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Sensory Acceptability and Characteristics of Cinnamon Roll Bread with Pineapple Puree (*Ananas comosus* L.) Substituted with Taro Flour

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ABSTRACT

The development of functional food can be applied to bakery products, it is hoped that bread can provide health effects for the body through the addition of food ingredients or substitution of highly nutritious foods. In this research, innovations were made in making cinnamon rolls with local food ingredients other than wheat flour, namely taro flour, pineapple puree, and cinnamon. This research contributed to produce cinnamon roll products that are favored by the public and have good nutritional value based on organoleptic and physicochemical characteristics. The research method used was a Completely Randomized Design (CRD) consisting of 5 levels of taro flour treatment, namely 0%, 40%, 60%, 80%, and 100%. Each sample will be analyzed through organoleptic tests using hedonic method to determine the most preferences formulation by panelists. The most preferences formulation will be characterized physicochemical, including final volume, texture, moisture content, starch content, and antioxidant activity. The results of organoleptic tests showed that the most liked bread by panelists was cinnamon roll bread substituted with 40% taro flour. Physicochemical characters show that cinnamon roll bread with 40% taro flour has a final volume 63.17 cm^2, hardness texture 5.65 N, moisture content 18.50%, starch content 44.97%, and antioxidant activity 16.32%.

KEYWORDS

Bread; Cinnamon roll; Pineapple puree; Substitution; Taro flour

1. INTRODUCTION

Functional food is a food product that contains ingredients with health benefits. Functional food has a good effect on health and reduces the influence of certain diseases and can increase the aesthetic value of the functional food base material [1]. Functional food development can be applied to bread products which are expected to provide health effects for the body through the addition of food ingredients or high nutritional food substitutions as a source of carbohydrates, protein, vitamins, and antioxidants [2].

One of the popular bread products in the community is sweet bread such as cinnamon roll bread [3]. Cinnamon roll bread is a food product made from the basic ingredients of wheat flour, water, yeast, sugar, salt, and the addition of cinnamon powder. Cinnamon roll bread comprises several bread doughs glued with a mixture of sugar and sprinkled with cinnamon powder, so cinnamon roll bread has a unique aroma. Cinnamon can be categorized as a functional food ingredient because it has several health properties for the body, namely as a medicine for respiratory, digestive, and feminine problems [4], [5], [6]. Cinnamon roll bread can be developed as a functional food, by adding other food ingredients or replacing basic ingredients with food ingredients that have health effects and high nutritional value.

In general, cinnamon roll bread is produced using wheat flour as the basic ingredient without any nutritional food substitution or fortification. In this study, an innovation was made to make cinnamon roll bread by substituting wheat flour with taro flour to increase nutritional value. Related research, the development of functional food using taro flour has been widely carried out such as in biscuit products,

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cookies, traditional cakes, shrimp meatballs, and steamed brownies [7], [8], [9]. Taro flour is a powdered food ingredient processed from taro plant tubers. Taro plants are a type of tuber that is a source of carbohydrates. Taro is included in 10 foods that are rich in vitamin E which is beneficial for the health of the body to protect against ultraviolet rays and prevent free radical damage [10]. In addition, taro is proven to contain compounds such as flavonoids, saponins, alkaloids, glycosides, phenols, and tannins that function as natural bioactive compounds in methanol solvents. Taro also has the potential as flour because it has a starch content of around 70-80%, yields reach 28.7% [11]. The starch contained in taro flour is easily digested, so taro flour is often used as a substitute for wheat flour. Taro flour has a brownish-white color, this is thought to be due to the drying and enzymatic process [12]. So, if that taro flour is applied to bakery products will not change the dominant color.

There has not been much innovation in cinnamon roll bread, even though this product has the potential to be developed or increased in nutritional value. Increasing the nutritional value of cinnamon roll bread can be done by adding pineapple which is rich in antioxidants. The advantages of bread include being easy to consume anytime and anywhere, nutritious, and can be enriched with other nutrients so that it is good for children to adults [13]. Pineapple fruit can be processed into pineapple puree to be used as an adhesive material for cinnamon roll bread. Pineapple puree is a processed pineapple product that is made into fruit pulp. Pineapple fruit is a source of antioxidants due to the phytochemical content of phenolic compounds and flavonoids. This antioxidant activity works by capturing free radicals, so it can inhibit cancer cell proliferation and become an anticancer agent [14]. Pineapple fruit contains the enzyme bromelain, where this enzyme will give an itchy effect when consumed in excess. The itching sensation occurs when the enzyme breaks down proteins in the mouth, and will disappear when swallowed. One way to remove the bromelain enzyme in pineapple is by cooking it. Bromelain enzyme has an optimum temperature activity character is 55 °C with an activity value of 4.05 U/ml, while temperatures above 55 °C the enzyme work begins to decrease, this is because the enzyme is a protein when it is at a high temperature it will denature so that the enzyme is damaged and its activity drops [15].

This research contributed to produce cinnamon roll bread products with different proportion of taro flour as the base ingredient and the addition of pineapple puree as the filling, which are rich in nutritional content such as carbohydrates, protein, antioxidants, and flavonoids, which are favored by the public. In addition, this cinnamon roll bread innovation is expected to be an alternative solution in reducing the need for wheat flour in Indonesia.

2. MATERIALS AND METHODS

2.1. Materials

The materials that used in this research were wheat flour (Cakra Kembar Bogasari), taro flour (Naya), sugar (Gulaku), brown sugar (Ricoman), salt (Dolpin), butter (Blueband), yeast (fermipan), milk (Ultra milk), egg yolk, vanilla (Koepoe Koepoe), cinnamon powder (Jay's), and pineapples. Materials needed in the analysis are distilled water, 3% HCL, 40% NaOH, 50 ml of Luff Schroll solution, 25% H_2SO_4, $Na_2S_2O_3$ 0.1 N, 2,2-Diphenyl-1-Picrylhydrazyl (DPPH), and ethanol absolute. The tools that used for the production of cinnamon roll bread were mixer (Miyako), oven (Kirin), desiccator, autoclave (B-One), spectrophotometer (B-ONE UV-Vis 100), and Universal Testing Machine (HD-B609B-S).

2.2. Sample Preparation

The procedure begins with peeling the pineapple, followed by washing it thoroughly and grating it. Subsequently, simmer the grated pineapple until the moisture was diminished. The preparation of cinnamon roll bread initiates with the precise measurement of raw materials and supplementary components, including wheat flour, taro flour, granulated sugar, yeast, butter, milk, and egg yolks. The dry components, including wheat flour, taro flour, yeast, and granulated sugar, were mixed using a mixer, afterwards butter, egg yolks, and liquid milk were incorporated. The process continues at the stirring stage until a smooth consistency was achieved, followed by the addition of 5 g of salt. Once the dough achieves a smooth consistency, it was shaped into thin sheets. The subsequent phase involves the application of butter and pineapple puree, followed by the distribution of palm sugar blended with cinnamon powder, ensuring an even coating over the dough. Subsequently, the dough rolls were shaped and sliced. The prepared dough rolls were positioned in a baking pan and allowed to proof for 15 minutes. The oven was preheated to a temperature of around 150-170 °C for 15-20 minutes until the bread dough is fully cooked or exhibits a brownish hue on the surface. The substitution of taro flour in the manufacture of cinnamon roll bread with pineapple puree consisting of 5 levels of treatment, such as 0% taro flour (P1), 40% taro flour (P2), 60% taro flour (P3), 80% taro flour (P4), and 100% taro flour (P5). The ingredients of each formulation can be seen in Table 1.

Table 1. The formulation of cinnamon roll bread.

Ingredients	P1	P2	P3	P4	P5
Taro flour (%)	0	40	60	80	100
Wheat flour (%)	100	60	40	20	0
Pineapples (g)	100	100	100	100	100
Milk (ml)	170	170	170	170	170
Brown sugar (g)	100	100	100	100	100
Sugar (g)	50	50	50	50	50
Butter (g)	40	40	40	40	40
Salt (g)	5	5	5	5	5
Yeast (g)	5	5	5	5	5
Cinnamon powder (g)	5	5	5	5	5
Egg yolk (g)	2	2	2	2	2

2.3. Organoleptic Analysis of Cinamon Roll

A hedonic test will be done for sensory analysis of cinnamon roll bread, involving 33 panelists. The participants received a questionnaire with parameters representing color, aroma, taste, and texture. Each panelist was assigned a preference score ranging from 1 to 5, where 1 indicated very dislike, 2 indicated dislike, 3 indicated neutral, 4 indicated like, and 5 indicated very like. The gathered scores were examined by ANOVA to determine the degree of panelist acceptance [16].

2.4. Volume Analysis

The volume measurement of cinnamon roll bread flour is conducted using a tool, such as a scraper, to assess the dispersion of the cinnamon roll bread through peeling. Samples of cinnamon roll bread were produced, followed by measurements of their diameter and height [11]. Upon acquiring the data, the calculation was executed using equation (1).

$$Volume = \pi \times r^2 \times t \quad (1)$$

2.5. Texture Analysis

Conducting a physical analysis by applying pressure to a product of specific dimensions to assess its texture. The product was thereafter positioned on the testing table and evaluated using the Universal Testing Machine. The information within the device can be transformed into precise data [17].

2.6. Moisture Content Analysis

The analysis of moisture content was conducted using the thermogravimetric method [18]. Empty porcelain cups were dried using an oven tool at a temperature of 105 °C for 24 hours, followed by an additional drying period of 15 minutes. The cups were then weighed using analytical scales and the measurements were recorded. The specimen was positioned in a porcelain cup. The filled porcelain cup was placed in the oven at a specified temperature of 105 °C for 3 hours, followed by a drying period of 15 minutes. This process was repeated until a stable point was reached and subsequently calculated using equation (2).

$$Moisture\ content = \frac{W1 - W2}{W1 - W0} \times 100\% \quad (2)$$

2.7. Starch Content Analysis

The starch content was determined using the Luff Schoorl method (AOAC 920.44). Measure the sample to a mass of 2 g. Then, incorporate 50 ml of distilled water and agitate for one hour. Thereafter, suspense was filtered using Whatman 42 filter paper and subsequently rinsed with distilled water until a volume of 1.250 L was achieved. Afterwards, the filtrate containing carbohydrates was solubilized and discarded. The material containing fat, followed by the starch residue on the filter paper, was washed five times with 10 ml of ether, permitting the ether to evaporate from the residue, and subsequently washed with 150 ml of 10% alcohol to further extract the dissolved carbs. Then, qualitatively transfer the residue from the filter paper into a flask by rinsing with 200 ml of distilled water and adding 10 ml of 25% HCl. After that, cover with a cooling counter and heat in a boiling water bath for 2.5 hours. Upon cooling, neutralize with a 45% NaOH solution and dilute to a final volume of 500 ml. Subsequently, filter by Whatman 42 and quantify the sugar content expressed as glucose from the resulting filtrate. Glucose quantification was conducted similarly to the assessment of reducing sugars. The weight of glucose, when multiplied by 0.9, equals the weight of starch [19].

2.8. Antioxidant Activity Analysis

Analysis methodology for antioxidant activity as per Williams et al. (1995) [20]. A 0.2 g sample was added with 5 ml of PA methanol, and macerate overnight at room temperature. Then, the overnight sample was centrifuged, and 0.2 ml of the supernatant extract was collected. Subsequently, mixed 0.2 ml of the sample with 2.8 ml of 0.1 mM DPPH, and the solution was incubated at room temperature in a dark environment for 1 hour. Afterward, utilize a 515 nm spectrophotometer to measure, ensuring to include a blank consisting of 0.2 ml ethanol and 2.8 ml of 0.1 mM DPPH reagent. The antioxidant activity was determined using equation (3).

$$Antioxidant\ activity = \frac{Absorbance\ of\ blank - absorbance\ of\ sample}{absorbance\ of\ sample} \times 100\% \quad (3)$$

3. RESULTS AND DISCUSSION

3.1. Organoleptic Characteristic

Organoleptic analysis conducted on cinnamon roll bread with pineapple puree and taro flour, utilizing a hedonic test with 33 untrained panelists. Each panelist was requested to indicate their preference for the five samples provided, utilizing a value range of 1-5 that included color, aroma, taste, and texture, as detailed in Table 2.

As seen in Table 2, the color parameter indicates a substantial difference between P1 and P2, P3, P4, and P5. The mean value derived from P2, P3, P4, and P5 diminished in comparison to P1. This is anticipated as a result of the incorporation of taro flour. Taro flour can influence the coloration of the final cinnamon roll bread product. The research indicates that an increased amount of taro flour correlates with a decreased level of color acceptability. This phenomenon is believed to be impacted by the Maillard reaction, which transpires when carbohydrates (reducing sugars) interact with amine groups, yielding a brown product. This reaction transpires during roasting, as the maillard reaction initiates at a temperature of 150 ºC [21]. The starch concentration in wheat flour ranges from 68% to 78%, whereas taro flour has approximately 80% [22]. The more the quantity of taro flour added, the darker the resultant color. The glucose in the bread flour can react with heat, resulting in non-enzymatic browning reactions like the Maillard reaction. This reaction transpires between carbohydrates with reducing sugars and primary amine groups [23], [24]. The incorporation of taro flour can influence the color of cinnamon roll bread, as taro flour possesses a darker hue than wheat flour. Taro flour will oxidize and turn brown upon contact with wet substances [25].

Table 2. Organoleptic characteristic of cinnamon roll.

Sample	Color	Aroma	Taste	Texture
P1 (0% taro flour)	$4.24^{c} \pm 0.85$	$3.55^{a} \pm 0.92$	$3.94^{c} \pm 0.85$	$3.61^{b} \pm 0.91$
P2 (40% taro flour)	$3.81^{b} \pm 0.83$	$3.70^{a} \pm 0.67$	$3.67^{bc} \pm 0.72$	$3.64^{b} \pm 0.71$
P3 (60% taro flour)	$3.52^{b} \pm 1.01$	$3.42^{a} \pm 0.85$	$3.42^{ab} \pm 1.01$	$3.52^{b} \pm 1.04$
P4 (80% taro flour)	$2.91^{a} \pm 0.86$	$3.33^{a} \pm 0.88$	$3.12^{a} \pm 1.00$	$2.91^{a} \pm 0.86$
P5 (100% taro flour)	$3.61^{b} \pm 0.72$	$3.52^{a} \pm 0.85$	$3.64^{bc} \pm 0.93$	$3.30^{ab} \pm 0.86$

Note: Superscript letter in the same row indicates a significant difference in the relationship between treatments and length of storage time with a confidence level of 95% ($\alpha = 0.05$).

The addition of taro flour did not result in a significant difference in the aroma parameter. Taro flour possesses no distinct aroma; thus, it does not influence food products when utilized [25]. The taste parameter indicated that an increase in taro flour corresponded with a decline in taste approval. The high flavonoid content in taro flour is believed to be influential, as certain flavonoid components may induce adverse effects, such astringency or bitterness [26]. The concentration of flavonoids in taro flour exceeds that seen in wheat flour. Taro flour has around 1.027 mg/gram, whereas wheat flour contains about 0.215 mg/g [27]. Consequently, it indicates that the incorporation of taro flour influences consumer preferences regarding taste attributes.

The texture preferences of the panelists indicated no significant differences among P1, P2, and P3, whereas significant differences were observed with P4 and P5. The average value in P4 and P5 diminished in comparison to P1. This was anticipated due to the composition of the utilized components. Wheat flour can absorb substantial quantities of water, hence attaining the appropriate dough consistency [28], [29]. Wheat flour comprises gliadin and glutenin proteins that, when combined with water, yield gluten. Gluten facilitates the leavening of bread during its manufacturing. Gluten possesses a robust cellular structure that retains the gas produced by yeast, preventing the dough from deflating. In contrast, taro flour lacks gluten, resulting in inadequate expansion of the bread as the proportion of taro flour increases [24]. The optimal texture of bread should possess elasticity, enabling it to revert to its original state, and should not readily get compacted [30]. This formulation indicates that a taro flour proportion exceeding 80% diminishes consumer acceptance of texture preferences in cinnamon roll bread. This may have been influenced by the reduction of gluten content in the bread, which resulted in a firmer texture. Organoleptic investigation, focusing on color, aroma, taste, and texture ratings, revealed that a cinnamon roll using 40% taro flour is more acceptable to panelists than those with 60%, 80%, or 100% taro flour proportions.

3.2. Volume

Table 3 illustrates that the final volume of P2 was 63.17 cm^2, whereas P1 was 62.86 cm^2. The final volume in P2 and P1 exhibits minimal variation. The determination of the final volume of bread demonstrates the dough's capacity to generate and retain the gas released during fermentation. The principal component of flour is gluten, a protein comprised of gliadin and glutenin, which influences the dough's elasticity and imparts viscoelastic qualities, enabling the dough to expand [31]. Gluten is a particular protein present in wheat grains. In the preparation of bread dough intended for fermentation or baking, gluten serves as a component that imparts adhesive characteristics, enabling raw elements to solidify and create a three-dimensional network. Conversely, the incorporation of gluten in the baking sector seeks to enhance dough strength, retain gas, absorb moisture, and establish structure. The findings of this final volume analysis are largely consistent with prior studies on sweet bread products utilizing a 10% ratio of *mocaf* flour, which yields a dough development volume of 43.67 cm^3 [15].

Table 3. Physical characteristics of cinnamon roll.

Sample	Final volume (cm^2)	Texture (N)
P1 (0% taro flour)	62.86	5.05
P2 (40% taro flour)	63.17	5.65

3.3. Texture

According to Table 3, the hardness texture result for P2 was 5.65 N, whereas for P1 it was 5.05 N. The data shows that P2 has higher results compared to P1. The higher result in P2 is due to the addition of other flours to the bread dough, so that the texture of the resulting bread is slightly dense, somewhat fibrous and not as soft as bread made from 100% wheat flour. The more the addition of coconut pulp flour will produce a higher or harder texture value of fiber-rich white bread [32]. This is because increasing the substitution of coconut pulp flour can reduce the amount of gluten protein contained in the dough, so the resulting texture is not as good as fresh bread with 100% wheat flour. The difference in the texture of the bread produced between treatments P2 and P1 is due to the gluten content in the flour used. Gluten contained in wheat flour is elastic, making bread dough able to hold CO_2 gas from yeast fermentation, so that the dough can expand and become soft. Taro flour does not contain gluten in it, so if there is an addition of taro flour, the bread will experience a decrease in softness. In addition, the texture of bread is also influenced by the starch ratio in taro flour. Starch in taro tubers is relatively high at 80%, the high starch content will cause the texture of hard and dense bread [33].

3.4. Moisture Content

As shown in Table 4, the P2 moisture content is 18.50%, which aligns with the features of cake products classified as intermediate moisture meals. Bakery products are included as intermediate moisture foods with total moisture content ranging from 10-20% [34]. The moisture content of cake with 100% wheat flour composition is 12.4% [31]. In addition, this result has met the quality standards of sweet bread according to SNI 01- 3840-1995 with a maximum result of 40% moisture content in sweet bread. The increase in moisture content in cinnamon roll bread with pineapple puree substituted with taro flour is influenced by the presence of taro flour and pineapple puree. Taro flour does not contain gluten, which can bind water during the stirring process, so more free water is contained. In addition, pineapple fruit has a high water content of around 82.86% [22].

Table 4. Chemical characteristics of P2 cinnamon roll.

Chemical characteristic	Result
Moisture	18.50 %
Starch	44.97 %
Antioxidant activity	16.32 %

3.5. Starch Content

Based on Table 4, cinnamon roll bread with pineapple puree substituted with taro flour has a starch content of 44.97%. These results are not much different from some research results related to the innovation of wheat flour sweet bread with other flour substitutions. The starch content of cinnamon roll bread is higher than some other sweet bread innovations. One of them is sweet bread made from 80% wheat flour and 20% breadfruit flour with a low starch content of 8.081% [29]. This shows that tuber commodities such as taro flour can influence in production of sweet bread products that have a high starch content.

3.6. Antioxidant Activity

The results shown in Table 4, cinnamon roll bread made with pineapple puree and taro flour exhibits antioxidant activity that inhibits free radicals by 16.32%. These results are not much different from some research results related to the innovation of wheat flour sweet bread with other flour substitutions. The composition of sweet bread made from wheat flour and basil flour have high antioxidant level [35].

However, the antioxidant activity content is known to be greater than the antioxidant activity in 100% wheat flour bread, which is 3.34% [36], [37].

Cinnamon roll bread with pineapple puree substituted with taro flour has antioxidant activity derived from cinnamon powder and the addition of pineapple puree. The cinnamon powder contains cinnamaldehyde compounds. Namely one of the dominant phytochemical compounds in cinnamon. This compound has a role as an antioxidant because it can inhibit the enzyme aldose reductase which cures oxidative stress [38]. The antioxidant activity of cinnamon has an inhibition value of 50%, namely 75 ppm. Pineapple fruit is also believed to be one of the fruits that has the ability to ward off free radicals. The free radical scavenging activity in pineapple fruit flesh is around 76.6% [39], [40].

4. CONCLUSION

The organoleptic test findings indicated that the cinnamon roll selected by the panelists was P2, composed of 40% taro flour and 60% wheat flour, which received scores of 3.81 ± 0.83 for color, 3.7 ± 0.67 for aroma, 3.67 ± 0.72 for taste, and 3.64 ± 0.71 for texture. The physicochemical properties of P2 included a final volume of 63.17 cm^2, a texture of 5.65 N, a moisture content of 18.50%, a starch content of 44.97%, and an antioxidant activity of 16.32%.

AUTHOR CONTRIBUTION

All author contributed equally to the main contributor to this paper. All authors read and approved the final paper. **Dininurilmi Putri Suleman**: Writing (review & editing), writing (original draft), supervision, conceptualization. **Mulyani Mukti Sari**: Writing (review & editing), writing (original draft), product development. **Alfi Nur Rochmah**: Investigation, conceptualization, validation, formal analysis. **Fitriyah Zulfa**: Investigation, conceptualization, validation, funding acquisition.

CONFLICTS OF INTEREST

The authors declare that they have no conflicts of interest to declare.

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REFERENCES

[1] R. Wylis Arief, E. Novitasari, and R. Asnawi, "Food diversification of cassava as functional food instead of rice in Lampung," *Planta Trop. J. Agro Sci.*, vol. 6, no. 2, 2018, https://doi.org/10.18196/pt.2018.081.62-69.

[2] A. Z. N. A. Shilbi and E. S. Murtini, "Optimization of ginger (*Zingiber officinale*) and cinnamon (*Cinnamomum verum*) on total phenolics, antioxidant activity and loaf volume of bread," *Adv. Food Sci. Sustain. Agric. Agroindustrial Eng.*, vol. 5, no. 1, pp. 102–110, 2022, https://doi.org/10.21776/ub.afssaae.2022.005.01.9.

[3] F. Admasu, E. G. Fentie, H. Admassu, and J.-H. Shin, "Functionalization of wheat bread with prebiotic dietary insoluble fiber from orange-fleshed sweet potato peel and haricot bean flours," *LWT*, vol. 200, p. 116182, 2024, https://doi.org/10.1016/j.lwt.2024.116182.

[4] R. A. H. E. Widyasari, G. Widodo, D. Devy, and M. Nurdialy, "Cinnamon java roll modification as alternative sweet snack for diabetes mellitus patients," *IOP Conf. Ser. Earth Environ. Sci.*, vol. 1187, no. 1, p. 012005, 2023, https://doi.org/10.1088/1755-1315/1187/1/012005.

[5] S. Maghaydah, A. Alkahlout, M. Abughoush, N. I. Al Khalaileh, A. N. Olaimat, M. A. Al-Holy, R. Ajo, I. Choudhury, and W. Hayajneh, "Novel gluten-free cinnamon rolls by substituting wheat flour with resistant starch, lupine and flaxseed flour," *Foods*, vol. 11, no. 7, p. 1022, 2022, https://doi.org/10.3390/foods11071022.

[6] R. Ribeiro-Santos, M. Andrade, D. Madella, A. P. Martinazzo, L. de Aquino Garcia Moura, N. R. de

Melo, and A. Sanches-Silva, “Revisiting an ancient spice with medicinal purposes: Cinnamon,” *Trends Food Sci. Technol.*, vol. 62, pp. 154–169, 2017, https://doi.org/10.1016/j.tifs.2017.02.011.

[7] M. Arıcı, G. Özülkü, B. Kahraman, R. M. Yıldırım, and Ö. S. Toker, “Taro flour usage in wheat flour bread and gluten-free bread: Evaluation of rheological, technological and some nutritional properties,” *J. Food Process Eng.*, vol. 43, no. 9, 2020, https://doi.org/10.1111/jfpe.13454.

[8] N. A. Salsabil, M. Dahlia, and M. Mariani, “The effect of taro beneng flour substitution (*Xanthosoma undipes* K. Koch) on brownie cookies making on sensory quality,” *Asian J. Eng. Soc. Heal.*, vol. 2, no. 8, pp. 649–654, 2023, https://doi.org/10.46799/ajesh.v2i8.95.

[9] E. Ervina, “The sensory profiles and preferences of gluten-free cookies made from alternative flours sourced from Indonesia,” *Int. J. Gastron. Food Sci.*, vol. 33, p. 100796, 2023, https://doi.org/10.1016/j.ijgfs.2023.100796.

[10] P. R. Pereira, É. de Aquino Mattos, A. C. N. T. F. Corrêa, M. A. Vericimo, and V. M. F. Paschoalin, “Anticancer and immunomodulatory benefits of taro (*Colocasia esculenta*) corms, an underexploited tuber crop,” *Int. J. Mol. Sci.*, vol. 22, no. 1, p. 265, 2020, https://doi.org/10.3390/ijms22010265.

[11] A. D. Lestari and S. Maharani, “Pengaruh substitusi tepung talas belitung (*Xanthosoma sagittifolium*) terhadap karakteristik fisika, kimia dan tingkat kesukaan konsumen pada roti tawar,” *Edufortech*, vol. 2, no. 2, 2018, https://doi.org/10.17509/edufortech.v2i2.12439.

[12] L. A. Andrade, A. C. da Silva, and J. Pereira, “Chemical composition of taro mucilage from different extraction techniques found in literature,” *Food Chem. Adv.*, vol. 4, p. 100648, 2024, https://doi.org/10.1016/j.focha.2024.100648.

[13] S. K. Chikpah, J. K. Korese, O. Hensel, B. Sturm, and E. Pawelzik, “Rheological properties of dough and bread quality characteristics as influenced by the proportion of wheat flour substitution with orange-fleshed sweet potato flour and baking conditions,” *LWT*, vol. 147, p. 111515, 2021, https://doi.org/10.1016/j.lwt.2021.111515.

[14] Aditika, B. Kapoor, S. Singh, and P. Kumar, “Taro (*Colocasia esculenta*): Zero wastage orphan food crop for food and nutritional security,” *South African J. Bot.*, vol. 145, pp. 157–169, 2022, https://doi.org/10.1016/j.sajb.2021.08.014.

[15] C. Varilla, M. Marcone, L. Paiva, and J. Baptista, “Bromelain, a group of pineapple proteolytic complex enzymes (*Ananas comosus*) and their possible therapeutic and clinical effects. A summary,” *Foods*, vol. 10, no. 10, p. 2249, 2021, https://doi.org/10.3390/foods10102249.

[16] R. Agustina, R. Fadhil, and Mustaqimah, “Organoleptic test using the hedonic and descriptive methods to determine the quality of Pliek U,” *IOP Conf. Ser. Earth Environ. Sci.*, vol. 644, no. 1, 2021, https://doi.org/10.1088/1755-1315/644/1/012006.

[17] S. N. Rahmadhia, D. R. Toni, and A. Fitriani, “Physical Characteristics of Kepok Banana Bud (*Musa paradisiaca* Linn.) Flakes With Variations of Mocaf Flour,” *J. Keteknikan Pertan.*, vol. 12, no. 1, pp. 77–92, 2024, https://doi.org/10.19028/jtep.012.1.77-92.

[18] AOAC, *Officials Methods of Analysis*, 18 Edn. USA: Association of Official Analytical Chemist Inc., 2005.

[19] F. Yuksel and A. Kayacier, “Effects of addition of stale bread flour on the acrylamide, fatty acid composition, resistant starch content, and in vitro glycemic index in wheat chips production using response surface methodology,” *LWT*, vol. 161, p. 113354, 2022, https://doi.org/10.1016/j.lwt.2022.113354.

[20] W. B. Williams, M. E. Cuvelier, and C. Berset, “Use of Free Radical Method to Evaluate Antioxidant Activity,” *LWT - Food Science and Technology*, vol. 28, no. 1, pp. 25–30, 1995, https://doi.org/10.1016/S0023-6438(95)80008-5.

[21] S. N. N. Makiyah, I. Setyawati, S. N. Rahmadhia, S. Tasminatun, and M. Kita, “Comparison of yam composite cookies sensory characteristic between sugar and stevia sweeteners,” *J. Agri-Food Sci. Technol.*, vol. 5, no. 2, pp. 120–133, 2024, https://doi.org/10.12928/jafost.v5i2.10211.

[22] Z. Zhang, L. Zhang, M. Chen, and Z. He, “Effects of taro powder on the properties of wheat flour and dough,” *Food Sci. Technol.*, vol. 42, 2022, https://doi.org/10.1590/fst.116221.

[23] T. A. Alflen, E. Quast, L. C. Bertan, and E. M. Bainy, “Partial substitution of wheat flour with taro

(*Colocasia esculenta*) flour on cookie quality," *Rev. Ciencias Exatas e Nat.*, vol. 18, no. 2, 2016, https://doi.org/10.5935/RECEN.2016.02.01.

[24] G. Abera, W. K. Solomon, and G. Bultosa, "Effect of drying methods and blending ratios on dough rheological properties, physical and sensory properties of wheat–taro flour composite bread," *Food Sci. Nutr.*, vol. 5, no. 3, pp. 653–661, 2017, https://doi.org/10.1002/fsn3.444.

[25] L. Amelia, S. Astuti, E. G. Fadhallah, and D. Koesoemawardani, "The effect of tapioca flour and bogor taro flour (*Colocasia esculenta* L. Schott) formulations on the chemical, physical, and sensory characteristics of catfish sausage (*Pangasius hypophtalmus*)," *Biol. Med. Nat. Prod. Chem.*, vol. 13, no. 2, pp. 321–328, 2024, https://doi.org/10.14421/biomedich.2024.132.321-328.

[26] V. Lebot, F. Lawac, and L. Legendre, "The greater yam (*Dioscorea alata* L.): A review of its phytochemical content and potential for processed products and biofortification," *J. Food Compos. Anal.*, vol. 115, p. 104987, 2023, https://doi.org/10.1016/j.jfca.2022.104987.

[27] R. F. M. Ali, A. M. El-Anany, H. M. Mousa, and E. M. Hamad, "Nutritional and sensory characteristics of bread enriched with roasted prickly pear (*Opuntia ficus-indica*) seed flour," *Food Funct.*, vol. 11, no. 3, pp. 2117–2125, 2020, https://doi.org/10.1039/C9FO02532D.

[28] R. Okuda, A. Tabara, H. Okusu, and M. Seguchi, "Measurement of water absorption in wheat flour by mixograph test," *Food Sci. Technol. Res.*, vol. 22, no. 6, pp. 841–846, 2016, https://doi.org/10.3136/fstr.22.841.

[29] H. Ye, Y. Zhang, L. Wang, J. Ban, Y. Wei, F. Fan, and B. Guo, "Dynamic study on water state and water migration during gluten–Starch model dough development under different gluten protein contents," *Foods*, vol. 13, no. 7, p. 996, 2024, https://doi.org/10.3390/foods13070996.

[30] O. T. M. Ershidat, E. M. Elsebaie, and M. R. Badr, "Impact of using plasma activated water in pan bread preparation on dough rheological characteristics and quality properties," *J. Cereal Sci.*, vol. 118, p. 103983, 2024, https://doi.org/10.1016/j.jcs.2024.103983.

[31] M. Shi, F. Wang, X. Ji, Y. Yan, and Y. Liu, "Effects of plasma-activated water and heat moisture treatment on the properties of wheat flour and dough," *Int. J. Food Sci. Technol.*, vol. 57, no. 4, pp. 1988–1994, 2022, https://doi.org/10.1111/ijfs.15317.

[32] Erminawati, W. Sidik, R. Listanti, and H. Zulfakar, "Formulation and characterization of bread using coconut-pulp flour and wheat flour composite with addition of xanthan-gum," *IOP Conf. Ser. Earth Environ. Sci.*, vol. 102, p. 012010, 2018, https://doi.org/10.1088/1755-1315/102/1/012010.

[33] S. Nigam and S. Tomar, "Development and quality evaluation of bread fortified with partial substituent raw taro flour" impact of raw taro flour on bread quality," *Int. J. Adv. Eng. Manag.*, vol. 4, no. 5, pp. 809–818, 2022, https://doi.org/10.35629/5252-0405809818.

[34] D. A. Pusuma, Y. Praptiningsih, and M. Choiron, "Karakteristik roti tawar kaya serat yang disubstitusi menggunakan tepung ampas kelapa," *J. Agroteknologi*, vol. 12, no. 01, p. 29, 2018, https://doi.org/10.19184/j-agt.v12i1.7886.

[35] J. Wattanakul, N. Manakitlap, C. Sarawong, K. Norajit, N. Uthai, and W. Julaya, "Effect of the partial replacement of wheat flour with a whole leave and a chloroplast-rich fraction derived from holy basil leaves on the nutrient composition, physical properties, and antioxidant activity of butter cookies," *Food Res.*, vol. 8, no. 4, pp. 151–161, 2024, https://doi.org/10.26656/fr.2017.8(4).413.

[36] Y. A. Czajkowska–González, E. Alvarez–Parrilla, N. del Rocío Martínez–Ruiz, A. A. Vázquez–Flores, M. Gaytán–Martínez, and L. A. de la Rosa, "Addition of phenolic compounds to bread: antioxidant benefits and impact on food structure and sensory characteristics," *Food Prod. Process. Nutr.*, vol. 3, no. 1, p. 25, 2021, https://doi.org/10.1186/s43014-021-00068-8.

[37] K. Pycia and E. Ivanišová, "Physicochemical and antioxidant properties of wheat bread enriched with hazelnuts and walnuts," *Foods*, vol. 9, no. 8, p. 1081, 2020, https://doi.org/10.3390/foods9081081.

[38] Y. I. Shoqairan, H. K. Darwish, M. A. H. Hamami, F. Y. Al-Juhaimi, I. A. M. Ahmed, and E. E. Babiker, "The influence of cinnamon powder on the antioxidant and antimicrobial properties of beef burger during refrigerated storage," *LWT*, vol. 188, p. 115422, 2023, https://doi.org/10.1016/j.lwt.2023.115422.

[39] N. S. Harith, N. A. Rahman, N. A. Zamanhuri, and S. A. Hashib, "Microwave-based antioxidant extraction from pineapple peel waste," *Mater. Today Proc.*, vol. 87, pp. 126–131, 2023, https://doi.org/10.1016/j.matpr.2023.02.384.

[40] A. Y. Andeswari, N. H. Zahro, R. Widyasaputra, M. P. Bimantio, and A. Ruswanto, "The effect of soaking time and size of fruit pieces on pineapple infused tea characteristic," *J. Agri-Food Sci. Technol.*, vol. 5, no. 1, pp. 57–64, 2024, https://doi.org/10.12928/jafost.v5i1.9851.