IOP Conf. Series: Earth and Environmental Science **733** (2021) 012076 doi:10.1088/1755-1315/733/1/012076

The concentration of sago flour to taro-mung bean composite flour on the quality of non-gluten biscuits

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Abstract. The utilization of local raw materials, such as taro, avoids the gluten content usually found in wheat flour and creates innovation in the product development of biscuits. Taro has low protein content, thus requires the addition of other ingredients to meet the quality of the biscuits. The material used as a source of protein is mung bean flour. Besides, sago flour was used to improve the texture for being softer and crisp. The addition of sago flour also functions as an adhesive to replace the gluten found in wheat flour. This study aimed to determine the concentration of sago flour in biscuits of taro-mung bean composite flour that meet the quality standards of biscuits. The concentration of sago flour to taro-mung bean composite flour consists of four levels (0%, 20%, 40%, and 60%). The results showed that the selected treatment was the concentration of sago flour of 60%, with a total expected value of 6.10. Characteristics of the selected product include water content of 1.78%, carbohydrates of 63.55%, protein of 3.15%, fat of 29.86%, ash of 1.61%, the acceptance level of taste of 73.3%, color of 96.7%, and aroma of 90.0%.

1. Introduction

Non-gluten biscuits are a necessity for people who have celiac diseases or those who have a gluten intolerance. Innovation in developing non-gluten biscuits can be done by utilizing local resources, including taro, mung beans, and sago. Taro tubers could also be used for making chips and flour. In the form of flour, taro can be more flexible in its processing and better shelf life. Likewise, while sago on the market, green beans are already in the form of flour that is ready to use [1, 2].

Research conducted by Puspitasari et al. [3] showed that composite flour with cowpea based on selected formulations could be processed into biscuits. Taro flour is prepared from taro, which is treated to reduce the itching that usually arises due to oxalate content. Research conducted previously by Nurani and Yuwono [4] has used *kimpul* flour as a raw material for cookies.

The addition of mung bean flour can increase the low protein content in taro flour. In addition to giving bioactive peptides and essential amino acids source, pulse proteins have functional properties, for instance, fat binding, water retention, foaming, and gelation, which increase their conceivable use in a large collection of food things [5]. For these reasons, legumes are ideal supplements for cereals in vegetarian diets with increased attention and concentration as functional ingredients. Among legumes,

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mung bean (*Vigna radiata L. Wilczek*) is a magnificent source of 23.25% protein [6]. It is one of the protein source plants of the least expensive and most productive [7]. Moreover, mung beans are rich in essential fatty acids, antioxidants, and minerals [8–10].

Adding sago flour will improve the texture and crispness of the resulting biscuits. The replacement of wheat flour with sago starch in the traditional formulation of cookies has been considered. It is reported that sago flour could submerge wheat flour to a degree of 40 percent in creating treats that discover great shopper acknowledgment in Southern Thailand. Nonetheless, purchaser acknowledgment of treats declined significantly when sago starch in the treat definition expanded past 40%, inferable from helpless appearance and a crumbly texture [11]. Sago can also be used as a raw material for the food industry. It can, among others, be processed into foods such as bagel (traditional cake), pearl sago, dry cakes, noodles, biscuits, crackers, *laksa* (fine noodles similar to vermicelli), and bio-ethanol [12]. This research aimed to determine the concentration of sago flour in biscuits of taro-mung bean composite flour.

2. Methods

This examination utilized a Randomized Block Design (RBD) with a single factor, namely the concentration of sago flour to taro-mung bean composite flour with four levels, and repeated three times. In a preliminary study, the fraction of taro flour and mung bean flour used as initial composite flour was 50:50. Then, in the real experiment, sago flour according to treatment with a percentage: 0%; 20%; 40%; and 60% were added.

2.1. Observation parameters

Chemical parameters tested were water content, carbohydrate content, ash content, protein content, and fat content. The organoleptic parameters tested were taste, color, and aroma.

2.2. Data analysis

The analysis of variance does chemical test data processing. In the event that there is a distinction, the Duncan test was done with a 95% confidence level, and organoleptic analyzed using the Friedman Test method.

2.3. Alternative selection

To determine the best treatment for the concentration of sago flour in taro-mung bean composite flour for biscuits in different formulations, an alternative selection was made. The definition of expected value is to choose a choice that has the greatest pay-off or least expense. For biscuit products, the parameters tested were water content, ash content, protein content, fat content, and taste, color, and aroma. The selection of alternatives was made in order to choose the greatest treatment from several present treatments. Decision making is a method of choosing the greatest treatment systematically. Determination of the importance of each factor carried out by the Analytical Hierarchy Process (AHP) test. Based on the Expectation Value method, as for defining the option of the greatest treatment.

3. Results

3.1. Chemical content

The results of the variance analysis presented that the percentage of sago flour to taro-mung bean composite flour was significantly different in water content, carbohydrate content, protein content, fat content, and ash content. Table 1 shows that the biscuit's water content with various sago flour addition was significantly different. The more proportion of sago flour that was added, the water content of biscuits will decrease. Water content is related to protein content; the more protein the more water content, and vice versa. In this study, the more sago flour was added, the less protein content.

The higher the extent of added sago flour, the carbohydrate content increases. The sago flour carbohydrate content has a higher amount than the composite of taro-mung bean flour. Sago flour has a carbohydrate content of 84.7%, while mung bean flour has a carbohydrate content of 72.86%, and taro flour has a carbohydrate of 71.56%. The statistical analysis result showed that there is a real association between treatments of carbohydrate content created. The more significant level of starch and the expansion in sago flour focuses are suspected on the grounds that sago flour contains higher sugar levels than sugar content in the composite flour of mung beans. As indicated by Baka et al. [12], sago contains a starch substance of 87.55%. The calculation of carbohydrate content in taro-mung bean-sago composite biscuits was finished by the distinction technique.

Table 1. Analysis of variance results chemical content of biscuits.

Treatment (% sago flour)	Water Content (%)	Carbohydrate Content (%)	Protein Content (%)	Fat Content (%)	Ash Content (%)
0	3.07 ± 0.04 d	58.27 ± 0.14 c	7.20 ± 0.02 a	29.10 ± 0.02 d	2.53 ± 0.05 d
20	2.61 ± 0.02 c	60.07 ± 0.07 b	5.62 ± 0.04 b	29.59 ± 0.03 c	2.23 ± 0.04 c
40	2.17 ± 0.03 b	60.17 ± 0.05 b	4.59 ± 0.05 c	29.86 ± 0.03 b	2.92 ± 0.03 b
60	1.78 ± 0.04 a	63.55 ± 0.11 a	3.15 ± 0.03 d	31.28 ± 0.03 a	1.61 ± 0.02 a

The greater quantity of added sago flour, the protein content decreases. The protein substance of sago flour has a lower amount compared to the composite of taro-mung bean flour. Sago flour has a protein content of 0.7%, while mung bean flour has a protein content of 19.09%, and taro flour has a protein of 6.43%. The higher the fraction of added sago flour resulted in a decrease of the protein level. These were supported by Tidore et al. [13], which shows the more starch flour is added, the lower the protein content. When the test is done, the greater the amount of sago flour added, the lower the amount of composite flour containing mung bean flour with high protein content, such that the protein content diminished. These were upheld by the finding of Man *et al.* [14]. The taro-mung bean-sago biscuits protein content is still below the Indonesian national standard (SNI) needed for biscuits (SNI 01-2973-1992), which contains at least 9% protein content.

The greater the percentage of added sago flour, the greater the fat substance increment. Fat assumes a critical function in the shelf life of food. Such moderately high-fat substances could be unwanted in heated food items since fat can advance rancidity in food, prompting the improvement of a horrendous and putrid compound. Fat is an energy source for biscuits [15]. This high-fat content was contributed by egg yolk as one of the biscuits' essential ingredients. The statistical analysis result indicated that there were substantial differences among treatments. The real difference was thought to be due to the difference in the percentage of sago flour added, which affects the fat substance difference. The greater the percentage of sago flour, the less proportion of taro-mung bean flour, the higher the fat substance of biscuits. These are supported by research results [16]. Mung beans have lesser oil content than wheat, which added to the diminishing fat substance of the cookies.

The more prominent the extent of added sago flour, the ash level decreases. Increasing the percentage of sago flour certainly reduces the proportion of mung beans, indicating a decrease in ash content. These upheld by the aftereffects of examination by Tidore et al. [13] shows that more starch flour was added, the ash content decreases as well as a decrease in ash content if the proportion of green beans decreases in the study [16]. There was thought to be caused by the addition of different levels of ash in the constituent materials. According to Puspitasari *et al.* [3], the composite ash powder of cowpea flour of 4.18%, and the ash substance of sago flour of 0.6%, so that with the expanding extent of sago flour, the subsequent ash substance of biscuits tends to be lower.

3.2. Organoleptic parameters

The score of aroma, color, and taste of biscuits shown in Figure 1. The highest total score of taste parameters obtained by treatment sago flour 0%, 20%, and 40%. According to Winarno [17], taste is determined by taste and mouth stimulation. The texture and consistency of the material will also affect the taste caused by the content.

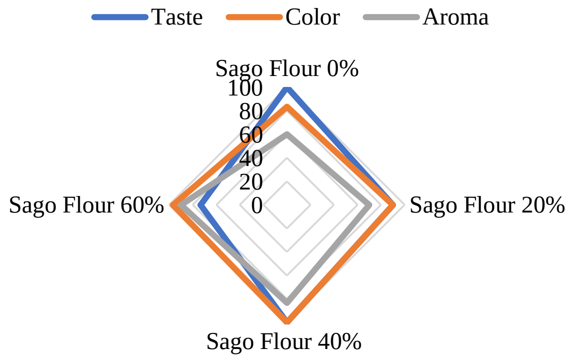

Figure 1. Result score of aroma, color, and taste of biscuits.

In the sago flour 60% treatment, there is the lowest score; this is possible because too much sago flour can make the texture of the biscuits more easily destroyed so that the panelists are less favored. The best score of the highest color parameter obtained by sago flour 40% treatment was 100%, while the lowest total score obtained by sago flour 0% treatment was 83.3. In the treatment of sago flour 0%, sago flour 20%, and sago flour 40%, the more the percentage of sago flour, the color of the biscuit will be more preferred. That was because the panelists liked the bright color of the biscuits. The more percentage of sago flour added, the more attractive the biscuit's color. The color of the biscuit is getting brighter due to the decreasing proportion of the composite of taro-mung bean flour, which can give the biscuit a dark color. In the treatment of sago flour 60%, the best score (3,4,5) from sago flour 40% decreased by 96.7%. It suspected that some panelists did not like the color of the biscuits that were too bright.

The best score of the highest aroma parameter obtained by sago flour 60% treatment was 90%, while the lowest best total score was obtained by sago flour 0% treatment by 60%. It suggests that the more the percentage of sago flour is added, the more biscuit aroma is preferred. That was presumably because of the more the percentage of sago flour, the unpleasant aroma of taro-mung bean composite flour.

3.3. Alternative selection

AHP is a decision making procedure for multi measures problems. The multi-criteria problem in AHP is easy in the form of a hierarchy containing three core components: decision-making goals, criteria of assessment, and valuation alternatives. The priority scale of each parameter is shown in Figure 2. A priority scale is used to determine the best alternative treatment.

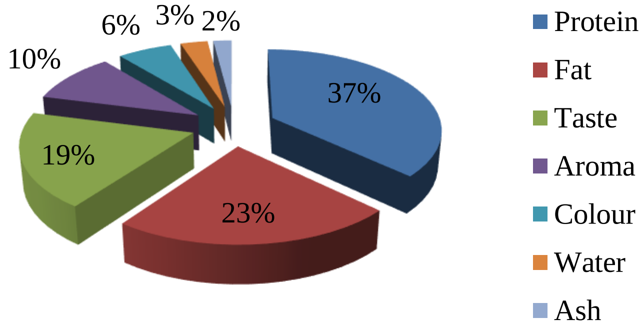

Figure 2. Priority scale of each parameter.

The best alternative is the treatment that has the highest expectation score. The results of the expected score for each treatment shown in the histogram presented in Figure 3. The highest expectation score founded in the treatment of sago flour of 60% with an expected score of 6.10.

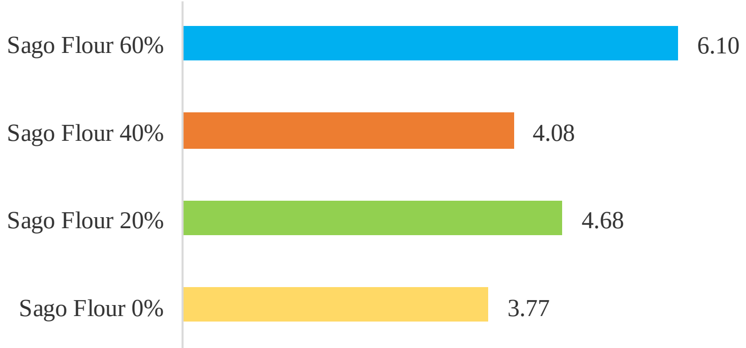

Figure 3. Total expectation value of biscuits.

4. Conclusions

Based on the study conducted, it determined that the treatment of concentration sago flour 60% as selected treatment with a total score of 6.10. Moisture content of 1.78% ± 0.04, carbohydrate content of 63.55% ± 0.11, protein content of 3.15% ± 0.03, fat content of 29.86% ± 0.03, ash content of 1.61% ± 0.02, taste level of 73.3%, color of 96.7%, and aroma of 90.0%.

Acknowledgment

This research was funded by internal research funds from the Institute for Research and Community Service, Universitas Wijaya Kusuma Surabaya.

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