Sensory and chemical properties of cookies formulated with South Kalimantan’s local commodities

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Abstract. Cookies are generally made from wheat flour which has low content of essential nutrients and fibers. In addition, excessive use of wheat flour may also cause dependency to the imported materials. Therefore, innovation is needed to reduce the dependency of use of wheat flour by using local materials. This study was aimed to determine the sensory and chemical characteristics and also production cost of three cookies formulations with local materials as the flour materials substituting the use of wheat flour. The three local materials were local banana namely talas banana (A), local sweet potato namely nagara sweet potato (B), and local bean namely nagara bean (C). The flours of those three materials were made by using the oven method with different preliminary treatments. The three formulations of cookies were differentiated by the ratio of three flours (A:B:C = 20:60:20; 10:60:30; and 30:60:10). Based on statistical analysis (Kruskal-Wallis), differences in composite flour formulations significantly affected the sensory characteristics (hedonic and scoring approaches) in several parameters (taste, colour, texture, and flavour). In terms of sensory aspect, formula 1 (A:B:C = 20:60:20) showed the best sensory characteristics, and also exhibited a prominent chemical characteristics, namely: water content (2.64%), ash content (0.89%), protein content (7.27%), fiber content (6.19%), fat content (22.84%), and carbohydrate content (66.36%).

Keywords: alternative material, cookies, flour, local commodity, substitution.

1. Introduction

Wheat flour is one of foodstuff it have many function on basic stuff to food product processing. The development of wheat flour consumption in Indonesia be affected by the population in Indonesia. Overall the national wheat flour consumption in 2006 reached 292,330 tons, and increased until 36% during 2006–2015, in 2015 the national flour consumption was 396,477 tons. The fluctuation of wheat flour development in urban and rural is same, tend to increase. Enhancement of consumption wheat flour is followed by development of food product [1]. To prevent dependence on wheat flour, to do food diversification with local food are use Talas banana, Nagara sweet potato, and Nagara bean, as alternate ingredients for flour.

Bananas are one of the nutritious foods, as a source of carbohydrates [2], vitamins (vitamin A, vitamin B, vitamin C) [3] and minerals (phosphor, calcium, iron) [4]. The biggest component is carbohydrates [5]. High content or nutritional value makes bananas good to used as a alternate ingredients for flour. Basically, almost all types of bananas can be processed into flour [6]. Talas banana is one of the local commodities of South Kalimantan that haven’t been used optimally.
Sweet potato (*Ipomoea batatas* L.) is one type of tubers [7]. Sweet potatoes have potential as food ingredients, and industrial raw materials [8]. Sweet potatoes have a variety of colors, these colors indicate the content specifications in sweet potatoes. Sweet potatoes are known as a source of carbohydrates [9] after rice, corn and cassava, moreover sweet potatoes contains vitamin A, and micro elements (Xn, Fe, Ca, K) [10]. Sweet potatoes also contains food fiber which is good for digestion process and low glycemic index [11].

Nagara sweet potato is local commodities from South Kalimantan, and has not processed properly. Legume is a source of protein. Many types of legumes that are very often consumed are soybean, mung bean, red kidney bean, and cowpea. Cowpea has the advantage of being easily cultivated and high in protein [12]. In 100 grams of cowpea, it contains 22% protein, vitamin B1, and low fat [13]. Nagara bean is one of the types of cowpea that are in South Kalimantan. To increase the nutritional value fermentation process on cowpea.

Cookies are one type of biscuit made from soft dough, high in fat content, it relative crispy when broken and the cross section of the piece is have dense textured. To increase the nutritional value and qualities of cookies, it can be done by use local food ingredients to replace wheat flour as raw material for making cookies. Then, that the food diversification program can be implemented and will reduce dependence on wheat flour.

2. Materials and methods

2.1. Materials

The materials include raw talas bananas, nagara sweet potatoes, nagara beans, yeast, water, sodium metabisulfite, egg yolk, powder milk, sugar, margarine, and chemical materials. And for the tools include knife, analytic balance, spoons, oven, oven pans, bowl, 80 mesh sieves, blender, mixer, rolling pin, and laboratory equipment.

2.2. Method

This research consists of 3 treatments and 2 repetition. The treatment is differentiated based on the percentage of flour mixed. First treatment (P1) contain 20% talas banana flour (a) : 60% Nagara sweet potato flour (b) : and 20% fermented Nagara bean flour (c). Second treatment (P2) contain 10% a: 60% b: 30% c, and the third treatment (P3) contain 30% a: 60% b: 10% c.

This method consists of some steps. The first step is making flour (talas banana, Nagara sweet potato, fermented Nagara bean), the second step is making cookies, and the third step is testing and data analysis.

2.2.1. Flour making process. The process of making flour uses the oven method. For talas bananas and Nagara sweet potatoes will be dried in an oven at 60 °C, for 12 hours. All raw materials are separated, peeled and sliced. To prevent or reduce browning reactions in talas bananas, the bananas soaked with 0.2% sodium metabisulfite solution. Browning reaction will have an impact on the color of banana flour, the color will become more dark. Thus prevention of these reactions is very necessary.

The preliminary process in making nagara bean flour is fermentation. The fermentation process uses the help of yeast. Nagara beans are processed into tempe, then dried, and made into flour. The fermentation process begins with soaking the Nagara beans for 12 hours. Then steamed for 20 minutes. Then mixed with yeast (1 gr : 100 gr). Nagara beans are fermented for ± 24 hours. After that, tempe is steamed for 20 minutes. Then dried in the oven for 12 hours at a temperature of 60 °C.

The material that has been dried, was blended using a blender. Then sifted using 80 mesh sieve. So that all flour sizes are the same. Flour is stored in a closed container to prevent contamination with air and other objects.

2.2.2. Cookies making process. The process of making cookies begin with prepare the tools and materials. Additional ingredients used for making cookies include egg yolk, refined sugar, margarine,
and milk powder. The processing begin with mixing margarine, refined sugar and egg yolks until blended. Then add other ingredients such as milk powder, talas banana flour, Nagara sweet potato flour, and fermented Nagara bean flour until it mix well. Then, flat the dough with a thickness of ± 1 mm. Then shape it as desire. Cook the dough in oven at a temperature of 120 °C for 25 minutes. The percentage of additional materials used in each treatment are the same. Material formulations can be seen in table 3.

Table 1. Material formulation for making cookies.

| Materials                                      | Treatment (grams) |
|-----------------------------------------------|-------------------|
| Composite flour:                              | P 1 | P 2 | P 3 |
| - Talas banana flour                          | 8   | 4   | 12  |
| - Nagara sweet potato flour                   | 24  | 24  | 24  |
| - Fermented Nagara bean flour                 | 8   | 12  | 4   |
| Refined sugar                                 | 25  | 25  | 25  |
| Margarine                                     | 24  | 24  | 24  |
| Egg yolks                                     | 10  | 10  | 10  |
| Milk powder                                   | 15  | 15  | 15  |

2.2.3. Data testing and analyzing. Cookies will be tested. First, test sensory characteristics consistence of hedonic test or preference level and scoring test. Second, is analyze proximate test (water content, ash content, crude fiber content, fat content, and carbohydrate content with by difference method). Third calculate of total calories. From results of the test, proceed with data analysis process. Hedonic test results, and scoring will be analyzed by the Kruskal-Wallis test. And the proximate test results were analyzed by Analysis of Variance (ANOVA).

3. Results and discussion

This study aims to determine the chemical characteristics of cookies made from composite flour. The use of composite flour can provide more value to the cookies produced, and can be accepted by consumers and can be consumed daily.

From the results of flour processing, flour was obtained with different characteristics, and to keep the quality of flour, required measurement of water content. Then obtained the characteristics of flour as follows:

Table 2. Characteristics of flour.

| Sample             | Yield  | Color         | Flavour               | Water content (%) |
|--------------------|--------|---------------|-----------------------|-------------------|
| Talas banana       | 30%    | Brown yellow  | Raw banana (not strong)| 6%                |
| Nagara sweet potato| 30%    | Dark brown    | Sweet potato (strong) | 4.2%              |
| Fermented Nagara bean | 40% | Light brown | Bean are abit unpleasant (strong) | 4.2% |

3.1. Sensory characteristics with a hedonic scale

From the results (table 3) of the Kruskal-Wallis analysis of sensory preference levels on a hedonic scale, it was found that flour formulations give significant effect on taste parameter. The results of the sensory analysis on the taste parameters in the composite flour treatment in cookies showed a score of 3.36–3.78 or rather like to like. With the average overall treatment of cookies shows a score of 3.51 which is close to likes. In general, all treatments have a taste that is acceptable to the panelis, because the cookies has a nice taste. Overall, cookies has a sweet taste. Each treatment has different taste, it can be caused percentage of the flour is different. Nagara sweet potato flour has a dominant taste. The use of sugar in
the process of making cookies, can improve flavour in other ingredients. Thus increasing the delicious cookies.

In color parameters, composite flour formulations have a significant effect. The composite flour treatment in cookies shows score 3.36–3.78 or close to likes. The physical appearance of cookies, from all treatments almost have same color, there are brown. Brown color is produced from Nagara sweet potato flour, which has a darker color than other flour. Talas banana flour and fermented Nagara bean flour have a light color. So, cookies has different level of darkness cookies. Usually the color of the base material used, will give effect to the final color of the product.

The flavour parameters in cookies show numbers 3.20–3.54 or rather like to like. The average flavour parameter for all treatments is 3.35, which is closer to rather like. Flavour is one of the most important parameters, because many consumers rate food products based on the flavour. The flavour of cookies is abit strong, it release specific flavour of margarine and butter. From the ingredients, fermented Nagara bean flour has an unpleasant aroma which is quite strong and tends to be unliked.

And on the texture parameters with a hedonic scale on the composite flour treatment in cookies shows the numbers 2.82–3.54 or rather like to like. The average hedonic score for texture parameters is 3.21, which is rather like. The flour formulation which has a significant effect on the texture produced can be due to starch content in flour. Amylose and amyllopectin in each flour are very influential on texture.

Table 3. Average of hedonic value.

| treatment | Taste | Color | Flavour | Texture |
|-----------|-------|-------|---------|---------|
| P 1       | 3.78 ± 0.14<sup>b</sup> | 3.78 ± 0.14<sup>b</sup> | 3.54 ± 0.08<sup>a</sup> | 3.54 ± 0.14<sup>b</sup> |
| P 2       | 3.46 ± 0.06<sup>ab</sup> | 3.46 ± 0.08<sup>a</sup> | 3.32 ± 0.06<sup>a</sup> | 3.28 ± 0.17<sup>b</sup> |
| P 3       | 3.36 ± 0.06<sup>a</sup> | 3.36 ± 0.06<sup>a</sup> | 3.20 ± 0.17<sup>a</sup> | 2.82 ± 0.14<sup>a</sup> |

<sup>a</sup> Each letters show significant different results

3.2. Sensory characteristics with a scoring scale

The parameters tested in the scoring test (table 4) are the level of sweetness, color, texture, and taste. The test results shows that each parameter has different score. From the Kruskal-Wallis analysis showing the composite flour formulation, it has a significant effect on the color produced, while the level of sweetness, texture, and taste parameters of the composite flour formulation have no significant effect.

The level of sweetness has a score level of, 1 = not sweet, 2 = rather sweet, 3 = a bit sweet, 4 = sweet, and 5 = very sweet. The test results show the score 3.34–3.64. The average sweetness level is 3.47, which is close to a bit sweet. Usually, cookies have a sweet taste, so it can be accepted by consumers.

From the results of the Kruskal-Wallis analysis it was found that flour formulations didn’t significant effect parameter of level of sweetness. It can be caused, sugar content from Talas banana flour, Nagara sweet potato flour, and fermented Nagara bean flour are little. So it doesn’t affect the level of sweetness of cookies.

The scoring scale on color parameters is 1 = black brown, 2 = dark brown, 3 = brown, 4 = light brown, and 5 = yellow brown. The results of sensory analysis on color parameters shows score 3.30–3.80. This score shows the characteristic color is brown approaching light brown. The average of all treatments is 3.59, which is light brown. The flour has different colors. The color of Talas banana flour and fermented Nagara beans tends to be brighter than Nagara sweet potato flour. The percentage of treatment will give different colors. The higher percentage of Nagara sweet potato flour will produce a darker color.

Scoring scale on texture parameters, namely, 1 = hard, 2 = not crunchy, 3 = rather crunchy, 4 = crunchy, 5 = very crunchy. The results of sensory analysis on texture parameters with a scaling scale on cookies show score 3.34–3.70. The overall average of all treatments is 3.49 which was rather crunchy. The texture of the cookies produced can be caused by several factors, from the pores of cookies, to their
expanding power, and the content inside the starch. In third treatment get a higher score. The high percentage of banana flour can make the texture of cookies more crunchy.

The rating scale for taste is 1 = not savory with aftertaste, 2 = not savory, 3 = savory with aftertaste, 4 = savory, 5 = very savory. The results of the sensory analysis on the taste parameters with the scoring scale in cookies showed score from 3.44 to 3.72. The overall average is 3.55 which is savory. The analysis showed that difference in the percentage of composite flour didn’t had significant affect of the cookies taste. However, from the three flours that used, the dominant taste was Nagara sweet potato flour, and fermented Nagara bean flour. Nagara sweet potato flour has a sweet taste, while fermented Nagara bean flour has a slightly acidic aftertaste.

**Table 4.** Average of scoring value.

| Treatment | Sweetness level | Colour | Texture | Taste     |
|-----------|-----------------|--------|---------|-----------|
| P1        | 3.64 ± 0.11a    | 3.80 ± 0.23b | 3.44 ± 0.06a | 3.72 ± 0.11a |
| P2        | 3.42 ± 0.08b    | 3.66 ± 0.08ab | 3.34 ± 0.03a | 3.44 ± 0.06a |
| P3        | 3.34 ± 0.20a    | 3.30 ± 0.31a  | 3.70 ± 0.08a | 3.5 ± 0.08a  |

*a Each letters show significant different results

3.3. **Chemical characteristics**

To determine the quality of the cookies produced, it is necessary to test the chemical characteristics. This characteristic is also a reference, that these cookies are worth daily consumption. From several tests conducted, the following results were obtained:

**Table 5.** Chemical characteristic.

| Chemical Characteristic (%) | Treatment       |
|-----------------------------|-----------------|
|                             | P1             | P2             | P3             | P3             |
| Water                       | 2.64 ± 0.12a    | 2.74 ± 0.13a    | 2.60 ± 0.14a    | 2.60 ± 0.14a    |
| Ash                         | 0.89 ± 0.06a    | 0.96 ± 0.05a    | 0.99 ± 0.04a    | 0.99 ± 0.04a    |
| Crude Fiber                 | 6.19 ± 0.04a    | 8.41 ± 0.14c    | 5.53 ± 0.12a    | 5.53 ± 0.12a    |
| Protein                     | 7.27 ± 0.06b    | 7.50 ± 0.01b    | 6.66 ± 0.30a    | 6.66 ± 0.30a    |
| Fat                         | 22.84 ± 0.34a   | 22.91 ± 0.30a   | 22.77 ± 0.41a   | 22.77 ± 0.41a   |
| Carbohydrate                | 66.36 ± 0.22a   | 65.89 ± 0.21a   | 66.99 ± 0.53a   | 66.99 ± 0.53a   |

*a Each letters show significant different results

Based on the results of chemical tests, on parameters of water content cookies range from 2.60%–2.74%. Analysis of variance (ANOVA) showed that each treatment of cookies had no significant effect on water content. The average water content of cookies is 2.66%. This is because the entire treatment of cookies using composite flour has the same base and ingredients. Based on the standard quality of biscuits, the maximum water content of cookies is 5%. So, from all treatment cookies are still within the standard limits of the quality.

The results of ash content ranged from 0.89%–0.99%. The results of the variance analysis (ANOVA) indicate that the formulation or percentage of flours has no significant effect on the ash content of cookies. The average ash content of all treatments is 0.95%. The highest ash content was found in the 3 th treatment, with percentage of 30% talas banana flour, 60% Nagara sweet potato flour, and 10% fermented Nagara bean flour. The high percentage of banana flour gives higher ash value. This can be cause in banana contain minerals that are quite high. Based on SNI 01–2973–1992, the ash content of cookies is based on SNI quality requirements. In SNI the maximum limit of ash content of a cookies is 1.6%.
Fiber content obtained range from 5.53%–8.41%. The results of the variance analysis test (ANOVA) said the treatment in cookies had a significant effect on crude fiber content. The average crude fiber content of all cookies is 6.71%. From materials used as flour, contains high crude fiber. So, that it can make an impact on crude fiber content in cookies. However, the fiber content from talas banana flour, Nagara sweet potato flour, and fermented Nagara bean are have different varies. So that when the three are mixed it will give an effect.

Cookies obtain protein ranged from 6.66%–7.50%. The results of variance analysis (ANOVA) showed that each treatment on cookies had a significant effect on protein content. The average protein content of all treatments was 7.14%. Based on SNI 2973–2011 about biscuits, protein content in biscuit is a minimum of 5%, 4.5% (for biscuit products mixed with fillers in dough), and 3% (for biscuit products which are coated or filled (coating/filling)) and pie. From all cookies treatment shows that protein levels that qualify in SNI standards are above 5%. High protein contain provide more value of cookies. Because protein is body needed to regenerate cells. These protein levels are higher when compared to cookies that are widely circulated in the market.

Based on the results of testing the fat content of each treatment of cookies obtained the results of fat content ranged from 22.77%–22.91%. The results of variance analysis (ANOVA), the treatment of cookies doesn’t have a significant effect on the fat content of cookies. The average fat content of all treatments was 22.84%. According to SNI 01–2973–1992, the minimum fat content in biscuits is 9.5%. Fat give a high energy. And it’s very good for supplying energy. Fat from cookies are produced from margarine, milk, and egg yolks. While the flour contains a small amount of fat. The results of the tests revealed that carbohydrate content ranged from 65.89%–66.99%. Variance analysis test (ANOVA) showed that each treatment of cookies formulations did not have a significant effect on carbohydrate content. The average carbohydrate content of all treatments was 66.41%. The highest carbohydrate content was in the third treatment, with the composition of composite flour 30% talas banana flour, 60% Nagara sweet potato flour, and 10% fermented Nagara bean flour. Carbohydrate content are influenced by water content, ash, fat, and protein. The higher content of other components, the lower the carbohydrate level. At minimum carbohydrate content of cookies is 70%. Of all treatments almost fulfilled. Carbohydrate content can’t be fulfilled because wheat flour is a source of carbohydrates replaced with other ingredients.

Energy is obtained from carbohydrate, fat, and protein are in food ingredients. Carbohydrates (K), protein (P), and fat (L) are types of nutrients that contain calories as a fuel for the body. Every gram of carbohydrate and protein contains an average of 4 fat calories while the average fat contains 9 calories. The treatment that have the largest calories is found in the first treatment with a percentage of composite flour of 20% talas banana flour, 60% Nagara sweet potato flour, 20% fermented Nagara bean flour with a total calories of 500.03 kal / 100 g. Calories from all of these cookies are high enough, compared to other food ingredients. White rice has 370 calories / 70 grams of calories, and instant noodles have 91 calories / 70 grams of calories. Study about biscuits made from composite flour of banana, sweet potato, tempe, and carrot, the total energy in the selected product was 402 cals. This value is smaller when compared to the calories contained in cookies in this study. Because the higher level of carbohydrate, protein, or fat it will affect the caloric value produce. A large enough calorie value is one of the advantages, because it provides enough energy for the body.
Table 6. Value of total calories.

| Treatment | Calorie (kal) | Total Calories/100 g |
|-----------|--------------|----------------------|
|           | K | P | L     |               |
| P1        | 265.43 | 29.08 | 205.52 | 500.03 |
| P2        | 263.55 | 30.01 | 206.17 | 499.73 |
| P3        | 267.97 | 26.62 | 204.92 | 499.52 |

4. Conclusion
From three treatments, the best results were obtained at the first treatment. With this composite flour, cookies are obtained with the most nutritional content or value, and can be accepted by consumers. This also shows, flour can be replaced with flour sourced from local commodities. Thus, the nutritional value of a product can be increased, and dependence on wheat flour can be reduced.

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