardness of the cookies. Moreover, based on the sensory evaluation the cookies resulted from all treatments are accepted by the panelists. Therefore, this research presents that the appropriate treatment combinations for producing cookies from the flour from banana "Raja Lawe" is the proportion of 40: 60% (banana flour: wheat flour) from and "Raja Labu" Banana is 80: 20% (banana flour: wheat flour).

1. Introduction

Banana is a fruit commodity that is widely grown in Indonesia. According to [1], banana growth in Indonesia increased steadily every year from 2011 to 2014. In 2014 banana plants in Indonesia reached 7,008,407 trees, which in fact far exceeded other fruits such as oranges, mangoes, pineapple, and bark. Bananas that are grown in Indonesia consist of many varieties, one of which is the "Raja Lawe" Banana. This banana is widely cultivated in the Banjarnegara area, Central Java. Lawe banana fruit has a length of 20-40 cm, a diameter of 3-4.5 cm, the color of the fruit skin even though it is ripe is yellowish green, and the taste of the fruit is sweet. Apart from the "Raja Lawe", in the Banjarnegara area, many varieties of plantain are also cultivated. There is "Raja Labu" that has 12-18 cm long and the diameter of 3.5-4.5 cm of the fruit. The fruit skin is green and will turn yellow when it is ripe.

One alternative food processing that can increase the durability of bananas is process it into flour and then it can be used as raw material for cake products [2]. According to [3], flour is



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most common forms of banana preservation. Banana flour contains a high starch that can be used in making baby food as an energy source. Besides, banana flour can be used as a variety of processed food products such as bread [4], pasta [5], noodles [6], and cookies [7]. Cookies were chosen as processed products in the application of “Raja Lawe” and “Raja Labu” flour because cookies are a familiar product for Indonesian consumption. Besides, cookies products also have a long shelf life. This research on making cookies from banana flour was carried out to increase the use of “Raja Lawe” and “Raja Labu” which are widely grown in the Banjarnegara area, Central Java. Also, the manufacture of cookie products is also intended to increase the shelf life of processed products from “Raja Lawe” and “Raja Labu”. The aim of this research was examining the potency of using the banana flour made from banana of “Raja Lawe” and “Raja Labu” as raw material for producing cookies.

2. Research methodology

2.1. Materials

This study uses bananas grown in Banjarnegara, Central Java, Indonesia, namely “Raja Lawe” and “Raja Labu”.

2.2. Experimental design

The treatments in this research were the type of banana flour (made from “Raja Lawe” flour (V1) and “Raja Labu” flour (V2)); and the proportion of banana flour: wheat, which consists of 5 levels (20:80 (P1); 40:60 (P2); 60:40 (P3); 80:20 (P4); 100: 0 (P5)). Therefore, there were 10 treatment combinations, and each treatment was performed for 3 replications.

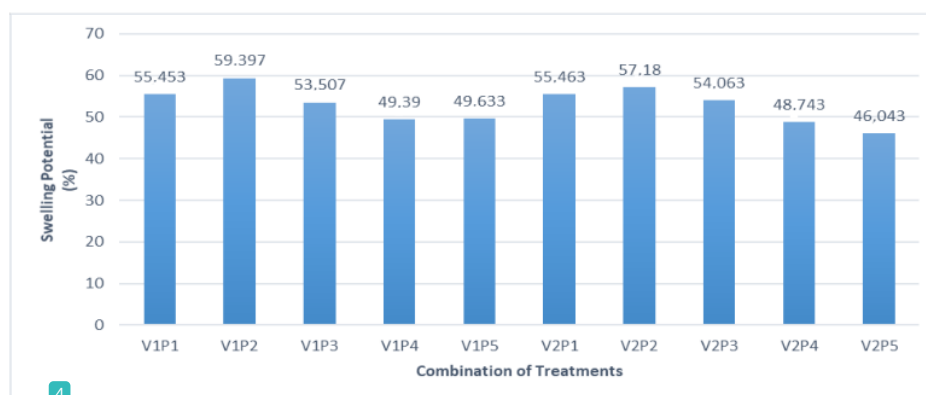
The variables in this study consisted of sensory variables including color, banana aroma, texture, taste, and preferences. The physicochemical variables observed were swelling power, hardness, color (L^* values), moisture content, and ash content. Moreover, the sensory evaluation was also conducted, including taste, color, texture, and flavor. The data of physicochemical were analyzed using F test at the 5% level and followed with Duncan's Multiple Range Test at the 5% level. Sensory parameters were analyzed using the Friedman test and the optimal treatment combination is determined using the Effectiveness Index Test.

3. Results and discussion

3.1. Swelling potential

The results showed that the treatment of banana flour and the proportion of banana flour: wheat had no significant effect on the swelling potential of banana flour cookies (Figure 1). The swelling potential value is between 45 to 60%.

The increasing proportion of banana flour tends to decrease the flower power of cookies. This is caused by reduced protein (gluten) in wheat flour and affects the structure formation of cookies. In the process of making cookies, air bubbles (CO_2 gas) will be formed which is produced by baking powder, then these air bubbles will be trapped in the dough structure formed due to the presence of gluten in the dough. Apart from gluten, starch can also trap air bubbles through the starch gelatinization process. Although banana flour does not contain gluten, banana flour contains starch and amylopectin. So that cookies with 100% banana flour treatment can still experience development. According to [8], gluten affects the development of cookies, because, with the reduction in gluten, the elasticity of the dough becomes poor so that the dough is unable to hold the air generated during the baking process.



V1: made from "Raja Lawe" flour, V2: made from "Raja Labu" flour

P1: the proportion of banana flour: wheat as 20:80, P2: 40:60, P3: 60:40, P4: 80:20, and P5: 100:0.

Figure 1. The swelling potential value of banana cookies.

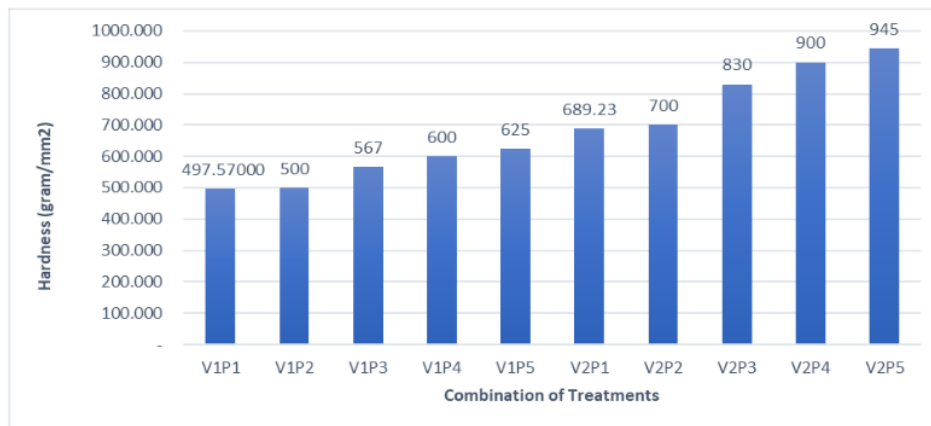
Banana flour does not contain gluten, so the starch, amylose, and amylopectin content in banana flour will affect the development of cookies. Amylose can form complexes with lipids in starch so that it can inhibit the development process. Meanwhile, the amylopectin branch contributes to increasing development value because amylopectin easily traps water [9]. According to [10] when kneading, starch will absorb water from the material and trap air to form small air bubbles, then proceed with the heating process, the gelatinization process occurs which begins with starch swelling, crystalline melting, starch dissolving, spreading, expanding, and development.

The addition of margarine (fat) in the making of cookies will change the texture, taste, and flavor of cookies. These fats can interact with starch granules and prevent hydration so that the increase in the viscosity of the material is low. The mechanism of inhibition is that the fat will form a layer on the outside of the starch granule and at the same time will inhibit the penetration of water into the granule. Fewer water penetration will result in high gelatinization and will form less fluffy cookies with a denser / compact texture [11].

This research on making banana flour cookies uses baking powder. Baking powder is a developer or inorganic substance that is added to the dough (can be single or mixed) to produce CO₂ gas. The function of baking powder is to release CO₂ gas regularly during baking so that the dough expands perfectly, keeps shrinkage, and to balance crumbs [12].

3.2. Hardness

The results displayed that the treatment of banana flour and the proportion of banana flour: wheat had no significant effect on the hardness of banana flour cookies (Figure 2). Hardness values between 500 to 950mg / mm².



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V1: made from “Raja Lawe” flour, V2: made from “Raja Labu” flour

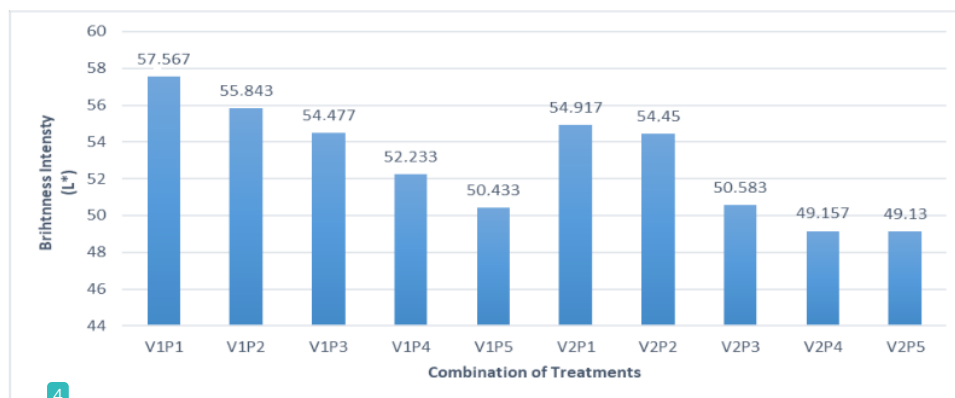
P1: the proportion of banana flour: wheat as 20:80, P2: 40:60, P3: 60:40, P4: 80:20, and P5: 100:0.

Figure 2. The hardness of banana cookies

Different banana varieties can affect the hardness of the cookies produced because the amylose and amylopectin content in each banana variety can be different. It is indicated that the amylose content in the “Raja Labu” banana is more than “Raja Lawe” banana. So that cookies with “Raja Labu” banana flour have a higher hardness than cookies with “Raja Lawe” banana flour. According to [13], amylose content affects starch retrogradation, starches that are high in amylose tend to increase retrogradation. Amylose molecules bind to each other and will bind to the amylopectin branch on the outside of the granule. This causes changes in texture, where retrogradation by amylose produces a strong structure due to increased hardness and stiffness [14].

3.3. Brightness colors (L^*)

The result showed that the type of banana flour had significant effect on the L^* parameter of banana flour cookies. The average value of L^* cookies for banana flour in the treatment of banana flour (J) is presented in Figure 3.



4

V1: made from “Raja Lawe” flour, V2: made from “Raja Labu” flour

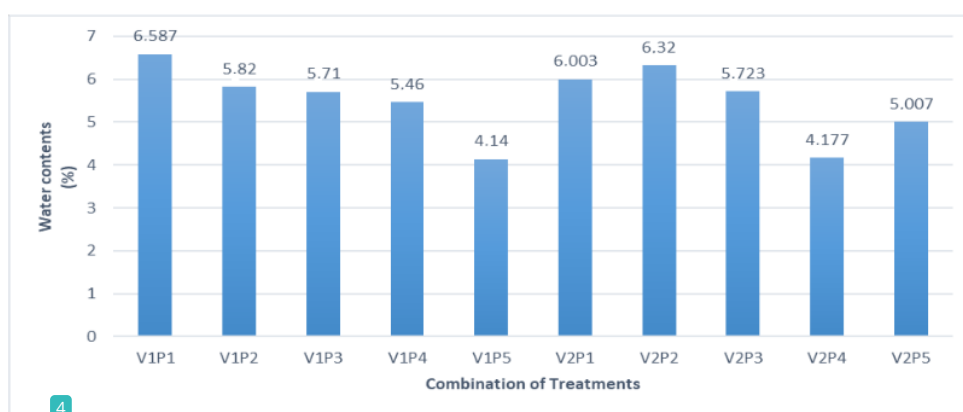
P1: the proportion of banana flour: wheat as 20:80, P2: 40:60, P3: 60:40, P4: 80:20, and P5: 100:0.

Figure 3. Brightness of the banana cookies

The formulation of banana cookies from “Raja Lawe” banana variety flour, and the proportion of banana flour: wheat =20:80 has brightness value on (L*) **56.5**. L * value that is close to 100 indicates that the analyzed sample has high brightness (bright) while an L * value that is close to zero indicates that the sample has a low brightness (dark). Samples containing more banana flour had a lower brightness level because of the sugar and protein content in the banana flour. The sugar and protein content in the product causes the Maillard reaction, where the Maillard reaction is a reaction between reducing sugar and protein.

3.4. Water content

The data showed that the treatments had no significant effect on the moisture content of banana cookies (Figure 4).



V1: made from “Raja Lawe” flour, V2: made from “Raja Labu” flour

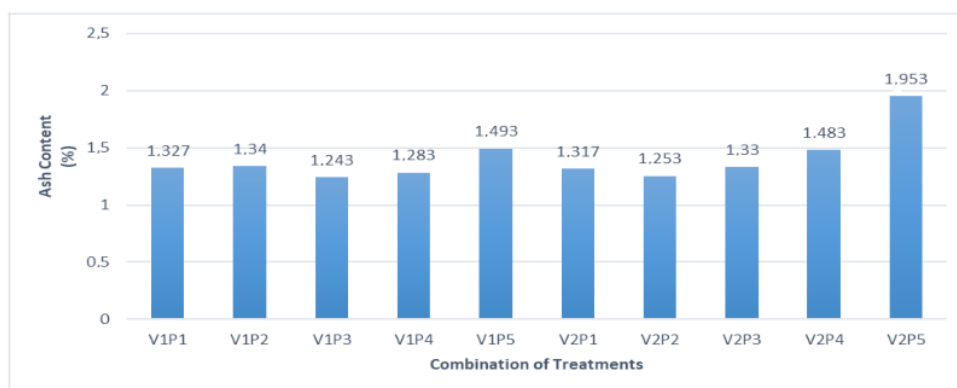
P1: the proportion of banana flour: wheat as 20:80, P2: 40:60, P3: 60:40, P4: 80:20, and P5: 100:0.

Figure 4. The water content of banana cookies

The formulation of banana cookies from the “Raja Lawe” variety banana and the proportion of banana flour: wheat =20:80, contains water content 6,59%. Meanwhile, the formulation of banana cookies from “Raja Labu” variety banana, with the proportion of banana flour: wheat = 100: 0 contains 4.14% water content. The water content in cookies tends to decrease as more banana flour is used. This is because the high starch content in banana flour affects reducing water content because the binding capacity of water molecules in banana starch is lower than that of water molecules in wheat flour.

3.5. Ash content

The average value of the ash content of banana flour cookies on the proportion of banana flour: wheat treatment is presented in Figure 5. The data showed that the proportion of banana flour: wheat had a significant effect on the ash content of the banana flour cookies



V1: made from “Raja Lawe” flour, V2: made from “Raja Labu” flour

P1: the proportion of banana flour: wheat as 20:80, P2: 40:60, P3: 60:40, P4: 80:20, and P5: 100:0.

Figure 5. Ash content of banana cookies

The formulation of banana cookies from “Raja Lawe” variety banana with the proportion of banana flour: wheat = 100: 0 contains 1.73% ash content. Bananas contain quite a lot of mineral elements and can function as a source of minerals in food, including potassium (400 mg / 100 g pulp) and magnesium (34 mg / 100 g fruit). So that cookies with a proportion of 100% banana flour have a higher ash content than wheat content.

3. Sensory variables

The results of the Friedman test on the effect of the combination of banana flour treatment with the proportion of banana flour: wheat on the sensory variable of banana flour cookies are presented in Figure 6. Figure 6 showed that the acceptance of the panelist was diverse regarding the cookies produced from the flour of banana “Raja Lawe” and “Raja Labu”. All of the evaluated parameters were scored between 2 to 4. Therefore, these cookies were accepted by the panelist but an improvement was required to increase the preferences of the consumers. Previous research that produced the product from the flour may improved by applying the pretreatment or other additional food additive [4], [15].



V1: made from “Raja Lawe” flour, V2: made from “Raja Labu” flour

P1: the proportion of banana flour: wheat as 20:80, P2: 40:60, P3: 60:40, P4: 80:20, and P5: 100:0.

Figure 6. Spider web diagram of the sensory value of banana flour cookies

The optimal treatment was determined to recommend producing cookies from banana flour of “Raja Lawe” and “Raja Labu”. Based on this research, the appropriate treatment combinations for producing cookies from the flour from banana “Raja Lawe” is the proportion of 40: 60% (banana flour: wheat flour) from and “Raja Labu” Banana is 80: 20% (banana flour: wheat flour).

4. Conclusion

The result shows that the flour from banana of “Raja Lawe” and “Raja Labu” could be utilized as a raw material for cookies production. Due to the differences in the inherent characteristic, the cookies produced from both bananas have different properties. The differences are indicated in the result of the color and hardness of the cookies. Moreover, based on the sensory evaluation the cookies resulted from all treatments are accepted by the panelists. Therefore, this research presents that the appropriate treatment combinations for producing cookies from the flour from banana “Raja Lawe” is the proportion of 40: 60% (banana flour: wheat flour) from and “Raja Labu” Banana is 80: 20% (banana flour: wheat flour). Further research is required to modify the process of cookies production and an additional food additive to improve the quality of the cookies to increase the acceptance of the consumers.

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