

Formulation and Evaluation of Mocifu (MOCAF-Purple Sweet Potato) Biscuits on Crude Fiber, Reducing Sugar, and Shelf Life

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ABSTRACT

Lifestyle changes in modern society have increased the demand for convenient yet nutritious foods such as biscuits. However, most commercial biscuits still rely on wheat flour, which contains gluten and may trigger allergies and celiac disease. In Indonesia, studies indicate that celiac disease affects approximately 2.8–3.6% of high-risk individuals, underscoring the need for gluten-free alternatives, such as modified cassava flour (MOCAF). This study aimed to evaluate the effect of substituting wheat flour with MOCAF and purple sweet potato on the crude fiber content, reducing sugar, and shelf life of biscuits. A completely randomized design was used with five MOCAF–purple sweet potato ratios (0:100, 25:75, 50:50, 75:25, and 100:0). The parameters tested were crude fiber, reducing sugar, and shelf life. Crude fiber content was determined by the gravimetric method (AOAC 962.09), while reducing sugar content was measured using the Luff-Schoorl method. Each parameter was analysed in triplicate. The shelf life was assessed through periodic sensory, moisture, and color evaluations over six weeks. Data were analysed using one-way ANOVA followed by the LSD at 5% significance. The highest fiber content (56.42% db) was observed in the 75:25 formulation. In contrast, the 100:0 formulation showed the best stability, maintaining low moisture (from 4.77% to 5.91%) and minimal color change ($\Delta E < 3$) after six weeks. Reducing sugar increased with higher proportions of purple sweet potato. This finding suggests that MOCAF and purple sweet potato have a significant impact on the nutritional and storage quality of biscuits. The 75:25 formulation has potential as a high-fiber functional biscuit, whereas the 100:0 formulation provides better storage stability up to 4 weeks at 25 °C.

Keywords: Biscuits; Mocaf; Purple Sweet Potato; Reducing Sugar; Shelf Life

INTRODUCTION

The rapid development of the times is affecting lifestyle changes among Indonesian people, including diets that tend to be unhealthy, such as the consumption of high-fat and low-fiber snacks. (Iferamuna et al., 2019). The modern lifestyle demands food that is practical, quick to eat, but still nutritious and healthy. Unfortunately, most fast food has a low nutritional content and is at risk of triggering health problems such as obesity and metabolic disorders (Setiadi & Ruswanti, 2024). Therefore, the development of food products that are practical and healthy is essential, one of which is biscuits made from alternative ingredients such as MOCAF and purple sweet potato.

Biscuits are a popular product because they have a long shelf life and are easily consumed in various situations. However, the majority of commercial biscuits still use wheat flour as the main ingredient. Wheat flour contains gluten, which is now a concern due to the increasing cases of gluten sensitivity, allergies, and celiac disease—autoimmune disorders that can affect various body systems (Raihan & Makkiyah, 2024; Daley & Haseeb, 2025). Recent Indonesian data show that serological indicators of celiac disease reach around 2.8–3.6% in high-risk groups, highlighting increasing gluten-related health risks in the population (Ahmed et al., 2025; Syam et al., 2024). Along with the increasing demand for gluten-free products, substituting wheat flour with local ingredients, such as MOCAF, is a relevant solution (Setiawan & Jayendra, 2023).

MOCAF (Modified Cassava Flour) is cassava flour produced through enzymatic fermentation, resulting in flour with a neutral aroma, soft texture, and improved techno-functional properties. Compared to conventional cassava flour and even wheat flour, MOCAF exhibits higher viscosity, better gel-forming ability, and greater rehydration and solubility capacities (Anindita et al., 2019; Putri, 2020). As a gluten-free ingredient that also contributes dietary fiber, MOCAF is widely explored as a substitute flour in various bakery products (Finani & Putra, 2023).

In addition to MOCAF, using purple sweet potato as a raw material for biscuits also adds value. Purple sweet potato is a good source of carbohydrates, calories and is rich in crude fiber, which aids digestion (Legowo et al., 2022; Pranova et al., 2022), while its natural sweetness can reduce the need for added sugar in biscuit recipes (Anugrah & Suryani, 2020). Importantly, purple sweet potatoes contain high levels of anthocyanins, which contribute to antioxidant activity, color intensity, and potential color stability during storage. Anthocyanins can also interact with other biscuit components, influencing browning reactions and overall shelf-life characteristics.

To address these nutritional and quality challenges in gluten-free biscuit reformulation, this study focuses on crude fiber, reducing sugar, and storage stability as key analytical parameters. Crude fiber was selected due to its importance in digestive health, as both MOCAF and purple sweet potato naturally contain higher fiber levels than wheat flour. Reducing sugar was examined for its role in Maillard reactions, flavor development, and textural changes during storage. Meanwhile, evaluating storage duration is crucial for assessing physicochemical and sensory stability, as moisture absorption, anthocyanin degradation, and microbial susceptibility can progressively impact product quality.

Despite the promising characteristics of MOCAF and purple sweet potato, fewer than five studies have investigated their combined effects on both nutritional attributes and storage stability in biscuit products. Therefore, this study aims to formulate and evaluate the impact of MOCAF–purple sweet potato (hereafter referred to as Mocifu) ratios on crude fiber content, reducing sugar levels, and shelf-life characteristics of gluten-free biscuits.

METHODS

Materials and Tools

The ingredients used to make Mocifu biscuits include MOCAF, purple sweet potato, powdered sugar, butter, chicken egg yolk, skim milk powder, salt, and water. For the fiber test, H₂SO₄ (0.3N), NaOH (1.5N), deionized water, and acetone were used (Mozin et al., 2019). Luff-Schoorl solution, H₂SO₄ 6N solution, KI powder, Na₂S₂O₃ solution, and amylum were used for the reduction sugar test (Legowo et al., 2022).

The tools used include mixers, basins, ovens and oven pans, measuring cups, forks, measuring spoons, biscuit molds, rolling pins, stoves, steamers, knives, cutting boards, food scales, 250 mL beakers, hotplates, Buchner funnels, filter paper, petri dishes, analytical scales, 100 mL measuring gourds, pipettes, backcoolers, hotplates, erlenmeyer flasks and lids, burettes, stands, and clamps (Legowo et al., 2022; Mozin et al., 2019), moisture analysers, and colorimeters.

Research Design

The research design used was a Complete Random Design (CDR) with different MOCAF and purple sweet potato comparison factors M1, M2, M3, M4, M5 (0:100; 25:75; 50:50; 75:25; 100:0). Each test was repeated three times, and for shelf life, testing was carried out with

organoleptic, moisture content, and color tests periodically for six weeks with two-week intervals. The research stage consists of two stages: the manufacture of Mocifu biscuits based on a predetermined formulation, followed by testing for crude fiber content, reducing sugar, shelf life, and organoleptic properties.

Making biscuits (Legowo et al., 2022) with modifications

The purple sweet potato is washed, then peeled, and weighed according to a predetermined ratio. After that, the sweet potato is steamed until it is cooked, and then it is crushed using a fork. Then, the MOCAF flour is added and mixed until it is evenly distributed. Other ingredients, such as butter, milk powder, powdered sugar, salt, and egg yolks, are added and mixed until evenly distributed using a mixer for 2 minutes. The biscuit formulation is shown in Table 1.

Table 1. Mocifu Biscuits Formulation (MOCAF: Purple sweet potato)

Ingredients	M1 (0:100)	M2 (25:75)	M3 (50:50)	M4 (75:25)	M5 (100:0)
MOCAF (g)	0	25	50	75	100
Purple sweet potato (g)	100	75	50	25	0
Butter (g)	25	25	25	25	25
Skim milk powder (g)	15	15	15	15	15
Powdered sugar (g)	35	35	35	35	35
Salt (tsp)	½	½	½	½	½
Egg yolk (piece)	1	1	1	1	1
Water (mL)	0	0	0	10	35

After all the ingredients are well mixed, the dough is rolled out using a rolling pin until it reaches a thickness of approximately 2–3 mm. It is then molded into a biscuit shape using a biscuit mold. The molded dough is then baked in the oven at approximately 120°C for 20 minutes. The cooked biscuits are then removed and cooled before serving. Before further testing, formulations are selected first based on the dough's ability to maintain its shape during printing and ease of handling during the manufacturing process. Formulations that do not meet basic physical criteria, such as dough that is too mushy to cause the biscuit to expand and not form properly, are not advanced to the next stage of testing.

Test Parameters

The parameters of the biscuit test set are crude fiber, reducing sugar, estimated shelf life, and the fresh Mocifu organoleptic test. Estimation of the shelf life was based on organoleptic tests during storage, moisture content, and ΔE values.

Crude fiber (Mozin et al., 2019)

A 1-gram sample of Mocifu biscuits was weighed and placed into a 250 mL beaker, then 50 mL of 0.3N H₂SO₄ was added. The mixture was heated at 70°C for 1 hour. Next, 2 mL of 1.5 M NaOH was added, and the mixture was heated for an additional 30 minutes at 70°C. The solution was filtered using a Buchner funnel. During filtration, the sediment was washed successively with hot water, 50 mL of 0.3N H₂SO₄, and 25 mL of acetone. The filter paper with the residue was then placed in a petri dish and dried in an oven at 105°C for 1 hour. After cooling, the residue was weighed. The crude fiber content was calculated using the appropriate formula.

$$\text{Crude fiber (\%)} = (W_2 - W_1)/W_0 \times 100 \quad (1)$$

where W_2 is the filter paper weight + sample after oven, W_1 is the filter paper weight, and W_0 is the sample weight.

Reducing Sugar (Legowo et al., 2022)

Reducing sugar testing utilizes the Luff-Schoorl method. A total of 1 g of sample was weighed and diluted in a 100 mL measuring flask. Then, the solution is taken in 50 mL and diluted by adding 10 mL of Luff-Schoorl solution, and then covered with a reverse coolant. The solution is then heated using a hotplate to a boil and then allowed to cool for 10 minutes. After heating, cool the solution quickly. Add 10 mL of 6N H_2SO_4 to the solution, transfer it to a sealed Erlenmeyer flask, and then add a spoonful of KI powder. The solution is then titrated using $Na_2S_2O_3$ until it forms a yellowish color. 1 mL of amylum is added to it, and the solution is titrated again until it becomes milky white. A blank determination was performed using the same procedure, but without the sample, to obtain the blank volume of $Na_2S_2O_3$. The actual titration value was calculated by subtracting the sample titration volume from the blank value.

The glucose content was calculated using the standard Luff-Schoorl glucose conversion table, based on the corrected volume of sodium thiosulfate ($Na_2S_2O_3$). Sugar content was expressed as:

$$\text{Sugar content} = \text{mg glucose (from table)} \times (\text{dilution factor/pipette volume}) \times (2) \\ (100/\text{sample mass (g)}) \times (1/1000)$$

The mg-glucose value was obtained by matching the corrected titration volume with the corresponding value in the Luff-Schoorl standard table.

Fresh Mocifu Organoleptic

The organoleptic test on fresh Mocifu biscuits (which have not been stored) was conducted using human sensory evaluation, including sight, taste, and aroma perception. A total of 32 untrained panellists participated in this evaluation. A hedonic preference test was applied to assess color, aroma, taste, texture, and overall acceptability using a **5-point hedonic scale**, where 1 indicates a very strong dislike, 2 a dislike, 3 a neutral response, 4 a like, and 5 a very strong like.

Estimated Shelf Life

The shelf-life evaluation was conducted over a 6-week storage period at 25 ± 2 °C and 65–70% relative humidity (RH). Biscuit samples were packaged in food-grade polypropylene (PP) jars with screw caps to limit moisture uptake during storage. Observations were conducted every 2 weeks, consisting of organoleptic assessments, moisture analyses, and color measurements. The organoleptic test involved 32 untrained panellists and assessed parameters such as color, aroma, taste, texture, and overall quality using a **9-point quality scale**, with higher scores indicating better quality. Fresh product acceptability was evaluated using a 5-point hedonic scale, while shelf-life sensory evaluation utilized a 9-point quality scale to better capture the gradual quality changes that occur during storage.

The moisture content of the samples was determined using a moisture analyser, following the SNI 2009 standard, which specifies that the maximum acceptable moisture content for

biscuits is 5% (Tahar et al., 2017). Color was measured using a colorimeter, where L^* indicates brightness, a^* represents positive red and negative green, and b^* indicates positive yellow and negative blue. After obtaining the L^* , a^* , and b^* values, the color difference between samples was calculated using the appropriate formula (Hiller, 2019).

$$\Delta E = \sqrt{(L_1^* - L_2^*)^2 + (a_1^* - a_2^*)^2 + (b_1^* - b_2^*)^2} \quad (3)$$

where L_1^* , a_1^* , and b_1^* represent the initial color values of the biscuits at week 0, and L_2^* , a_2^* , and b_2^* represent the color values after storage at each evaluation interval.

Data Analysis

Data acquisition was analysed using One-Way ANOVA. If a difference is observed, the test continues to the *Least Significant Difference* (LSD) with a 95% confidence interval. Statistical analyses were performed using SPSS software version 22.

RESULTS AND DISCUSSIONS

The results of making biscuits are shown in Figure 1. It can be seen that the M1 formulation product (purple sweet potato flour without MOCAF) produces a dough with a very soft texture that cannot hold its shape when pressed, resulting in a broad and uneven biscuit shape. This formulation differs from others, which produce dough with a more suitable consistency, allowing the biscuit shape to be maintained after molding and baking. Based on these results, the M1 formulation was excluded from further analysis because it did not meet the established physical criteria. Meanwhile, the M2 formulation also produced a relatively soft dough that could not be shaped using a biscuit cutter; however, unlike M1, it still formed a coherent structure during baking and did not spread excessively. Although its shape differed from typical biscuits due to being piped rather than molded, the product maintained adequate structural integrity, allowing it to be included in further physicochemical and sensory evaluations.



Figure 1. Appearance of Mocifu Biscuits Formulation (MOCAF: Purple Sweet Potatoes)

Crude Fiber

Although crude fiber represents only a portion of total dietary fiber, it is commonly used as an indicator of insoluble fiber contribution in processed food products. In this study, crude fiber content was evaluated to compare the relative fiber characteristics among biscuit formulations derived from MOCAF and purple sweet potato. The results of crude fiber analysis for different formulations are presented in Table 2.

Table 2. Crude Fiber and Reducing Sugar of Mocifu Biscuits

Treatments	Crude fiber (% dry basis)	Reducing sugar (%)
M5	46.75 ± 2,30 ^b	8.12 ± 0,01 ^a
M4	56.42 ± 2,53 ^c	14.14 ± 1,20 ^b
M3	35.15 ± 3,84 ^a	15.42 ± 1,46 ^b
M2	32.74 ± 3,37 ^a	14.97 ± 1,35 ^b

Different superscript letters in the same column show a marked difference based on the LSD test at a significance level of 5% ($p < 0.05$)

The variation in crude fiber content in biscuits from each formulation can be influenced by the proportion of MOCAF and purple sweet potato used. MOCAF is known to contain approximately 6% dietary fiber, which is significantly higher than wheat flour (0.3%) (Mahmudah et al., 2024). Purple sweet potatoes also have a relatively high fiber content, ranging from 9.4% to 16.5%. However, the use of high amounts of purple sweet potatoes tends to lower the measured fiber levels after processing. The phenomenon is due to thermal processing processes, such as steaming, which causes the starch granules to expand, break down the cell structure, and damage the fiber tissue. According to Zhang et al. (2023), steaming of purple sweet potato can induce the disintegration of granules and the formation of microfibrillar structures, signalling the degradation of crude fibers. These findings are also in line with the research of Legowo et al. (2022), which stated that the use of high amounts of purple sweet potato flour tends to reduce the final fiber content.

MOCAF has an insoluble fiber content (Soewondo et al., 2023) that can maintain its fiber structure even when exposed to high-temperature processing (Daley & Haseeb, 2025; Yang et al., 2023) in contrast to purple sweet potatoes, whose fiber is more susceptible to degradation (Zhang et al., 2023). The higher crude fiber content observed in the M5 formulation relative to M2–M4 is due to its 100% MOCAF composition, which retains fiber integrity during baking, whereas formulations containing more purple sweet potato (M2–M4) experience fiber degradation from thermal processing, offsetting the naturally higher fiber content of the purple sweet potato. Thus, the difference in fiber content between formulas is primarily due to the inherent properties of the ingredients, thermal treatment, and the interaction of these ingredients during the biscuit-making process.

Reducing Sugar

Reducing sugar content is a type of sugar that can act as a reducing agent because it has a free aldehyde or ketone group (Ridhani et al., 2021). Testing was conducted to assess the impact of using naturally sweet purple sweet potatoes on the sugar content in biscuits (Anugrah & Suryani, 2020). As shown in Table 2, reducing sugar level increased with higher proportions of purple sweet potato, with M3 recording the highest content. The 100% MOCAF formulation (M5) had the lowest sugar content due to the absence of purple sweet potato, and MOCAF itself contributes minimal residual sugar after fermentation. This explains the deviation of M5 from the trend observed in other formulations. Heating during baking may also partially hydrolyse starch into simple sugars, but the effect is minimal in MOCAF-based biscuits (Wei et al., 2017). Overall, incorporating purple sweet potato enhances natural sweetness and is important for both the nutritional and sensory quality of the biscuits, consistent with previous

findings (Legowo et al., 2022).

Fresh Mocifu Organoleptic Test

The overall sensory results are shown in Table 3. Organoleptic tests were conducted to determine panelists' preferences among five biscuit formulations by assessing color, aroma, taste, texture, and overall liking. The results suggest that each formula exhibits distinct strengths across various attributes.

Regarding the color attribute, the sample M3 scored the highest, indicating that the balanced blend of MOCAF and purple sweet potato creates the most visually appealing biscuit for the panellists. For the scent attribute, the M2 and M3 samples achieved the same superscript high score, likely due to the distinctive aroma of purple sweet potato, which becomes more prominent as its proportion increases. The high volatile compound content in purple sweet potatoes also enhances its aroma. According to Jiang et al. (2024), after processing, 54 volatile compounds were identified in purple sweet potato, with aldehydes and terpenes being the main contributors, making them the dominant aroma indicators. The taste attribute showed that sample M2 received the highest score, indicating that panellists preferred the sweetness contributed by the purple sweet potato. Samples M3 and M4 were rated moderately and were not significantly different from M2, suggesting that while the natural sugar in purple sweet potato enhances sweetness, the difference among these formulations was not statistically significant. Sample M5 had the lowest taste score. All samples had similar texture scores, showing comparable crispiness and density. Regarding overall liking, M4 scored slightly higher than M3 and M2, but the differences were not statistically significant, suggesting that M3 and M4 provided a balanced impression across visual appeal, taste, and texture. Sample M5 was slightly less preferred overall but did not differ significantly from the other formulations.

Table 3. Organoleptic Test of Fresh Mocifu

Treatments	Colors	Aromas	Tastes	Textures	Overall
M5	3,56 ± 0,8 ^b	3,19 ± 1,12 ^b	2,94 ± 1,08 ^b	3,09 ± 1,0 ^a	3,28 ± 0,77 ^a
M4	3,5 ± 0,72 ^b	3,16 ± 1,05 ^b	3,34 ± 1,0 ^{ab}	3,22 ± 0,94 ^a	3,66 ± 0,87 ^a
M3	4,0 ± 0,98 ^a	3,44 ± 0,72 ^a	3,31 ± 0,9 ^{ab}	2,91 ± 0,93 ^a	3,56 ± 0,8 ^a
M2	3,5 ± 0,95 ^b	3,50 ± 0,8 ^a	3,69 ± 0,95 ^a	3,16 ± 0,95 ^a	3,53 ± 0,8 ^a

Different superscript letters in the same column show a marked difference based on the LSD test at a significance level of 5% ($p < 0.05$)

Estimated shelf life

The shelf life of the biscuit products is evaluated based on their ability to maintain sensory quality, moisture content, and color stability during storage. This assessment is essential to ensure the product remains safe to eat over a specific period without significant quality deterioration. The results of the shelf life evaluation during storage are detailed in Figure 2 (color), Figure 3 (aroma), Figure 4 (taste), Figure 5 (texture), Figure 6 (overall), Figure 7 (moisture content), and Figure 8 (total color change ΔE), observed over six weeks at two-week intervals. The comprehensive data are displayed as follows:

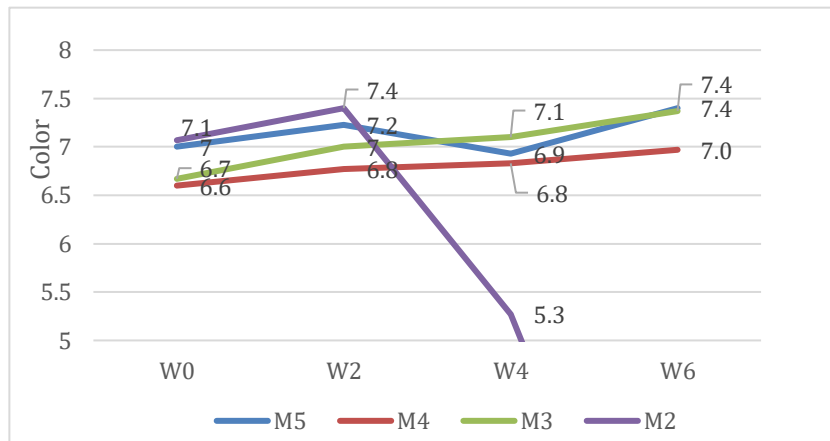


Figure 2. Evaluation of the color aspect of the biscuits during storage

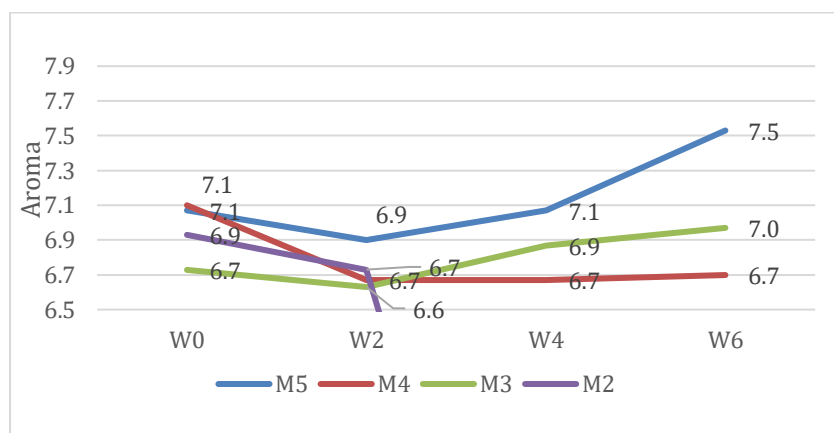


Figure 3. Assessment of the aroma aspect of the biscuit during storage

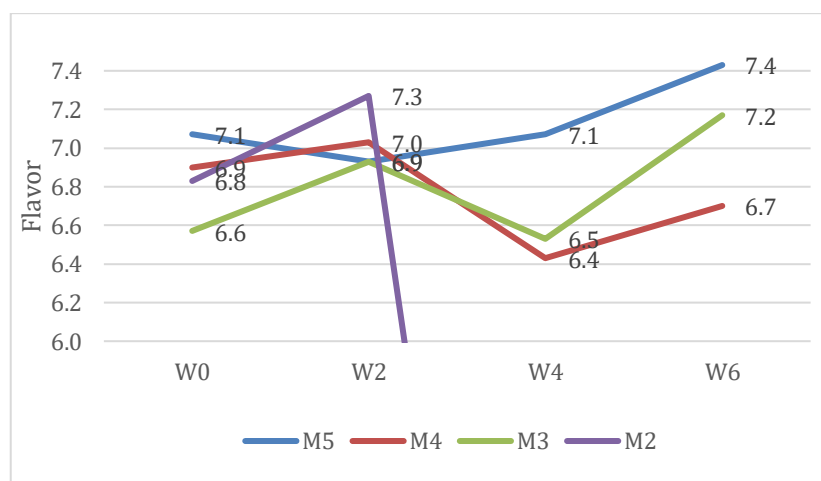


Figure 4. Evaluation of the flavor aspect of biscuits during storage

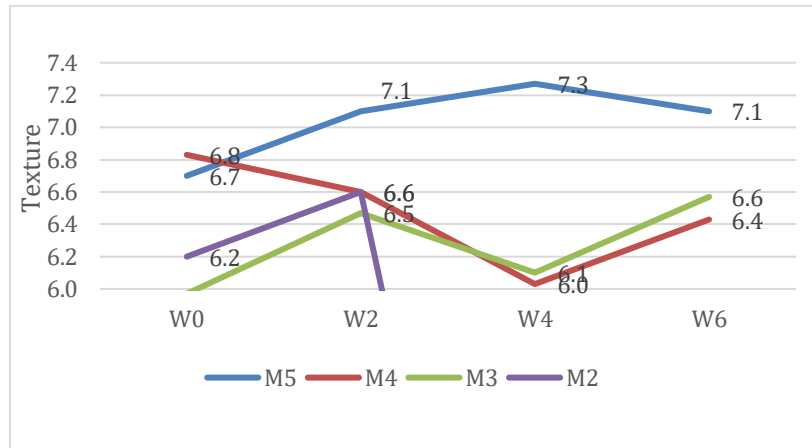


Figure 5. Assessment of the texture aspect of biscuit during storage

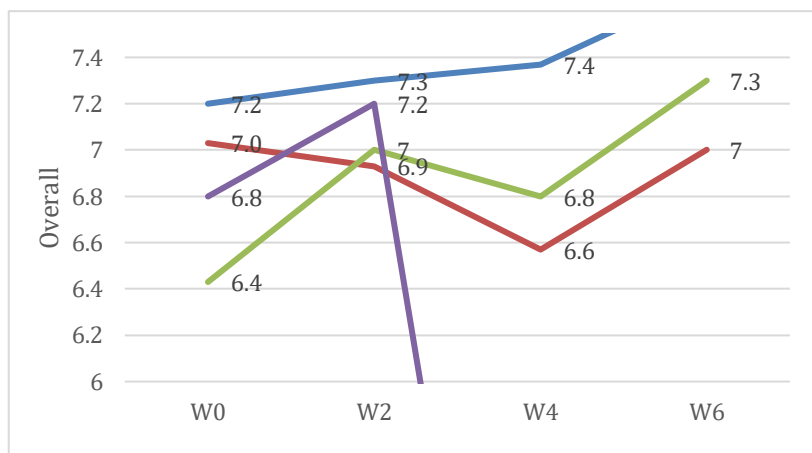


Figure 6. Reception of the overall aspect of the biscuit during storage

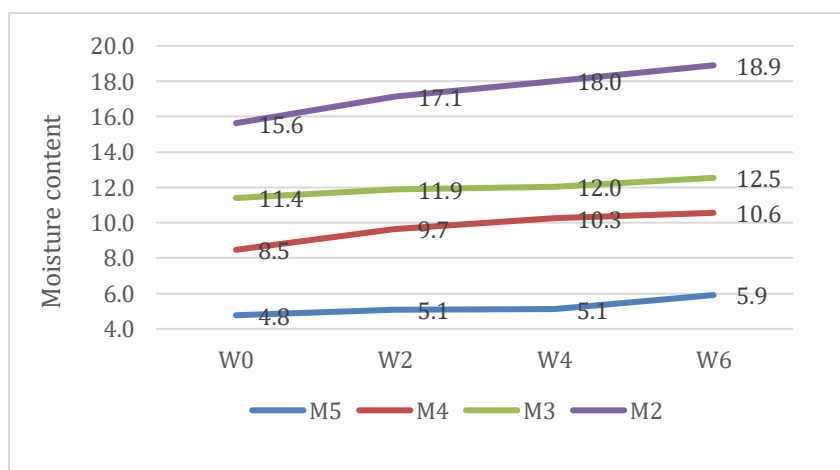


Figure 7. Moisture content of biscuits during storage

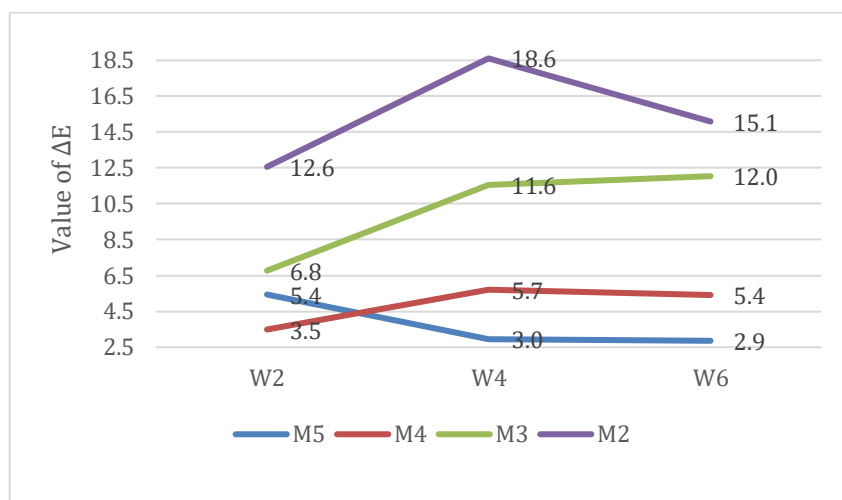


Figure 8. Value of ΔE biscuits during storage

Based on the results of organoleptic tests during storage, the formulation of M5 showed the most stable score across all parameters until week 6. The result suggests that products with a 100% MOCFAF composition can effectively preserve sensory quality. However, the formulation M2 exhibited a significant decrease in score starting from week 4, with some parameters dropping sharply. By week 6, all sensory parameters had experienced a decline in score of 1.00 ± 0.00 . This decline is caused by physical deterioration, including changes in color to a duller or darker shade, a rough texture due to increased moisture, and the development of an unpleasant aroma resulting from fungal growth on the biscuits. The MOCFAF formulations with purple sweet potato at M3 and M4 showed moderate stability, maintaining overall scores close to 6. It suggests that using MOCFAF in high proportions can help preserve the sensory quality of the biscuits for a more extended period during storage.

The moisture content of the entire formulation increases during storage. The M5 formulation exhibited the lowest and most stable moisture content, with values of $4.77 \pm 0.26\%$ in week 0 and $5.11 \pm 0.09\%$ at week 4. Importantly, M5 was the only formulation that maintained moisture content at or below the 5% maximum limit for biscuits as specified in SNI 2973:2009 (Tahar et al., 2017). In contrast, the M2 formulation has increased drastically, reaching $18.90 \pm 0.63\%$ in week 6. The high moisture content increases the moisture of the product, causes the texture to become mushy, and creates an environment that supports the growth of microorganisms (de Morais et al., 2018; Kathalsar et al., 2020). The moisture content in the product is likely a primary cause of the drastic decline in organoleptic quality in the formula. The formulations of M3 and M4 also exhibited a relatively high increase in moisture content, although not as rapid as that of the M2 formulation. This difference in the stability of the moisture content is related to the nature of the raw material. Purple sweet potatoes have a high water content, ranging from 60.9% to 70.1% (Xu et al., 2024), whereas MOCFAF has a low water content, with values of 13.3% to 13.8% (Diniyah et al., 2018).

Total color change (ΔE) reflects the extent to which the color of the biscuit changes from the initial condition (Pandiselvam et al., 2023). The formulation of M5 recorded a ΔE of 5.44 ± 1.37 in the 2nd week, then decreased to 2.95 ± 1.91 in the 4th week and 2.86 ± 1.28 in the 6th week. This decrease indicates that, after a slight discoloration at the beginning of storage, the product's color becomes more stable, approaching its original state. The M2 formulation experienced a ΔE of 12.56 ± 1.02 in the 2nd week, which increased sharply to 18.61 ± 6.21 in the 4th week, then decreased to 15.09 ± 1.73 in the 6th week. According to Minaker et al.,

(2021), ΔE values greater than 3 are perceptible to the human eye, while $\Delta E > 12$ indicates very noticeable and visually striking color changes.

Color deterioration in purple sweet potato-containing formulations is strongly influenced by anthocyanin degradation. Anthocyanins are sensitive to pH, light, oxidation, and water activity, and their degradation follows first-order kinetic behavior, in which the pigment concentration decreases exponentially over time (Enaru et al., 2021). Higher moisture content accelerates anthocyanin breakdown through increased molecular mobility and enhanced oxidative reactions. This explains the sharp color change in the M2 formulation, which had the highest moisture content during storage. According to (Sun et al., 2020; Xue et al., 2024) that the moisture content directly affects anthocyanin stability.

These three parameters, organoleptic scores, moisture content, and total color change, are interrelated. The M2 formulation, which experienced the highest increase in moisture content, also exhibited the most significant discoloration and a drastic decrease in organoleptic scores, particularly after week 4. Meanwhile, the formulation of M5, which had a stable moisture content, exhibited high color stability and an organoleptic score until week 6. Minaker et al., (2021) further emphasized that ΔE values exceeding 12 produce visually striking changes that significantly affect overall product perception.

Based on the results of organoleptic observations, moisture content, and ΔE values, the formulation of M5 is considered to have the longest shelf life and the most stable quality for at least four weeks of storage at room temperature ($\approx 25^\circ\text{C}$). This formulation maintains low moisture content, stable color attributes, and good sensory performance during storage. Meanwhile, the formulation of M2 remains acceptable only up to the 2nd week, as it exhibits a drastic change in all evaluated parameters. In comparison, M3 and M4 are still acceptable up to week four, although quality degradation begins to appear thereafter, indicating a shorter stability than M5.

CONCLUSION

Addition of MOCAF to purple sweet potato improved the nutritional potential and storage performance of the biscuits. The M4 formulation yielded the best balance between fibre content and acceptable sensory quality, while the M5 formulation demonstrated superior stability during storage, particularly in terms of moisture retention and colour changes. Notably, the 100% MOCAF (M5) formulation remained acceptable for up to four weeks of storage at room temperature ($\approx 25^\circ\text{C}$), based on moisture content, sensory evaluation, and color stability. In this context, Mocifu biscuits may be considered a *health-oriented snack alternative*, not solely based on fiber levels, but also due to the use of naturally gluten-free local raw materials that support dietary diversity and contribute to fibre intake when compared to conventional wheat-based biscuits. Nevertheless, future studies should analyse total dietary fibre (TDF) to further validate and strengthen nutritional claims.

The findings of this study highlight the feasibility of MOCAF-based gluten-free biscuits for industrial and SME-scale production, especially as an affordable and accessible functional snack alternative. Further optimization is recommended to control moisture accumulation during storage, evaluate sugar reduction strategies, and improve packaging to extend shelf life stability.

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