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Effect of Mocaf Flour and Tiwai Onion Formulation on Fiber, Antioxidant Activity, and Organoleptic Properties of Onion Sticks

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ABSTRACT:
Background: Diabetes mellitus is a degenerative disease with a high prevalence in Indonesia. Efforts to control blood glucose levels can be achieved by consuming foods with a low glycemic index, high fiber, and rich in antioxidants. Mocaf flour has a lower glycemic index and higher fiber content than wheat flour, while Tiwai onions are rich in flavonoids and phenolic compounds, which act as natural antioxidants.
Aims: This study aims to determine the effect of mocaf flour and tiwai onion formulation on fiber content, antioxidant activity, and organoleptic characteristics of onion sticks, as well as to determine the best formula.
Methods: This study used an experimental design with a Completely Randomized Design (CRD) of three treatments and three replications. The treatment formulations were F1 (48 g mocaf : 15 g tiwai onion), F2 (42 g mocaf : 21 g tiwai onion), and F3 (36 g mocaf : 27 g tiwai onion). Fiber content analysis was carried out using the gravimetric enzymatic method, antioxidant activity using the DPPH method, and organoleptic tests were carried out on 30 untrained panelists using a hedonic scale. Data were analyzed using ANOVA and further tests were carried out if there were significant differences.
Result: The results showed that the formulation affected fiber content, antioxidant activity, and organoleptic properties. Formulation F1 produced the highest fiber content (2.28%) and the best acceptability in terms of taste and texture. Formulation F3 had the highest antioxidant activity (190.13 μg/ml) and the most preferred color by panelists. This indicates that increasing the mocaf composition increases fiber content, while the addition of tiwai onions strengthens antioxidant activity.
Conclusion: The combination of mocaf flour and Tiwai onions has the potential to produce onion sticks, a healthy, functional snack that consumers will love. This product can be used as a local food alternative to support diet management for people with diabetes mellitus and to strengthen the use of local food ingredients in nutrition and dietetics innovations.

Keywords: Mocaf Flour, Tiwai Onion, Onion Sticks, Fiber Content, Antioxidant Activity, Organoleptic

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INTRODUCTION

Diabetes mellitus is a global health problem that continues to increase from year to year.(Nurmaguphita & Sugiyanto, 2019; Rosyid et al., 2019; Safaruddin & Permatasari, 2022)According to the International Diabetes Federation (IDF) in 2021, there were 537 million people aged 20–79 living with diabetes, and Indonesia ranked fifth with 19.47 million sufferers.(Ginting & Fernanda, 2024; Meilani et al., 2023; Rizky et al., 2024)This situation requires alternative foods that can help control blood glucose levels through low glycemic index, high fiber, and antioxidant-rich foods.(Afifah et al., 2020; Agustina & Anjani, 2017; Marlina et al., 2019; Puspita et al., 2020).

However, the current consumption patterns of Indonesian people tend to shift towards instant foods and foods high in simple carbohydrates which have a high glycemic index.(Ariyani, 2019; Inayah et al., 2021; Mado et al., 2020)Onion sticks, a popular snack, are generally made from wheat flour, which is low in fiber and unsuitable for people with diabetes. This highlights the gap between the ideal practice of consuming low-glycemic index foods and the actual conditions faced by the community.

Amidst these conditions, Indonesia has a significant opportunity to develop functional food products utilizing local ingredients with high nutritional value. Cassava, which can be processed into mocaf flour, is a key ingredient.(Asmoro, 2021; Dina et al., 2023; Nazriati et al., 2021), has a low glycemic index and high fiber content, making it a potential substitute for wheat flour. Furthermore, shallots, a plant native to Kalimantan, are known to be rich in bioactive compounds, including flavonoids and phenolics, which act as antioxidants.(Bone et al., 2019; Fridayanti et al., 2017; Prasetya, 2023)The combination of these two ingredients opens up the possibility of creating a healthier, functional snack in the form of onion sticks.

Several previous studies have examined the use of mocaf (mocaf) and other local food ingredients such as moringa leaves, ginseng, and snakehead fish in stick products. However, these studies focused more on assessing physicochemical and organoleptic aspects without comprehensively measuring fiber content and antioxidant activity.(Annisa & Rahayu, 2022; Kristanti et al., 2020; Putri et al., 2022)This creates a research gap that can be filled through this study, so that its novelty lies in the analysis of the combination of mocaf and tiwai onions on fiber, antioxidant activity, and organoleptic characteristics of onion sticks.

The choice of Mocaf flour and shallots was not arbitrary. Mocaf flour has a low glycemic index and 6 g of fiber per 100 g, and shallots have strong antioxidant activity with an IC50 value of 41.46 ppm. By combining these ingredients, we hope to produce onion sticks that are organoleptically appealing and have functional value that supports blood glucose control in diabetics. This study's novelty lies in its comprehensive analysis of mocaf flour and tiwai onion formulations and their combined effects on the fiber content, antioxidant activity, and organoleptic characteristics of onion sticks. Previous research has not investigated this combination.

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METHOD

Research Design

This study employed a completely randomized design (CRD) for experiments. Three formulations of onion sticks made from mocaf flour and tiwai onions were used, each with three replications. Parameters tested included fiber content, antioxidant activity, and organoleptic characteristics.

Participant

The panelists in this study were 30 untrained panelists. They participated in organoleptic tests to assess the color, aroma, taste, and texture of the onion stick product.

Population and the methods of sampling Instrumentation

The study population consisted of onion stick products formulated with mocaf flour and tiwai onions. The sampling method was purposive sampling of panelists willing to participate in the organoleptic test. The test instrument was a hedonic assessment questionnaire with a scale of 1–5 (1 = dislike very much, 5 = like very much). The instrument's validity was based on the organoleptic (hedonic) test standards, while its reliability was demonstrated through the consistency of the panelists' assessment results.

Instrument

The instruments used in this study include:

- Organoleptic test sheet (color, aroma, taste, texture).
- Gravimetric enzymatic method for fiber content analysis.
- DPPH (2,2-diphenyl-1-picrylhydrazyl) method for analysis of antioxidant activity.

Procedures and if relevant, the time frame

The research was conducted in January–April 2025 in several laboratories:

- Food Science Laboratory of the East Kalimantan Ministry of Health Polytechnic for making onion sticks.
- Postharvest and Agricultural Product Packaging Laboratory, Mulawarman University for antioxidant activity testing.
- Jember State Polytechnic Food Analysis Laboratory for dietary fiber content testing. The research procedure includes the stages of making onion sticks according to the formulation (F1, F2, F3), fiber testing, antioxidant testing, and organoleptic testing by panelists.

Analysis plan

The research data were analyzed using ANOVA with a 95% confidence level to determine the effect of different formulations on fiber content, antioxidant activity, and organoleptic properties. If significant differences were found, further testing (post hoc testing) was conducted to determine the best treatment.

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RESULTS AND DISCUSSION

Result

This study produced data on the organoleptic characteristics, fiber content, and antioxidant activity of onion sticks made from mocaf flour and tiwai onions..

1. Organoleptic Test Results

Organoleptic tests were conducted by 30 untrained panelists on color, aroma, taste, and texture for three formulations (F1, F2, and F3). The average results are shown in Table 1.1.

Table 1.1 Organoleptic Test Results of Onion Sticks

Treatment	Color (Mean ± SD)	Aroma (Mean ± SD)	Taste (Mean ± SD)	Texture (Mean ± SD)
F1 (48 g mocaf : 15 g tiwai onion)	3.50 ±	3.40 ±	3.38 ±	3.99 ±
F2 (42 g mocaf : 21 g tiwai onion)	3.80 ±	3.43 ±	3.10 ±	3.50 ±
F3 (36 g mocaf : 27 g tiwai onion)	4.17 ±	3.24 ±	2.63 ±	2.86 ±

Description: Scale 1–5 (1 = dislike very much, 5 = like very much).

The results showed that the most preferred color was in F3 (4.17 – like), the highest aroma was in F2 (3.43 – neutral), the highest taste was in F1 (3.38 – neutral), and the best texture was also in F1 (3.99 – neutral).

2. Fiber Content Test Results

Fiber content testing was conducted using an enzymatic gravimetric method. The results of the fiber content analysis for the three onion stick formulations are shown in Table 2.1.

Table 2.1 Fiber Content of Onion Sticks (%)

Treatment	Fiber content (%)
F1 (48 g mocaf : 15 g tiwai onion)	2.28
F2 (42 g mocaf : 21 g tiwai onion)	1.95
F3 (36 g mocaf : 27 g tiwai onion)	1.72

The analysis results showed that F1 had the highest fiber content, at 2.28%. This was due to the higher mocaf composition compared to the other treatments.

3. Antioxidant Activity Test Results

Antioxidant activity testing was performed using the DPPH method. Antioxidant activity values are shown in Table 3.1.

Table 3. Antioxidant Activity of Onion Sticks (µg/ml)

Treatment	Antioxidant Activity (µg/ml)
F1 (48 g mocaf : 15 g tiwai onion)	120.45
F2 (42 g mocaf : 21 g tiwai onion)	155.87
F3 (36 g mocaf : 27 g tiwai onion)	190.13

The results showed that the higher the addition of red onion, the higher the antioxidant activity. The highest value was found in F3, with a result of 190.13 µg/ml.

Overall, formulation F1 yielded the best results in terms of fiber content, flavor, and texture, while F3 produced higher antioxidant levels and color. This indicates that the combination of mocaf flour and Tiwai shallots can affect the nutritional and organoleptic qualities of the onion sticks depending on the proportions used.

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Discussion

The results of this study indicate that the formulation of mocaf flour and tiwai shallots significantly affected the fiber content, antioxidant activity, and organoleptic characteristics of the onion sticks. These findings have important implications for the development of functional foods, particularly for people with diabetes mellitus.(Jenkins et al., 1976), confirmed that water-soluble fiber can slow glucose absorption and reduce insulin response, so the presence of the highest fiber content in formulation F1 (2.28%) strengthens the role of mocaf flour in glycemic control. On the other hand, the high antioxidant activity in formulation F3 (190.13 μg/ml) in accordance with flavonoids and phenolics act as free radical scavengers, thus protecting body tissues from oxidative damage.(Mudjiran & Karneli, 2024; Suryanto & Wehantouw, 2019; Zahra et al., 2021)Thus, the combination of mocaf and Tiwai onions not only provides basic nutritional value but also physiological functions that support health.

This research's contribution lies in expanding the study of functional foods based on local ingredients. Unlike previous studies that focused solely on physicochemical and organoleptic aspects, this study integrates fiber analysis and antioxidant activity, providing a more comprehensive understanding. This aligns with Roberfroid's (2000) concept of functional foods, which defines functional foods as foods that not only have nutritional value but also provide additional health benefits.(Kusumayanti et al., 2018; Sihite & Hutasoit, 2023; Zulaikhah & Sidhi, 2021)With this discovery, the public can access a healthy snack alternative that is low in glycemic index, rich in fiber, and high in antioxidants, while also supporting efforts to utilize local resources such as cassava and shallots.

In practical terms, developing onion sticks based on mocaf and tiwai onions contributes to diversifying local functional foods. It expands the use of cassava and native plants while offering consumers healthier alternatives to wheat-based snacks. However, the current results should be interpreted with caution due to several limitations. First, the organoleptic evaluation was conducted with only 30 untrained panelists, who may not have accurately captured consumer preferences. Second, the nutritional analysis was limited to fiber and antioxidant activity. Important parameters, such as the glycemic index, protein content, and fat content, were not measured. Third, no physiological trials were conducted to directly assess the impact of product consumption on diabetic patients.

Future research should therefore include a more comprehensive nutritional profile, clinical trials involving diabetic populations, and a larger trained sensory panel to ensure more reliable consumer insights. Studies on shelf-life stability and packaging innovations are also necessary to enhance the product's practical and commercial value.

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CONCLUSION

This study proves that the formulation of mocaf flour and shallots affects the fiber content, antioxidant activity, and organoleptic characteristics of shallot sticks. Formulation F1 (48 g mocaf : 15 g shallots) provides the highest fiber content as well as the best acceptability in taste and texture, while formulation F3 (36 g mocaf : 27 g shallots) produces the highest antioxidant activity and color. This shows that the higher the proportion of mocaf, the greater the fiber content produced, while the increase in shallots contributes to increased antioxidant activity.

Thus, the combination of mocaf flour and shallots has the potential to produce a functional snack that is not only organoleptically appealing but also beneficial in supporting a healthy diet, particularly for people with diabetes mellitus. This research underscores the importance of utilizing local food ingredients as innovative nutritional and dietetic products that support both public health and food security.

AUTHOR CONTRIBUTION STATEMENT

KAN designed the study, collected data, and wrote the main manuscript. RPU provided guidance in research design, data analysis, and theoretical framework development. ES supervised the methodological process, guided the interpretation of the results, and revised the final manuscript. All authors read and approved the manuscript for publication.

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