

## THE EFFECTS OF MARGARINE SUBSTITUTION WITH PEANUT PASTE ON THE CHARACTERISTICS OF SAGO COOKIES

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**Abstract.** *The principle of making sago cookies without wheat flour through the substitution of margarine with peanut paste is predicted to boost the nutritional content of cookies and also employ alternative components to replace margarine to develop products that are acceptable to consumers. This study aimed to determine the right concentration of peanut paste to substitute for margarine in the manufacture of sago cookies. This study was designed using a one-factor Complete Randomized Design (CRD), namely the substitution of margarine with peanut paste at five substitution levels of 100:0%, 75%:25%, 50%:50%, 25:75%, and 0%:100% repeated twice. Observed variables include moisture content, ash content, protein content, fat content, carbohydrate content, cookie thickness, cookie diameter, cookie spreading ratio, and sensory characteristics. The results showed that the optimal treatment to produce sago cookies, characterized by the highest acceptance across all sensory attributes such as color, taste, aroma, texture, and overall likeness, involves the substitution of margarine with peanut paste at a ratio of 75% to 25%. Cookies subjected to this treatment exhibited specific characteristics, including a moisture content of 3.72%, an ash content of 1.75%, a protein content of 10.05%, a fat content of 17.56%, and a carbohydrate content of 66.93%. Additionally, these cookies possessed a thickness of 0.54 cm, a diameter of 5.30 cm, and a spreading ratio of 10.15. Furthermore, these cookies were characterized by a slightly broken surface, a slightly irregular shape without damage, a texture that crumbles slightly when pressed with fingers, a crispiness when bitten, and easy crumbling in the mouth. They also feature a slight sago flavor and a distinct sago taste. Overall, the 75% margarine to 25% peanut paste substitution ratio yields cookies that encompass a comprehensive profile of desirable sensory qualities.*

**Keywords:** *sago cookies; margarine; peanut paste; sensory; physicochemical*

### 1. Introduction

Cookies are a well-favored snack that is enjoyed by a substantial global population. They have achieved widespread popularity due to their attractive attributes, including a broad customer demographic, convenience as a pre-prepared meal, affordability, significant nutritious content, availability in a range of enjoyable tastes, and a long shelf life. The terms "biscuits" or "cookies," used interchangeably in various regions, denote baked goods largely composed of soft wheat flour, sugar, and fat. These items may also contain additional components including milk, salt, flavorings, and aerating agents. These cookies/biscuits often include a modest amount of moisture, typically ranging from 1-5% (Devi & Khatkar, 2016; Xu *et al.*, 2020). According to the Indonesian National Standards Agency 1992 (Badan Standarisasi Nasional, 1992), cookies are a variety of biscuit that is prepared using a soft dough containing a significant amount of fat. When broken, cookies are

reasonably crispy and have a firm texture in their cut cross section. In Indonesia, the average consumption of cookies is satisfactory. According to the Central Bureau of Statistics ([Badan Pusat Statistik, 2022](#)), the projected average consumption growth for cookies in 2021-2022 is expected to be approximately 24.22%, which is greater than the average consumption growth of wet cakes at 17.78%.

The fundamental components of cookies comprise flour with a moderate protein content, fat, and sugar. Wheat flour, which is typically used in cookie-making, contains a relatively small amount of protein that forms gluten. The gluten formation in cookies is solely responsible for creating the appropriate attributes ([Mohammadi et al., 2022](#)). Therefore, alternative flours that are not derived from wheat can be utilized in gluten-free cookie production ([Xu et al., 2020](#)). In earlier research on gluten-free cookies, several types of flours have been utilized, including those produced from cereals such as rice, maize, sorghum, and millet, as well as legumes, pseudocereals, and their mixtures. Studies have used maize starch and pea protein, waxy rice starch, and combinations of maize starch and potato starch ([Giuberti et al., 2017](#); [Mancebo et al., 2015](#); [Šarić et al., 2018](#)) as examples. Therefore, sago starch can also be used as an ingredient in cookie production.

In terms of quantity, fats and oils rank third as crucial components in cookie production. From a sensory standpoint, fat plays a significant role as one of the primary ingredients that affects the overall texture of the cookie ([Devi & Khatkar, 2016](#)). One type of fat used in cookie production is margarine. Margarine is another fat source commonly utilized in the production of sago cookies. Margarines play a crucial role in the lipid industry. Unlike shortening, which is a basic fat blend, margarine is characterized by being a water-in-oil (W/O) emulsion. Margarine is a compound consisting of 80% fat and 15–16% water, along with additional components such as salt, flavorings, emulsifiers, colorants, vitamins, and other substances ([Nguyen et al., 2020](#); [O'Brien, 2004](#)).

Many traditional margarines contain trans fats, which have been linked to an increased risk of heart disease ([Chougui et al., 2015](#); [Islam et al., 2019](#); [Sivakanthan & Madhujith, 2020](#); [Venturini et al., 2019](#)). Health-conscious consumers are increasingly seeking products with healthier fat profiles. Using alternative fats, such as healthier oils or butter substitutes, can address these concerns and make cookies a more attractive option for health-conscious individuals. Peanut paste is utilized as a fat substitute for margarine in the production of brown rice flour cakes. When substituted at a rate of 50%, the cakes achieve a satisfactory level of acceptance ([Asimah et al., 2016](#)).

Peanut kernels contain 44-56% fat and 20–30% protein based on the dry weight of the kernels and are also a source of vital minerals such as phosphorus, calcium, magnesium, and

potassium, as well as vitamins E, K, and B (Bonku & Yu, 2020; Çiftçi & Suna, 2022). Despite the high fat content of peanut kernels, the saturated fat content in peanut kernels is actually quite low. Instead of its high fat content, peanut fat is primarily composed of 80% unsaturated fatty acids, specifically 45% oleic acid and 35% linoleic acid. Oleic acid plays a significant function in preventing cardiovascular disease by lowering LDL levels and boosting HDL levels (Asimah *et al.*, 2016; Bilal *et al.*, 2020). In addition, peanut seeds contain 25–30% of high-quality protein. The principle of making sago cookies without wheat flour through the substitution of margarine with peanut paste is predicted to boost the nutritional content of cookies and also employ alternative components to replace margarine to develop products that are acceptable to consumers. This study was conducted to determine the optimal concentration of peanut paste as a substitute for margarine in the production of sago cookies.

## 2. Methods

### 2.1. Materials

The primary materials utilized in the study included sago starch, margarine (Blue Band, PT Upfield Manufacturing, Indonesia), and peanuts. Supplementary materials comprised powdered sugar, salt, vanilla powder, instant coconut milk (Kara, PT Kara Santan Pertama, Indonesia), egg yolk, and Cheddar cheese (Kraft, PT Kraft Ultrajaya, Indonesia). The sago starch components were sourced from the output of the works of the students at the Faculty of Agriculture, Pattimura University, whereas the remaining ingredients were procured from supermarkets and retailers in Ambon City.

### 2.2. Sago Cookies Production

The peanuts, after their testae were removed, underwent roasting in an electric oven (Maspion) for a duration of 20 minutes at a temperature of 150°C. The roasted peanuts were ground into a paste using a chopper capsule meat grinder (600 MI, Krisbow, Indonesia). The sago starch underwent a roasting process for a duration of 5 minutes. The subsequent step involved combining powdered sugar (375 g), salt (0.5 g), vanilla powder (0.5 g), egg yolk (36 g), instant coconut milk (125 mL), and grated cheese (250 g). Additionally, margarine was replaced with peanut paste (totaling 250 g) based on the respective concentration of each ingredient. The mixture was then thoroughly blended until homogenous. Next, the dough was supplemented with 450 g of roasted sago starch and thoroughly blended until it achieved a uniform consistency. Subsequently, the dough was shaped using a mold measuring 0.4 cm in thickness and 4 cm in diameter. It was then subjected to baking in an oven at a temperature of 150 °C for a duration of 20 minutes.

### 2.3. Chemical Analysis

The moisture content, ash content, protein content, and fat content of cookies were assessed

using the AOAC standard testing procedure (AOAC, 2023). The carbohydrate content was calculated by difference.

#### **2.4. Thickness**

The thickness of the cookies was determined following the method from (Chopra *et al.*, 2018). The cookies, which had just been taken out of the oven, were allowed to cool at ambient temperature for a duration of 30 minutes. Subsequently, six cookies were arranged in a vertical stack on a tray, and their combined thickness was measured using a caliper. To determine the thickness of one cookie, the reading was subsequently divided by 6. The technique was repeated three times, and the mean value was utilized as the measurement for the thickness of the cookies (in centimeters), along with the corresponding standard deviation value.

#### **2.4. Diameter**

The caliper was used to measure the diameter of the cookies. Three measurements were conducted, with each cookie measurement being turned by 90° (Chopra *et al.*, 2018). The measurement of the diameter was expressed in centimeters. The diameter value was calculated as the mean of the three measurements.

#### **2.5. Spread Ratio**

The spread ratio of cookies was calculated by dividing the diameter by the thickness of the cookies (Chopra *et al.*, 2018). This value was frequently employed as a measure of the caliber of cookies. Calculation utilizing the values of diameter and thickness was repeated three times.

#### **2.6. Sensory Analysis**

##### **2.6.1. Ranking Test**

A sensory study was conducted utilizing a ranking test to ascertain the degree of panelist preference for sago cookies. The panel consisted of 30 semi-trained individuals who were instructed to provide a subjective evaluation of the samples provided. Panelists were trained to recognize and describe sensory attributes specific to the product being evaluated including sweetness, saltiness, bitterness, acidity, texture, aroma, and appearance. The parameters examined were taste, color, aroma, texture, and overall preference. The panelists were instructed to assign a ranking value of 1 to the most favored cookie and a ranking value of 5 to the least favored cookies in order to rank the cookie samples. The ranking was conducted to ensure that each sample had a unique ranking score.

##### **2.6.2. Descriptive Quality Attribute**

The descriptive quality characteristics of sago cookies were evaluated for appearance, texture, mouthfeel, aroma, and taste using the modified approach of Popov-Raljić *et al.* (2013), as outlined in Table 1.

Table 1. Descriptive Quality Attribute of Sago Cookies

Quality attribute	Definition	Score	Description
Appearance	The visual evaluation of the surface and shape of cookies	5	Smooth surface, absence of fractures, consistent shape, and free from any damages.
		4	Barely noticeable fractures, minor shape irregularities, free from any damage.
		3	Apparent fractures, irregular shapes, devoid of any damages.
		2	Surface dominated by fractures, uneven shape, and minor damages.
		1	Severe surface fractures, distorted form, and substantial damage.
Texture	The structure of breakage examined through both visual observation and palpation.	5	No crumbling.
		4	Notable crumbling.
		3	Slightly crumbling
		2	Significant crumbling
		1	Intensive crumbling
Mouthfeel	Evaluation of chewiness and crispiness through oral examination.	5	Extremely crunchy upon biting, readily melting in the mouth.
		4	Crunchy upon biting, with a smooth melting sensation in the mouth.
		3	Slightly crunchy upon biting, easily melted in the mouth
		2	Very little crunchy upon biting, not easy melted in mouth
		1	No crunchy upon biting, difficult to melt in the mouth
Aroma	Evaluation of aroma through the sense of smell.	5	Having a very significant sago aroma
		4	Significant sago aroma
		3	Having a slightly significant sago aroma
		2	Very little sago aroma
		1	No sago aroma
Taste	Taste evaluated through oral examination.	5	Having a very significant sago taste
		4	Significant sago taste
		3	Having a slightly significant sago taste
		2	Very little sago taste
		1	No sago taste

## 2.7. Data Analysis

The data acquired were subjected to statistical analysis using Analysis of Variance (ANOVA) to assess the physicochemical characteristics. If the treatment exhibits a significant and substantial effect, the analysis will proceed with the Tukey test at a significance threshold of 95% ( $\alpha = 0.05$ ). The Friedman test was used to examine the ranking of the sensory test. The difference test was conducted by comparing the value with the critical value from the table of rankings, which was 34, given the number of panelists (30) and the number of treatments (5). The analyses were conducted using the Minitab Software version 17 (Minitab LLC., USA).

## 3. Results and Discussion

### 3.1. Chemical Characteristics

The ANOVA revealed a highly significant impact ( $P < 0.01$ ) of substituting margarine with peanut paste on the moisture content of sago cookies. The sago cookies prepared with 100% peanut paste substitution for margarine had the greatest moisture content value of 4.56%, which was substantially different from all other substitution levels. The treatment involving 0% margarine and 100% peanut paste had a lowest moisture content of 2.54% (Table 1).

This demonstrates that increasing the amount of peanut paste used as a substitute for margarine in sago cookies, up to a maximum of 100%, results in a reduction in the moisture level of the cookies. Utilizing various forms of fat will result in discrepancies in the texture of cookie dough. The reason for this is that various forms of fat possess a Solid Fat Index (SFI), which serves as a measure of the amount of solid components found in shortening. Margarine exhibits solid characteristics when kept at room temperature. It is essentially a combination of crystalline and liquid triglycerides, with the liquid portion being surrounded by fat crystals. The SFI of peanut paste is 30%, which is lower than the SFI of margarine at 50%. As a result, the dough's consistency is more aerated. The presence of this varied dough structure results in increased water absorption (Jacob & Leelavathi, 2007). Consequently, an increase in the amount of peanut paste results in a decrease in the moisture level of the sago cookies. The moisture percentage of sago cookies, when substituted with peanut paste, fell within the range of 2.54-4.56%. This moisture content complies with the maximum limit of 5% set by the Indonesian quality requirements for cookies (Badan Standarisasi Nasional, 1992).

The analysis of variance revealed that substituting margarine with peanut paste had a highly significant impact ( $P < 0.01$ ) on the ash content of sago cookies. The sago cookies with a substitution treatment of 100% peanut paste had the greatest ash level of 2.15%, which was substantially different from the treatments of 50% peanut paste and 50% margarine, 25% peanut paste and 75% margarine, and 100% margarine. The treatment with 100% margarine and 0%

peanut paste had the lowest ash concentration, measuring 1.47% (Table 2).

Table 2. Chemical Characteristics of Sago Cookies

Substitution Ratio (margarine: peanut paste)	Moisture content (%)	Ash content (%)	Protein content (%)	Fat content (%)	Carbohydrate content (%)
100% : 0%	4.56±0.16 a	1.47±0.01 d	9.51±0.12 c	17.06±0.58 a	67.41±0.62bc
75% : 25%	3.72±0.03 b	1.75±0.11 cd	10.05±0.47 c	17.56±0.10 a	66.93±0.43 c
50% : 50%	3.44±0.03 b	1.81± 0.01 bc	11.14±0.14 b	14.50±0.61 b	69.11±0.79 b
25% : 25%	2.89±0.03 c	2.08±0.10 ab	11.34±0.07 b	13.83±0.26 bc	68.43±0.10 bc
0% : 100%	2.54±0.03 d	2.15±0.06 a	12.78±0.30 a	12.67±0.18 c	71.30±0.29 a

notes: values followed by similar letter within the column was not significantly different at  $\alpha$  0.05 by Tukey Test

This demonstrates that increasing the amount of peanut paste used to substitute margarine in sago cookies, up to 100%, resulted in a higher ash content. Peanuts are a significant source of minerals such phosphorus, calcium, magnesium, and potassium (Asimah *et al.*, 2016). Therefore, when peanut paste was used to replace margarine in cookies, the ash content of the cookies increased proportionally. The addition of peanut paste to replace margarine has resulted in an ash content exceeding the standard for cookies, which has a maximum allowable level of 1.5%. Since the ash content exceeds the standard for cookies, it indicates that the substitution has introduced a higher concentration of minerals into the cookie formulation.

The analysis of variance revealed a highly significant impact ( $P < 0.01$ ) on the protein content of sago cookies when margarine was replaced with peanut paste. The sago cookies with a substitution treatment of 100% peanut paste and 0% margarine had the highest protein content, measuring 12.78%. This value was substantially different from the protein content of the cookies treated with various levels of substitution. The cookies prepared with a 100% margarine had the lowest protein content, measuring at 9.51%. This value was not statistically different from the cookies treated with a 75% margarine : 25% peanut paste ratio, but it was different from those treated with a 50% : 50% and 25% : 75% ratio (Table 2).

The relation between the amount of peanut paste used as a substitute for margarine and the protein level of sago cookies was evident. This can be attributed to the peanut protein level, which is over 25% (25g/100 g) (Bonku & Yu, 2020; Gonçalves *et al.*, 2023), exceeding the protein amount of margarine, which is roughly 0.67 g/100g (Database Nilai Gizi, 2018). Consequently, an increase in the ratio of peanuts to margarine directly correlates with an increase in the protein content of sago cookies. The minimum protein content requirement for cookies is 9% (Badan Standarisasi Nasional, 1992). Therefore, sago cookies that have undergone margarine substitution treatment with peanut paste satisfy the protein content of the Indonesian quality standards for cookies.

The analysis of variance showed a highly significant effect ( $P < 0.01$ ) on the fat content of

sago cookies when margarine was replaced with peanut paste. The sago cookies with a substitution treatment of margarine and peanut paste (25% : 75%) had the highest fat content value, which was 17.06%. This value was not substantially different from the sago cookies with 100% margarine and 0% peanut paste, but it was considerably different from the other levels. The cookies with a 0%:100% substitution had the lowest fat content at 12.67%. This value was not substantially different from the fat content of the cookies with a 25%:75%, but it was different from the fat content of the cookies with a 50%:50% substitution ratio (Table 2).

This evidence indicates a discernible trend toward a reduction in the fat content of sago cookies when substituting margarine with peanut paste at varying proportions, reaching up to 100%. The fat content of margarine is approximately 80 g/100 g (Database Nilai Gizi, 2018), whereas the fat content of peanut paste ranges from 44-56 g/100 g (Bonku & Yu, 2020). The discrepancy in fat content between margarine and peanut paste elucidates that the substitution of margarine with increasing amounts of peanut paste leads to a diminution in the overall fat content of sago cookies. It is noteworthy that the fat content requirement for cookies is set at a minimum of 9.5%, and thus, sago cookies subjected to the treatment of margarine substitution with peanut paste satisfy the stipulated Indonesian quality standards for cookies.

The outcomes of the analysis of variance revealed a notably substantial impact ( $P < 0.01$ ) exerted by the substitution of margarine with peanut paste on the carbohydrate content of sago cookies. The sago cookies subjected to the complete substitution (0% margarine: 100% peanut paste) exhibited the highest carbohydrate content at 71.30%, a statistically significant difference from the other substitution ratio. Conversely, the sago cookies derived from the 75% margarine: 25% peanut paste displayed the lowest carbohydrate content at 66.93%, and while this value did not demonstrate statistical significance when compared to the 100% margarine: 0% peanut paste and 25% margarine: 75% peanut paste treatments, it differed significantly from the 50% margarine: 50% peanut paste (Table 2).

The calculation of carbohydrate content through “by difference” method indicated a positive correlation between the amount of peanut paste utilized as a substitute for margarine and the resultant increase in carbohydrate content. The carbohydrate content by difference is ascertained by subtracting other constituents, including moisture, ash, protein, and fat content. A reduction in the levels of these alternative components within sago cookies is associated with an elevation in the carbohydrate value. The results show variations in carbohydrate content depending on the ratio of margarine to peanut paste. Notably, the highest carbohydrate content is observed when using 100% peanut paste and the lowest when using 100% margarine. The carbohydrate content generally decreases as the proportion of peanut paste increases, and the proportion of margarine



decreases. One possible explanation for this trend could be the composition of the two ingredients. Margarine typically contains fats and may have lower carbohydrate content compared to peanut paste, which contains proteins, fats, and carbohydrates. As the proportion of peanut paste increases in the mixture, so does the overall carbohydrate content.

### 3.2. Physical Characteristics

The findings from ANOVA indicated that the substitution of margarine with peanut paste had a significant impact on the physical attribute of sago cookie's thickness. Notably, sago cookies subject to the margarine substitution treatment at a ratio of 0% margarine: 100% peanut paste exhibited the greatest thickness, measuring 0.73 cm. This thickness was statistically different from the 50% margarine: 50% peanut paste treatment, which yielded the thinnest cookies at 0.43 cm. However, the latter treatment did not exhibit statistical difference from the remaining three substitution ratios (Table 3). Table 3 shows a tendency for thickness to decrease as more peanut paste was used to replace margarine, up to 50%, and then increase again as the amount of peanut paste increased to 100%. Margarine and peanut paste have different fat contents and compositions (Chen & Yang, 2023). The decrease in thickness when the cookies were prepared with 25-50% substitution of margarine with peanut paste might be attributed to changes in the fat structure, which later affecting the texture and spreadability of the cookie dough. Beyond 50% of substitution, the increase could be due to the unique properties of peanut paste, such as its natural oils and moisture content.

Table 3. Physical characteristics of sago cookies

Substitution Ratio (margarine : peanut paste)	Thickness (cm)	Diameter (cm)	Spread Ratio
100% : 0%	0.68±0.10 a	6.63±0.33 a	9.66±0.92 a
75% : 25%	0.54±0.09 ab	5.30±0.63 ab	10.15±2.92 a
50% : 50%	0.43±0.02 b	4.37±0.36 b	10.30±1.36 a
25% : 25%	0.63±0.03 ab	4.41±0.10 b	7.00±0.16 a
0% : 100%	0.74±0.01 a	4.39±0.25 b	5.93±0.23 a

notes: values followed by similar letter within the column was not significantly different at  $\alpha = 0.05$

The outcomes of the ANOVA revealed a pronounced impact ( $P < 0.01$ ) on the physical attributes pertaining to the diameter of sago cookies consequent to the substitution of margarine with peanut paste. Notably, sago cookies featuring the widest diameter were those produced with a complete margarine without peanut paste (100%:0%), measuring 6.63 cm. This dimension was found to be not statistically different ( $P > 0.05$ ) from the 75%:25% treatment; however, it exhibited significant difference from the 50%:50%, 25%:75%, and 0%:100% substitutions. The latter three treatments, in turn, did not exhibit any significant distinctions among themselves, as elucidated in Table 3. For a visual representation, refer to Figure 1, which delineates the outcomes of the sago cookies.

Typically, fat functions as a lubricant that imparts flexibility to cookie dough. The quantity and composition of fat utilized in the production of cookies influence the viscoelastic characteristics of the dough. Decreasing fat content or substituting it with liquid fat will result in hard cookies, whereas using solid fat with a higher SFI value will have a softening effect and enhance the aeration of the dough. This will cause the cookies to expand and increase in diameter when baked (Jacob & Leelavathi, 2007; Pareyt & Delcour, 2008). Therefore, an increase in the amount of peanut paste leads to a decrease in the fat content, and a decrease in the SFI value results in a reduction in the diameter of sago cookies.

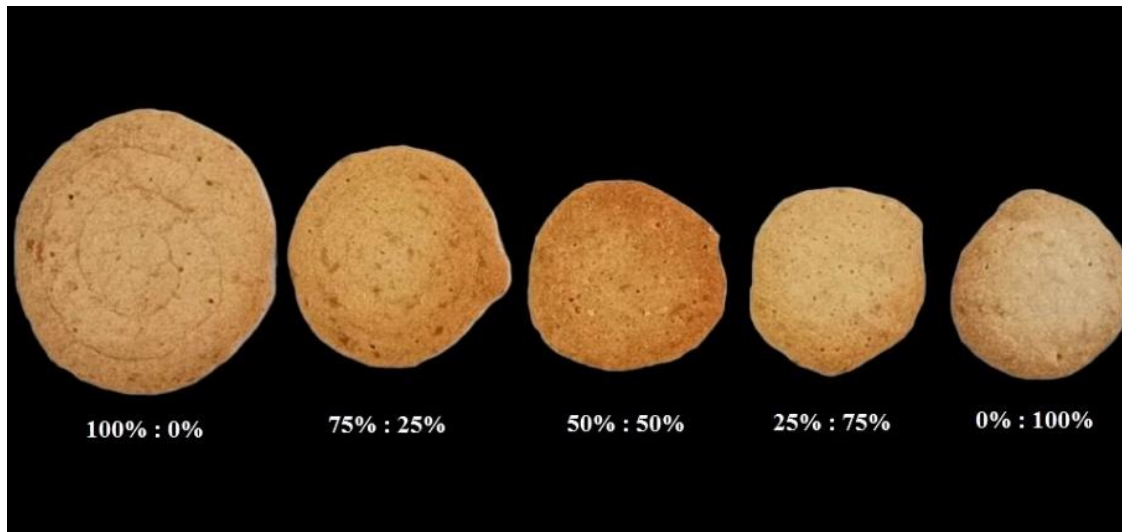


Figure 1. Sago cookies with different substitution ratios (margarine: peanut paste)

The ANOVA results indicated that replacing margarine with peanut paste did not have a statistically significant impact ( $P > 0.05$ ) on the physical properties of the spread ratio of sago cookies. The spread ratio of sago cookies fell within the range of 5.93-10.30, as seen in Table 3. These findings aligned with previous study on cookies, which had shown that various forms of fat did not significantly impact the spread ratio. Instead, the thickness of the cookie plays a more crucial role in determining the spread ratio, as opposed to the diameter (Jacob & Leelavathi, 2007).

### 3.3. Sensory Characteristics

#### 3.3.1. Descriptive Quality Attributes

Based on the descriptive quality attribute test in Figure 2, the appearance assessed was the appearance of the surface and shape of the cookies. Panelists rated sago cookies with 75% : 25% and 50%:50% margarine to peanut paste substitution ratios as having barely noticeable fractures, minor shape irregularities, and being free from any damage, and thus their appearances scored 3.96 and 3.53, respectively. Meanwhile, sago cookies with margarine to peanut paste ratios of 100%:0%, 25%:75%, and 0%:100% were rated as having apparent fractures, irregular shapes, and devoid of any damages, and thus their appearances scored 3.03, 2.5, and 2.6, respectively.

The evaluation of descriptive quality attributes related to texture revealed that all variations involving the substitution of margarine with peanut paste exhibited a texture that exhibited a degree of slightly crumbliness under finger pressure (ranging from 2.53 to 3.06). The assessment of mouthfeel characteristics gauged the crispness upon biting into the cookies and the resultant sensation in the mouth. Panelists' evaluations indicated that sago cookies prepared with margarine to peanut paste ratios of 100%: 0% to 25%: 75% manifested a crunchy mouthfeel upon biting and were easily melted in the mouth (scoring between 3.53 and 3.73). The treatment involving 100% margarine was characterized by a highly crunchy mouthfeel upon biting and considerable ease of crumbling in the mouth (scoring 4.73). Conversely, sago cookies exclusively composed of 100% peanut paste were perceived to possess mouthfeel characteristics that were slightly crunchy upon biting and easily crumbled in the mouth (scoring 3.2).

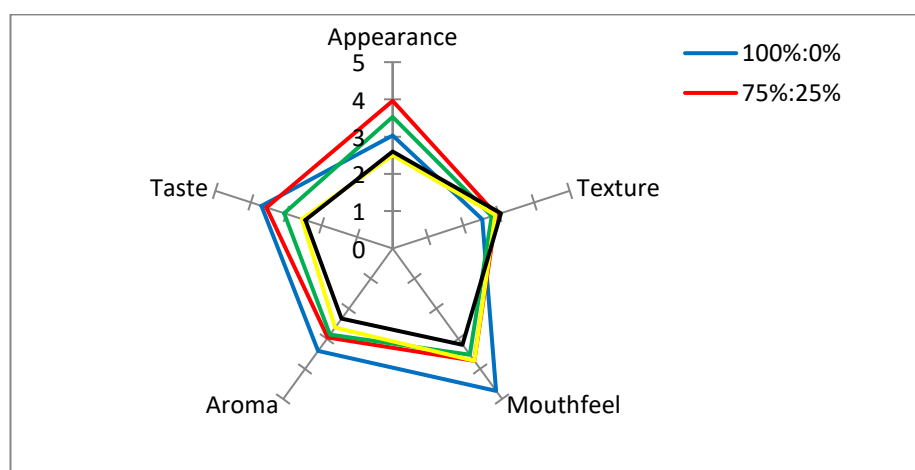


Figure 2. Descriptive quality attribute of sago cookies with different substitution ratio (margarine: peanut paste)

Regarding the descriptive quality characteristics of aroma, the panelists' evaluations indicated that sago cookies resulting from the substitution of margarine with 100% peanut paste lacked the characteristic aroma of sago (scoring 2.33). In contrast, other treatments incorporating 100% margarine or in combination with peanut paste exhibited a somewhat sago aroma (scoring between 2.63 and 3.40). The presence of aromatic compounds from roasted peanuts was observed to overshadow the distinctive aroma of sago starch in these instances.

The evaluation by panelists regarding the descriptive quality attributes of taste indicated that cookies produced with 100% and 75% margarine exhibited flavors reminiscent of sago, receiving ratings of 3.70 and 3.56, respectively. When the substitution with peanut paste reached 50% and 75%, the panelists assigned lower ratings of 3.06 and 2.56, respectively, to the cookies, suggesting a diminished sago-like taste. However, when 100% peanut paste replaced margarine, panelists perceived the cookies as devoid of sago flavor, giving them ratings indicative of a sago-flavorless taste.

### 3.3.2. Acceptance of The Sago Cookies

The treatment exhibiting the lowest cumulative sum of ranks is deemed to possess the utmost degree of acceptance as per the ranking test. As delineated in Table 4, the substitution ratio of 75% margarine to 25% peanut paste demonstrated the highest degree of preference or acceptance for the color of sago cookies, as evidenced by a sum of ranks totaling 61.0. This level of favorability did not exhibit a statistically significant difference from the favorability associated with the 100% margarine; however, it differed significantly from the favorability linked to the 50%:50%, 25%:75%, and 0%:100% margarine to peanut paste ratios. This establishes a direct relation between the quantity of peanut paste utilized as a substitute for margarine and the extent of dislike conveyed by the panelists concerning the color of the cookies.

Peanut paste typically contains more proteins than margarine that together with reducing sugars contribute to the Maillard reaction, which is responsible for browning during baking. Peanut paste may have more proteins, leading to more browning and a darker color. The Maillard reaction does not only influence color but also contributes to the development of complex flavors and aromas (Žilić *et al.*, 2021). The increase in this reaction with increased peanut paste substitution may result in cookies that are perceived as less appealing in terms of color.

Table 4. The acceptance of the cookies based on their sensory characteristics

Substitution Ratio (margarine: peanut paste)	Average				
	Color	Taste	Aroma	Texture	Overall
100%:0%	70.5 ab	65.0 a	75.5 a	77.0 ab	76.0 a
75%:25%	61.0 a	74.0 a	71.0 a	62.0 a	68.0 a
50%:50%	99.5 b	90.0 a	85.5 a	78.0 ab	88.5 ab
25%:75%	111.5 b	98.0 a	108.0 b	102.0 b	99.0 ab
0%:100%	107.5 b	123.0 b	110.0 b	131.0 b	118.5 b

notes: values followed by similar letter within the column was not significantly different at  $\alpha$  0.05

The ranking test identifies the treatment characterized by the minimal sum of ranks as having the utmost level of acceptance. According to Table 4, in terms of the taste for sago cookies, the 100% margarine : 0% peanut paste exhibits the highest degree of favorability or acceptance, registering a cumulative rank of 65.0. This liking level was not significantly different from the taste preferences observed for other substitution ratios, except for the 0% margarine: 100% peanut paste. The findings indicate that the utilization of peanut paste as a substitute for margarine in sago cookies results in a favorable taste perception by panelists up to a 75% substitution ratio. However, when the substitution reaches 100%, replacing all margarine with peanut paste, panelists express a disliking for the taste of sago cookies. Margarine and peanut paste have distinct flavor profiles. Margarine typically contributes a buttery and rich flavor (Wassell, 2014), while peanut paste introduces a nutty and sometimes intense taste (Davis & Dean, 2016; Lykomitros *et al.*, 2016). As

the proportion of margarine decreases and peanut paste increases, the shift in flavor may not align with the expected or preferred taste, leading to a decrease in taste liking. Furthermore, the panelists valued that as the proportion of peanut paste increased, the cookies were perceived to lack the distinct taste of sago.

The substitution of margarine with peanut paste exerts a notable impact on the extent to which panelists express liking or acceptance of the aroma of sago cookies. The treatment demonstrating the least number of ranks is deemed to elicit the highest degree of acceptance based on the ranking test. As illustrated in [Table 4](#), in relation to the aroma of sago cookies, the 75% margarine: 25% peanut paste attained the highest level of liking or acceptance, accruing a total rank of 71.0. This liking level was statistically different from the aroma preferences observed for the 100% : 0% and 50% : 50% margarine to peanut paste, but differed from the preferences 25%:75% and 0%: 100% substitution ratios.

These findings indicated that, concerning the aroma of sago cookies, the substitution of margarine with peanut paste can be endorsed by panelists up to a 50% substitution ratio. However, when the substitution exceeds 50%, leading to more than half of the margarine being replaced by peanut paste, the level of acceptance among panelists for the aroma of sago cookies diminished.

The substitution of margarine with peanut paste significantly influenced the extent to which panelists express liking or acceptance of the texture of sago cookies. The substitution ratio exhibiting the least sum of ranks was identified as eliciting the highest level of acceptance based on the ranking test. As indicated in [Table 4](#), concerning the texture of sago cookies, the 75% : 25% margarine to peanut paste ratio attained the highest level of liking/acceptance, accumulating a total rank of 62.0. This liking level was not statistically distinct from the preferences observed for the 100% :0% and 50% : 50% substitution ratios but differed from the preferences under the 25% : 75% and 0% : 100% substitution ratio. Consequently, sago cookies with a 75% : 25% margarine to peanut paste substitution ratio were characterized as a more acceptable texture. Margarine contributes to the fat content in cookies, playing a key role in providing a desirable texture, such as tenderness and moisture ([Pareyt & Delcour, 2008](#)). Reducing margarine and increasing peanut paste can alter the fat composition, potentially leading to a less preferred texture, such as dryness or a lack of softness. The mouthfeel of cookies is influenced by the fat content, and changes in this aspect can affect the overall texture perception ([Devi & Khatkar, 2016](#)). Peanut paste may not provide the same mouth-coating and smooth texture that margarine does, leading to a decrease in liking among panelists

The substitution of margarine with peanut paste exerted a substantial influence on the overall degree of liking or acceptance of sago cookies among panelists. As per the ranking test, the

treatment yielding the lowest sum of ranks was associated with the highest level of acceptance. As depicted in Table 4, the 75% : 25% margarine to peanut paste substitution ratio emerged with the highest overall liking/acceptance, showing a total rank of 68.0. This liking level did not exhibit statistical difference from other treatments that retained margarine, yet it was notably different from the 0% : 100% margarine to peanut paste treatment. These findings highlighted that, on the whole, sago cookies subject to the 75% : 25% margarine to peanut paste substitution ratio were endowed with a highest level of acceptance compared to other treatments. However, they remain acceptable even when peanut paste was introduced alongside margarine. Notably, the overall level of acceptance among panelists declines when peanut paste fully replaced margarine at a 100% substitution ratio.

#### 4. Conclusions

The optimal treatment for the production of sago cookies, characterized by the highest acceptance across all sensory attributes such as color, taste, aroma, texture, and overall likeness, involves the substitution of margarine with peanut paste at a ratio of 75% to 25%. Cookies subjected to this treatment exhibited specific characteristics, including a moisture content of 3.72%, an ash content of 1.75%, a protein content of 10.05%, a fat content of 17.56%, and a carbohydrate content of 66.93%. Additionally, these cookies possessed a thickness of 0.54 cm, a diameter of 5.30 cm, and a spreading ratio of 10.15. Furthermore, these cookies were characterized by a slightly broken surface, a slightly irregular shape without damage, a texture that crumbles slightly when pressed with fingers, a crispiness when bitten, and easy crumbling in the mouth. They also feature a slight sago flavor and a distinct sago taste. Overall, the 75% margarine to 25% peanut paste substitution ratio yields cookies that encompass a comprehensive profile of desirable sensory qualities.

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