DOI: http://dx.doi.org/10.35941/jtaf.26724.8.5.2026.60-67

EFFECT OF BREAD IMPROVER ADDITION ON PREFERENCE, VOLUME EXPANSION, NUTRITIONAL VALUE, AND TOTAL CALORIES OF SWEET BREAD SUBSTITUTED WITH MODIFIED CASSAVA FLOUR (MOCAF)

Yuliani*, Nova Solina Purba, Nuzlul Musdalifah,Yupita Veby Sagita, Christina Elvina Utarini

Agricultural Product Technology Study Program, Faculty of Agriculture, Mulawarman University, Samarinda City, East Kalimantan 75119, INDONESIA
**) Corresponding author: yulianicandra482@gmail.com*

Submission: 16.4.2025; Acceptance: 20.2.2026; Published: 29.4.2026

ABSTRACT

Modified cassava flour (mocaf) can be used as an alternative to wheat flour to reduce wheat flour consumption. Previous research has shown that substituting wheat flour with mocaf to produce sweet bread with physical and sensory characteristics similar to those of sweet bread made from 100% wheat flour requires a maximum of 20%. Efforts to increase the mocaf substitution to 40% must be accompanied by product modifications, such as the addition of a bread improver, to ensure that the resulting bread remains soft and palatable. This study aimed to determine the effect of adding a bread improver on the preference, volume expansion, nutritional value, and total calories of sweet bread substituted with 40% mocaf. The study was designed using a non-factorial Completely Randomized Design. The amount of bread improver added was 0 g (control), 0.2, 0.4, 0.6, and 0.8 g. The results of the study showed that the addition of bread improvers had a significant effect (p <0.05) (based on the Duncan Multiple Range Test) on total calories, as well as water, ash, protein, and carbohydrate content, and preference for texture, outer color, and inner color of sweet bread (based on the Dunn post hoc test). There was an increase in water, ash, and protein content and a decrease in carbohydrate and total calorie content with increasing amounts of bread improver added to sweet bread, making it a healthier alternative to bread. Meanwhile, the fat content and bread volume expansion were not affected by the amount of bread improver. The panelists liked the color, aroma, texture, and taste of the sweet bread. The addition of a bread improver of 0.8 g / 100 g produced bread that could match the nutritional value and total calories of sweet bread made from 100% wheat flour (without mocaf substitution).

Keywords**:** Bread improver, mocaf, nutritional value, sweet bread, total calories

INTRODUCTION

Rapid population growth has led to an annual increase in wheat flour consumption in China. According to data from the Central Bureau of Statistics, in 2023, Indonesia imported 10,586.6 million tons of wheat seeds (BPS, 2023). Food products made from wheat that are often found in the market include bread, noodles, cakes, and cookies (Zhang, 2020).

The increase in wheat flour consumption in Indonesia is driven by the continued growth of the wheat flour-based product industry, such as bakeries, biscuit factories, and instant noodle manufacturing. This growth indicates that the Indonesian appetite for processed foods made from wheat flour remains high. One effort to reduce the dependence on wheat flour in sweet bread production is to develop substitute ingredients that can reduce imported commodities and utilize local Indonesian commodities, especially in East Kalimantan, namely cassava. Modified cassava flour (MoCAF) is an alternative substitute for wheat flour derived from cassava (Fadilah et al., 2015).

The abundant availability of cassava in East Kalimantan offers an alternative for developing flour substitutes using local commodities. According to data from the East Kalimantan Provincial Food Crops Agriculture Service, cassava production reached 65,167 tons in 2020 (Dinas Pangan,Tanaman Pangan, dan Hortikultara, Kalimantan Timur, 2021). Judging from the raw materials used to make mocaf, it has good development prospects because of the abundant availability of cassava, and the possibility of a shortage of raw materials can be avoided.

Mocaf flour resulting from yeast fermentation has a water content of 13.14%, ash content of 4.82%, protein content of 1.12%, and fat content of 4.28% (Helilusiatiningsih, 2023), and the carbohydrate content in the form of amylose is quite high, approximately 15-25% (Tako et al., 2014). Research by Yasa et al., (2016) and Nur'utami et al., (2020) found that to produce sweet bread with physical properties (volume expansion) and sensory properties (preference for structure, texture, color, and smell of bread crumbs) that are close to bread without mocaf (100% wheat), the maximum amount of mocaf substituted is only 20%.

This study examined the processing of sweet bread by replacing 40 amount of the wheat flour with mokaf flour. Bread made using mocaf substitution resulted in reduced gluten in the dough, resulting in less carbon dioxide being trapped in the dough during fermentation, resulting in less rise and smaller, denser pores. In this study, bread improver was added with the aim of helping to increase the bread's rising power and the preference for sweet bread, so that it can match or even be better than the quality of sweet bread without mocaf substitution. Bread improvers are additives used to make bread softer and rise better. Bread improvers are made from a mixture of tapioca flour, soy flour, flour treatments (sodium stearoyl lactylate, calcium sulfate), hemicellulose, alpha amylase enzymes, and emulsifiers designed to modify the characteristics of bread dough. The ingredients of this bread improver are thought to affect the nutritional content of sweet bread substituted with mocaf by 40%. Lambert-Meretei et al. (2010) developed a method to evaluate the effect of bread improver dosage and concentration on bread crumb texture. Bread improver (containing lecithin, ascorbic acid, and alpha-amylase) was added to the flour at concentrations of 0.2%, 0.4%, and 0.6%. The hardness, chewiness, stickiness, cohesiveness, and elasticity of the bread were determined using rheological analysis.

MATERIALS AND METHODS

Materials

The basic ingredients used to make sweet bread are high-protein wheat flour (Cakra Kembar brand) and mocaf flour (Ladang Lima brand). Other ingredients included a bread improver (Bakerin Plus brand), which contained a mixture of tapioca flour, soy flour, flour treatment (sodium stearoyl lactylate, calcium sulfate, hemicellulose enzyme, and alpha amylase enzyme), instant yeast (Fermipan brand; the yeast to be used was ensured to be active by mixing 3 g of yeast and 30 g of sugar into 20 g of water, then letting it stand for 10 min until it foams or bubbles; if foam forms, it means the yeast is active), granulated sugar (Gulaku brand), butter (Hollman brand), full cream milk powder (Dancow brand), chicken eggs, and salt. The chemicals used for proximate analysis were sulfuric acid, 10% sodium hydroxide, 0.02 N hydrochloric acid, catalyst (containing sodium sulfate, copper sulfate, and selenium), petroleum benzine, saturated boric acid, methylene red, and methylene blue. All chemicals were obtained from Merck (Darmstadt, Germany).

Experimental Design

This study used a non-factorial completely randomized design consisting of five levels of bread improver amount treatment, each carried out with three replications. The bread improver amount treatments consisted of: control (0.0 g), 0.2, 0.4, 0.6, and 0.8 g. was made from wheat flour and mocaf flour at a ratio of 60:40. The total raw material of the flour mixture per treatment was 100 g. For comparison, sweet bread (PM) was prepared using 100% wheat flour without the addition of mocaf and without the addition of bread improver.

Research Parameters

The parameters tested in this study were preferences (hedonic test) for the color, aroma, taste, and texture of the bread, the bread volume expansion test, the proximate test (nutritional value), and the total calorie content of the bread. The hedonic test for the color, aroma, texture, and taste of sweet bread substituted with mocaf used 25 untrained panelists, following the method suggested by

DOI: http://dx.doi.org/10.35941/jtaf.26724.8.5.2026.60-67

Setyaningsih et al. (2010). Bread volume expansion testing was performed according to the method suggested by Wardani et al. (2012), with some modifications. Proximate tests covering water, ash, fat, protein, and carbohydrate content were performed according to the method described by AOAC (2019), and total calorie testing using the Atwater factor was performed according to Almatsier (2002).

Data Analysis

Sensory hedonic test data were analyzed using the non-parametric Friedman test. If the test results showed a significant difference between the treatments, a Dunn test was performed. Data from the bread volume expansion test, proximate test, and total calories were analyzed using a one-way analysis of variance (one-way ANOVA) test, with a further test using Duncan's Multiple Range Test (DMRT). If the data distribution shows that it is not normal or/and not homogeneous, the test was switched to using the Kruskal-Wallis test, which was followed by a Tukey difference test if there was a significant difference between treatments.

Processing of Sweet Mocaf Bread

Sweet Mocaf Bread (SMB) processing for each treatment uses raw materials of high protein wheat flour (60 g), mocaf flour (40 g), granulated sugar (30 g), full cream milk powder (12 g), instant yeast (3 g), 1 g salt, bread improver (BI) (the amount of BI according to the treatment is 0.0, 0.2, 0.4, 0.6, and 0.8 g). All dry ingredients were placed in a dry container and stirred with a spatula until evenly mixed. Next, a mixture of 30 g of chicken egg yolk and white was added and stirred evenly using a mixer, starting with low to high speed until a semi-smooth texture was obtained. Then, 15 g of butter was added, and stirring was continued using a mixer at high speed. During the stirring process, sufficient water is required to form a dough until it becomes smooth. Next, the first fermentation process was carried out for 60 min, after which the dough was deflated, and continued by weighing the dough was weighed as much as 50 g each. The dough was shaped into balls and placed on a baking sheet lined with the parchment paper. The dough was then proofed for 30 min. The dough was baked in an electric oven at 170 °C for 25 min or until cooked through. The comparison bread (PM) in this study was an original sweet bread made with 100 g of wheat flour, without the addition of mocaf and BI, while the other ingredients were the same as in the SMB.

RESULTS AND DISCUSSION

Sensory Hedonic Characteristics (Preference) on Sweet Mocaf Bread

The recapitulation of the data from the results of the preference test for color, aroma, texture, and taste of sweet bread substituted with mocaf is presented in Table 1.

Table 1. Effect of the amount of bread improver (BI) on the sensory hedonic characteristics of sweet mocaf bread

BI (g)	Color		Aroma	Texture	Taste
	Outer of bread	Inside of bread			
0.0	3^{a}	4^{a}	4	4^{a}	4
0.2	4^{ab}	4^{ab}	4	4^{b}	4
0.4	4^{a}	4^{ab}	4	4^{bc}	4
0.6	4^{a}	4^{ab}	4	4^{ac}	4
0.8	4^{b}	4^{ab}	4	4^{a}	4
PM	4^{b}	4^{b}	4	4^{b}	4

Note: Data (median) were obtained from 75 responses. Data were analysed by Friedman test. Data within the same column followed by different letter showed a significant difference (Dunn's test, $p<0.05$). PM: comparison of sweet bread made from 100% wheat flour, without mocaf substitution, and without the addition of BI (bread improver). Preference score: 1=dislike very much, 2=dislike, 3=like somewhat, 4=like, 5=like very much

The addition of BI did not significantly affect the panelists' preference for the aroma of the control, SMB, and PM samples. All treatments were preferred by the panelists (score: 4). The formation of bread aroma is more influenced by the basic ingredients used, such as yeast, which produces enzymes that ferment/convert compounds that produce alcohol and carbon dioxide, resulting in the distinctive aroma of bread will be formed due to the formation of acids, aldehydes, and esters. Although mocaf flour has a distinctive aroma, this aroma is masked by the use of other ingredients such as milk, butter, and eggs, which have stronger aromas. This is what makes the bread smell distinctly different.

The panelists preferred (score 4) the texture of the sweet bread in all SMB and PM treatments. With the addition of 0.6 g BI, the texture began to become slightly sandy, and with the addition of 0.8 g BI, the texture was very brittle and sandy/crumbly. This extremely brittle and sandy/crumbly texture indicates that the composition exceeds the recommended usage limit. This is in accordance with Kusnedi (2021), who reported that using the recommended composition, BI could work optimally without disrupting the function of other ingredients. However, if the amount is less than the recommended composition, there is a high possibility that the bread will be dense, and if it exceeds the upper limit of use, the gluten chain will be damaged, and the bread dough structure will become brittle.

There was no significant difference in taste preferences among all treatments, and the panelists preferred the taste of SMB (score 4). Based on research by Kartikasari et al. (2019), the use of BI does not interfere with the taste of the resulting bread; in fact, the addition of BI helps improve and balance the taste of sweet bread. The combination of enzymes (alpha amylase, hemicellulose, and protease) in the BI composition breaks down starch into simple sugars, which are a food source for yeast fermentation, producing gas, which also increases the sweetness of bread (Kusnedi, 2021). In addition, BI can help control the acidity level in bread by balancing the fermentation and baking processes, which reduces the overly strong sour taste that can appear in bread fermented for too long.

Volume Expansion of Bread

The data from the volume expansion test of sweet bread substituted with mocaf (SMB)and the comparison bread (PM) are presented in Table 2.

Table 2. Effect of bread improver on volume expansion of sweet bread substituted with mocaf

Bread improver (g)	Volume expansion of SMB (%)
0.0	37.10±0.26^{a}
0.2	39.09±1.47^{a}
0.4	40.59±1.72^{ab}
0.6	42.96±1.38^{ab}
0.8	44.19±1.83^{ab}
PM	47.54±1.63^{b}

Notes: Data (mean ± SD) obtained from three replicates. Data were analyse by Kruskal-Wallis test. Data within the column followed by different letter showed significant differences (Tukey test, $p<0.05$). PM: Sweet bread made from 100% wheat flour, without mocaf substitution and without the addition of bread improver (BI).

The addition of BI significantly affected the expansion power of the resulting SMB. The increase in the amount of BI showed an increase in the volume of SMB, which ranged from (37.10% to 44.19%. PM bread had the highest volume expansion, namely 47.54%. The increase in the amount of BI made the dough more elastic to trap CO_2 gas produced during fermentation by yeast, allowing the dough to expand and form pores. (Rosalina et al., 2018). Penelitian terdahulu yang dilakukan oleh Previous research conducted by Nur'utami et al. (2020) howed that the higher the percentage of mocaf flour added, the lower the rise power of sweet bread. This is because mocaf does not contain gluten protein, which can form dough elasticity, increase the CO_2 capture capacity of yeast fermentation, and form the dough structure (Putri, 2023). Therefore, by adding BI, which contains a combination of alpha amylase and hemicellulose enzymes, it functions to cut the starch in the bread dough into simple sugars, which are a food source for

DOI: http://dx.doi.org/10.35941/jtaf.26724.8.5.2026.60-67

yeast for fermentation, producing gas, which increases the expansion of the bread volume.

Nutritional Value And Total Calories

The proximate testing results of sweet bread substituted with mocaf, including water, ash, fat, protein, carbohydrate, and total calorie content, are presented in Table 3.

The addition of different amounts of BI significantly affected the SMB moisture content. The moisture content of the sweet bread ranged from 15.40 to 23.00%. These test results still meet the bread quality standards according to SNI 01-3840-1995, which is a maximum of 40%. Making bread using mocaf flour requires the addition of ingredients that can help bind the starch granules to maintain the attractive force between the starch granules and the gas in the dough. (Koswara, 2009). Bread improvers (BI) bind starch granules in dough, ensuring proper gas retention during fermentation. Furthermore, BI contains the enzyme amylase, which breaks down starch into smaller molecules, helping the yeast absorb water and increase gas production in the dough (Chen et al., 2021), and emulsifiers that can strengthen gluten and increase the ability of amylose to retain moisture, thus allowing bread dough to retain more water and produce bread that rises and has a good texture.

Table 3. Effect of the amount of bread improver (BI) on the nutritional value and total calories of sweet bread substituted with mocaf (SMB)

Bread improver (g)	Water content (%)	Ash content (%)	Protein content (%)	Fat content (%)	Carbohydrat content (%)	Calories (kkal/100 g)
P1 (0,0)	15.41±0.18[a]	1.56±0.04[a]	9.07±0.06[a]	11.19±0.20	62.76±0.21[f]	388.11±1.25[e]
P2 (0,2)	16.26±0.11[b]	1.85±0.01[b]	9.22±0.04[b]	11.26±0.12	61.41±0.14[e]	383.87±0.89[d]
P3 (0,4)	17.44±0.14[c]	2.35±0.05[c]	9.53±0.08[c]	11.38±0.19	59.29±0.18[d]	377.79±1.29[c]
P4 (0,6)	18.48±0.14[d]	2.94±0.04[d]	9.75±0.10[d]	11.39±0.20	57.42±0.24[c]	371.28±1.38[b]
P5 (0,8)	20.37±0.07[e]	3.34±0.03[e]	10.02±0.04[e]	11.58±0.20	54.69±0.11[b]	363.09±1.35[a]
PM	23.00±0.50[f]	1.48±0.19[a]	13.52±0.13[f]	11.80±0.30	50.43±0.94[a]	361.10±1.53[a]

Notes: Data (mean ± SD) were obtained from three replicates. Data were analysed by ANOVA. Data within the same column followed by different letter indicate a significant difference (DMRT, $p<0.05$). PM: sweet bread made from 100% wheat flour without mocaf substitution and without the addition of bread improver.

The ash content of the SMB increased with the amount of BI used. Bread improvers also contain minerals such as magnesium, calcium, and potassium. These minerals come from the raw materials in the BI content, such as soybean flour, tapioca, and calcium sulfate. This can enhance the interaction between minerals in the bread dough, resulting in complex compounds that contribute to the increase in the ash content of sweet bread substituted with mocaf.

The protein content of SMB increased with an increase in BI. The protein content of bread is influenced by the type of flour used and the added protein sources, such as milk, eggs, and other additives (Nuraisyah et al., 2018). Mocaf flour has a much lower protein content than high-protein wheat flour, which has approximately 12-14% protein. (Abidin et al., 2013). Therefore, substituting 40% wheat flour with mocaf flour reduced the overall protein content of the sweet bread. In sweet bread preparation, mocaf substitute flour enhances gluten network formation, thereby retaining moisture and improving the dough structure. This improved dough structure allows the proteins from the ingredients to mix evenly and bind tightly within the dough (Kartikasari et al., 2019). Bread improvers contain protein derived from soybean flour, malt, and tapioca flour, although the amounts are small. Therefore, using more BI can increase the protein content of sweet bread substituted for mocaf by 40%.

The fat content of SMB ranged from 11.19% to 11.58%. The addition of BI did not significantly affect SMB fat content. This is because the added BI was in small amounts and contained only a small amount of fat derived from soy flour and tapioca flour. Meanwhile, the largest amount of fat in SMB comes from the ingredients used in making sweet bread, such as eggs, milk, butter, and flour. Therefore, overall, BI did not affect the fat content of SMB. The use of ingredients such as eggs, butter, and milk is important for producing sweet bread that tastes delicious with a soft and fragrant texture (Male et al., 2017). The fat content of the sweet bread was higher than the maximum sweet bread quality standard according to SNI 01-3840-1955, which is 3. The fat content of SMB was also not significantly different from that of PM bread.

The carbohydrate content of SMB ranged from 54.69 to 62.76%. Other nutritional components can also affect the carbohydrate content calculated using the by-difference method (Riskiani et al., 2014). Differences in the carbohydrate content of ingredients, such as flour, also affect the carbohydrate content of sweet bread (Hastian and Basir, 2022). The carbohydrate content of SMB decreased with increasing amounts of added BI and was higher than that of PM bread. Mocaf contains approximately 87.3% carbohydrate, whereas wheat flour contains approximately 60-68% carbohydrate (Dwipayanti et al., 2020).

The total calories of SMB ranged from 363.09 to 388.11 kcal, which was higher than the total calories of PM bread (361.10 kcal). The total calorie content of sweet bread is influenced by nutritional components such as fat, protein, and carbohydrates. The energy obtained from food products is usually expressed in calorie units. The total calories were determined using an empirical calculation method by converting nutritional components, such as fat, protein, and carbohydrates, into kilocalorie units by multiplying these components by a conversion factor. The conversion factors for fat, protein, and carbohydrates are 9, 4, and 4 kcal, respectively (Almatsier, 2002). The higher the amount of BI used in making sweet bread as a mocaf substitute, the lower the total calories of the sweet bread produced. This is because BI increases the functional properties of flour, thereby reducing the need for high-calorie ingredients, such as fat and additional sugar, in the process of making sweet bread.

CONCLUSION

The addition of bread improver had a significant effect ($p<0.05$) on the preference for texture, outer color, inner color, volume expansion, water content, ash content, protein content, carbohydrate content, and total calories of sweet bread with mocaf. There was an increase in water, ash, and protein content and a decrease in carbohydrate and total calorie content with increasing amounts of bread improver added to sweet bread, making it a healthier alternative to bread. Meanwhile, the fat content and bread volume expansion were not affected by the amount of bread improver. From a sensory perspective, sweet bread was preferred for outer color, inner color, aroma, texture, and taste, equaling the preference for sweet bread without mocaf substitution and without the addition of bread improver. The addition of a bread improver at 0.8 g / 100 g produced bread that matched the nutritional value and total calories of sweet bread made from 100% wheat flour (without mocaf substitution).

REFERENCES

Abidin, A.Z., Devi, C., Adeline, 2013. Development of wet noodles based on cassava flour. Journal of Engineering and Technological Sciences 45(1), 97–111. https://doi.org/10.5614/j.eng.technol.sci.2013.45.1.7

Almatsier, S. 2002. Prinsip Dasar Ilmu Gizi. PT Gramedia Pustaka utama, Jakarta.

AOAC., 1995. Official Methods of Analysis of AOAC International. In L. GW (Ed.), Journal Of AOAC International (21 ed., Vol. 1).

BPS, 2023. Impor Biji Gandum dan Meslin menurut Negara Asal Utama, 2017-2022. Badan Pusat Statistik. https://www.bps.go.id/id/statisticstable/1/MjAxNiMx/impor-biji-gandum-dan-meslin-menurut-negara-asal-utama2017-2022.html

Chen, Y., Eder, S., Schubert, S., Gorgerat, S., Boschet, E., Baltensperger, L., Boschet, E., St, C., Kuster, S., Fischer, P., Windhab, E. J., 2021. Influence of amylase addition on bread quality and bread staling. ACS Food Science & Technology 1, 1143–1150. https://doi.org/10.1021/acsfoodscitech.1c00158

Dinas Pangan, Tanaman Pangan, dan Hortikultara, Kalimantan Timur, 2021. Data Pertanian tanaman pangan 2016-2020. Satu Data Kalimantan Timur. https://data.kaltimprov.go.id/dataset/datapertanian-provinsi-kaltim-tahun-2016-2020.

Dwipayanti, H., Agustini, N.P., Antarini, A.A.N., 2020. Pengaruh rasio tepung mocaf dan tepung tempe terhadap karakteristik brownies kukus. Jurnal Ilmu Gizi: Journal of Nutrition Science 11(2), 96–104. https://doi.org/10.33992/jig.v11i2.1185

Fadilah, A.N., Widodo, W., Widodo, A.S., 2015. Sikap konsumen terhadap produk donat berbahan mocaf sebagai pengganti tepung terigu. AGRARIS: Journal of Agribusiness and Rural Development Research 1(2), 149–156. https://doi.org/10.18196/agr.1218

Hastian, Basir, E., 2022. Pengaruh jenis tepung terhadap karakteristik karbohidrat dan organoleptik kerupuk stick tempe. Sultra Journal of Economic and Business 3(1), 79–92.

Helilusiatiningsih, N., 2023. Teknologi pengolahan tepung mocaf dengan 3 metode fermentasi, kajian analisis proksimat. Journal of Food Technology and Agroindustry 5(2), 97–101. https://doi.org/10.24929/jfta.v5i2.2772

Kartikasari, S.N., Sari, P., Subagio, A., 2019. The effect of improver addition on sweet bread made from wheat flour. Food ScienTech Journal 1(1), 8-19. https://doi.org/10.33512/fsj.v1i1.6193

Koswara, S., 2009. Teknologi Pengolahan Roti. eBookPangan. https://tekpan.unimus.ac.id/wp-content/uploads/2013/07/Teknologi-Roti-Teoridan-Praktek.pdf

Kusnedi, R., 2021. Pengaruh penambahan pengembang roti terhadap parameter organoleptik pada pembuatan roti manis. Jurnal British 1(2), 60–71.

Lambert-Meretei, A., Szendrei, E., Nogula-Nagy, M., 2010. Methode to evaluate the effects of bread improver additive on bread crumb texture properties. Acta Alimentaria, An Internasional Journal of Food Science 39(2), 180-191. https://doi.org/10.1556/aalim.39.2010.2.10

Male, U., Naiu, A. S., Yusuf, N., 2017. Karakteristik gizi roti manis ubi jalar dengan penambahan bubur rumput laut. Jurnal Ilmiah Perikanan dan Kelautan, 5(3), 60–64. https://doi.org/10.37905/.v5i3.5282

Natasia, Facrureza, D., 2023. Pengaruh substitusi alpukat mentega dan alpukat pluwang dalam pembuatan sponge cake terhadap daya terima masyarakat dan uji proksimat. Jurnal Manajemen Perhotelan dan Pariwisata 6(2), 468–478.

Nur'utami, D.A., Fitrilia, T., Oktavia, D., 2020. Pengaruh lama fermentasi terhadap karakteristik sensori dan daya kembang roti mocaf (modified cassava flour). Jurnal Agroindustri Halal 6(2), 197–204. https://doi.org/10.30997/jah.v6i2.3255

Nuraisyah, A., Raharja, S., Udin, F., 2018. Karakteristik kimia roti tepung beras dengan tambahan enzim transglutaminase. Jurnal Teknologi Industri Pertanian 28(3), 319–331.

Puspitasari, B.C., Widyastuti, S., Amaro, M., 2023. Pengaruh konsentrasi ragi roti instan dan karagenan terhadap mutu roti tawar tersubstitusi tepung sorgum. Pro Food: Jurnal Ilmu dan Teknologi Pangan 9(1), 33–45. https://doi.org/10.29303/profood.v9i1.296

Putri, D.A., 2023. Review: Evaluasi fisik terhadap penggunaan tepung komposit pada kualitas cookies. Food Scientia Journal of Food Science and Technology 3(1), 1–26.

https://doi.org/10.33830/fsj.v3i1.3696. 2023

Putri, N.P.Y.A.E., Damiati, D., Marsiti, C.I.R., 2021. Uji kualitas red velvet cake dengan menggunakan ekstrak umbi bit (*Beta vulgaris* L.) sebagai bahan pewarna. Jurnal Kuliner 1(1), 1–14. https://doi.org/10.23887/jk.v1i1.32811

Ridhani, M.A., Vidyaningrum, I.P., Akmala, N.N., Fatihatunisa, R., Azzahro, S., Aini, N., 2021. Potensi penambahan berbagai jenis gula terhadap sifat sensori dan fisikokimia roti manis: Review. Pasundan Food Technology Journal 8(3), 61– 68. https://doi.org/ 10.23969/pftj.v8i3.4106

Riskiani, D., Ishartani, D., Affandi, D.R., 2014. Pemanfaatan tepung ubi ganyong (*Canna edulis* Ker.) sebagai pengganti tepung terigu dalam pembuatan biskuit tinggi energi protein dengan penambahan tepung kacang merah (*Phaseolus vulgaris* L.). Jurnal Teknosains Pangan 3(1), 96–105.

Rosalina, L., Suyanto, A., Yusuf, M., 2018. Kadar protein, elastisitas, dan mutu hedonik mie basah dengan substitusi tepung ganyong. Jurnal Pangan dan Gizi 8(1), 1–10. https://doi.org/10.26714/jpg.8.1.2018. 1-10

Setyaningsih, D., Apriyantono, A., Sari, M. P., 2010. Analisis Sensori untuk Industri Pangan dan Agro. IPB Press, Bogor.

Tako, M., Tamaki, Y., Teruya, T., Takeda, Y., 2014. The Principles of starch gelatinization and retrogradation. Food and Nutrition Sciences (5), 280–291. http://doi.org/ 10.4236/fns.2014.53035

Wardani, D.E., Liviawaty, Junianto, 2012. Fortifikasi tepung tulang tuna sebagai sumber kalsium terhadap tingkat kesukaan donat. Jurnal Perikanan dan Kelautan 3(4), 41–50.

Yasa, I.W.S., Zainuri, Z., Zaini, M.A., Hadi, T., 2016. Mutu roti berbahan dasar mocaf: “formulasi dan metode pembuatan adonan". Pro Food: Jurnal Ilmu dan Teknologi Pangan 2(2), 120–126.

Zarkasie, I.M., Prihandini, W.W., Gunawan, S., Aparamarta, H.W., 2017. Pembuatan tepung singkong termodifikasi dengan kapasitas 300.000 ton/tahun. Jurnal Teknik ITS 6(2), 621-623. https://doi.org/10.12962/j23373539.v6i2.24923

Zhang, A., 2020. Effect of wheat flour with different quality in the process of making flour products. International Journal of Metrology and Quality Engineering 11(6), 1-6. https://doi.org/10.1051/ijmqe/2020005