Journal of Allied Health Disciplines 2025, 1(9), 1-5

Nutritional Composition of Noodles Made from Mocaf and Mocaf-Tempe

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ABSTRACT

According to the data from the World Instant Noodles Association (WINA), Indonesia is ranked as the second-largest consumer of instant noodles in the world in 2023. However, most noodles in Indonesia are made from imported grains, thus there should be a substitution for this flour to minimize grain imports. This study aimed to evaluate the nutritional composition of noodles made from Modified Cassava Flour (MOCAF) and MOCAF-tempe, two locally sourced Indonesian ingredients. The analysis focused on protein, fat, carbohydrate, and total energy content using proximate method. Results showed that MOCAF-tempe noodles had higher protein, fat, and energy content, while carbohydrate content decreased compared to noodles made solely from MOCAF. MOCAF-tempeh noodle had significantly higher protein content as compared to the commercial instant noodles. The protein content in MOCAF-tempe noodles met the Indonesian National Standard for instant noodles, indicating improved compliance with the nutritional guidelines. These findings highlight the potential of utilizing locally available, sustainable ingredients to develop functional and protein-enriched noodles. Incorporating tempe into MOCAF-based noodles produces a more nutritious instant noodle product with improved macronutrient balance and energy content, providing a healthier alternative to conventional wheat-based noodles while promoting the use of local food resources.

Keywords: Instant Noodle, Mocaf, Tempe, Nutrient composition

1 INTRODUCTION

Urban lifestyles have shifted dietary habits towards more practical choices, with noodles frequently serving as a substitute for rice [1]. According to data from the World Instant Noodles Association (WINA), a total of 120.21 billion servings of instant noodles were produced worldwide in 2023, with Indonesia ranking as the second-largest consumer [2]. Currently, most noodles available on the market are made from wheat flour. According to the Food Consumption Statistics Report issued by the Ministry of Agriculture, wheat flour consumption has shown a steady increase, reaching the highest level recorded in the past eight years. The average per capita consumption rose from 2.75 kg in 2022 to 2.94 kg in 2023, reflecting a growing reliance on wheat-based products in the Indonesian diet [3]. Wheat-based noodles are characterised by a relatively high energy content; however, they are limited in terms of protein and dietary fibre. Therefore, efforts to improve the nutritional value of noodles are often undertaken through the substitution of alternative food ingredients [4].

One of the alternative local ingredients that is more affordable, environmentally friendly, and sustainable as a substitute for wheat flour is Modified Cassava Flour (MOCAF), which is derived from cassava and possesses characteristics similar to wheat flour [5, 6]. Several studies have demonstrated that MOCAF can serve as a replacement for wheat flour, with substitution ratios ranging from 20% to 100% [7]. However, products made with MOCAF substitution tend to contain lower levels of protein and fat compared with wheat flour, but are higher in carbohydrates, fibre, calcium, and iron [8]. Therefore, the addition of protein sources to MOCAF-based noodles, such as low-fat, protein-rich foods like tempeh, can enhance the nutritional value of the resulting product [9].

Tempeh is a traditional Indonesian food produced through a simple fermentation process; however, substantial scientific evidence supports its health benefits [10]. Tempeh has been recognised as a plant-based protein source comparable to meat, as it contains a complete profile of amino acids and is more easily digested and absorbed by the body [11, 12]. The incorporation of tempeh into MOCAF-based noodles is therefore considered a promising strategy to improve their protein quality and overall nutritional profile, while simultaneously promoting the utilisation of locally available and sustainable food resources. Accordingly, this study aims to analyse the nutritional composition including carbohydrates, protein, fat, and total energy of noodles formulated from MOCAF and tempeh, with the objective of determining whether the combination of these local raw materials can serve as a viable and nutritionally advantageous alternative to commercially available instant noodles.

Article Information

Received : 4 September 2025
Accepted for publication: 7 November 2025
Published: 30 November 2025

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2 MATERIAL AND METHODS

This study employed a true experimental design using a Completely Randomised Design (CRD) with two replications and two treatment levels. Formula F0 served as the control (without the addition of tempeh flour), while Formula F1 consisted of a composite flour formulation with a ratio of 75% MOCAF to 25% tempeh flour. A 25% substitution was applied to meet the minimum claim for a protein source as specified by BPOM and to exceed the standard outlined in SNI 3551:2018 (⩾6 g). This level of substitution also helps maintain the product's texture, preventing excessive fragmentation. The data collected were analysed using SPSS software using descriptive analysis.

Table 1: Formulation of Noodle

Treatment	Mocaf Flour (g)	Tempe Flour (g)
F0	100	0
F1	75	25

The preparation of MOCAF flour began with the peeling of fresh cassava, followed by thorough washing and slicing into thin pieces approximately 0.2 cm in thickness using a slicer. The cassava slices were then subjected to fermentation for 12 hours in a solution prepared with a ratio of 1 kg cassava, 1 liter of water, and 1 g of Bimo-CF starter from Badan Litbang Pertanian Indonesia. Upon completion of fermentation, the slices were drained and dried in an oven at a temperature of 60°C for 6 hours until fully dehydrated. The dried cassava was subsequently milled using a food processor and passed through an 80-mesh Tyler sieve to yield fine and homogeneous MOCAF flour [13].

The process of converting tempeh into flour involved several stages. First, tempeh was sliced to a thickness of 0.5 cm and steamed for 3 minutes. After steaming, the tempeh was cooled at room temperature and then dried in an oven at 60°C for 6 hours. The dried tempeh was ground using a food processor and sieved through an 80-mesh sieve [14].

The preparation of the noodle dough was carried out by blending MOCAF flour and tempeh flour in accordance with the specified formulation. From the total amount of flour, 50 grams of MOCAF flour was set aside for the gelatinisation process. This portion was mixed with salt and water, then heated in a non-stick pan for approximately 2 minutes until a gel-like consistency was achieved. The resulting gel was then combined with the remaining MOCAF flour, tempeh flour, and 10 grams of egg. The mixture was subsequently kneaded until a uniform and elastic dough was formed. The dough was rolled into thin sheets with a thickness of 1.2–2 mm using a noodle maker, followed by steaming for 3 minutes. The noodles were then cooled at 100°C for 10 minutes and dried in an oven at 60°C for 3 hours [15].

After product preparation, a proximate analysis was conducted on all samples to determine carbohydrates, fat, and protein levels performed based on the Association of Official Analytical Chemists (AOAC) standard methods, selected according to the specific nutrient components being measured.

3 RESULT

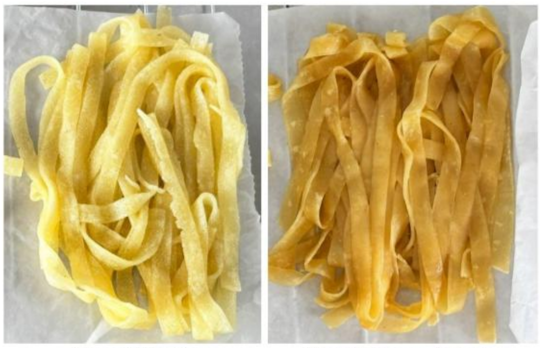

Figure 1: Picture of Noodles

Figure 1 showed that the mocaf-tempe noodle had a darker yellow colour as compared to the mocaf noodle, while table 2 reported that the energy, carbohydrate and fat content of the mocaf-tempeh noodle were higher than the mocaf noodle expressed as % per 100 gram.

Table 2: Nutrient composition of noodles made from Mocaf and Mocaf-Tempe per 100g

Nutritional Composition	Mocaf Noodle	Mocaf And Tempe Noodle
Protein (%)	2.26	13.16
Fat (%)	1.93	9.57
Carbohydrate (%)	85.28	68.44
Total Energy (kcal)	367.49	412.47

Table 3 showed the nutrient comparison between Mocaf noodle, mocaf tempe noodles and commercial noodles. The energy and fat content of the commercial noodle is higher than the Mocaf tempe and mocaf noodles. The protein content of the mocaf-tempeh noodle is the highest as compared to the mocaf noodle and commercial noodle.

Table 3: Nutrient content per serving of noodles made from Mocaf, Mocaf-Tempe and commercial noodle

Nutrition Content	Mocaf Noodle (69g)	Mocaf Tempe Noodle Formula (69g)	Commercial Noodle (69g)
Energy (kcal)	253.66	284.60	301.00
Carbohydrate (g)	58.83	47.20	49.10
Protein (g)	1.56	9.08	8.00
Fat (g)	1.33	6.61	7.30

4 DISCUSSION

Mocaf noodles without tempe had lower protein content compared to mocaf-tempe noodles and commercial noodles. This finding is supported by previous studies showing that the addition of tempe flour to mocaf-based products, such as cookies, can increase the protein content [16]. Tempe flour is a good source of protein, containing 50.69% protein per 100 grams of flour, whereas mocaf flour contains only 1.2% protein per 100 grams of flour [8,17]. Commercial noodles also have more protein than mocaf noodle due to the higher gluten in wheat flour [18]. According to the Indonesian National Standard (SNI 3551:2018) for instant noodles, the minimum protein content for dry or instant noodle products is 6%. This indicates that the protein content of MOCAF noodles alone does not meet the standard, whereas MOCAF–tempeh noodles comply with SNI 3551:2018 [19, 20].

Fat content was higher in mocaf-tempe noodles than in mocaf noodles and commercial noodles. Several previous studies have reported that increasing the proportion of tempeh flour in product formulations, such as MOCAF cookies and cassava crackers, contributes to a higher fat content in the final product [16, 21]. The elevated fat content in such products is attributed to the high lipid content of the raw material. Tempeh flour contains approximately 25.94 g of fat per 100 g, whereas MOCAF flour contains only 0.6 g per 100 g [8,17]. The relatively high fat content in tempeh flour originates from its primary raw material, soybeans [16]. The total energy of mocaf-tempe noodles was higher than that of mocaf noodles. This finding is consistent with previous research, which showed that increasing the substitution of tempe flour resulted in higher total calorie content in the final product[21]. The addition of tempe flour contributes to an increase in fat content, thereby raising the overall total energy of the product [8,17].

Carbohydrate content decreased in MOCAF–tempeh noodles compared to MOCAF noodles and commercial noodles. This finding is consistent with previous studies on MOCAF cookies and cassava crackers, which reported that higher tempeh flour substitution resulted in lower carbohydrate content in the final product [16,22]. The reduction in carbohydrate content can be attributed to the use of the substitution ingredient [4]. Tempeh flour, derived from fermented soybeans, is high in protein and relatively low in carbohydrates. In contrast, mocaf noodle and commercial noodle, made from cassava and wheat, were high in carbohydrates due to the high starch content [8, 23].

Noodles made from MOCAF generally contain high levels of carbohydrates because cassava primarily serves as an energy reserve for the plant and is therefore dominated by starch [24]. However, when MOCAF is partially substituted with tempeh flour, its nutritional profile changes. Tempeh, derived from soybeans as a legume, is rich in protein and fat to support seed germination and early plant growth [23]. Consequently, the addition of tempeh flour increases the protein and fat content of the noodles while reducing their carbohydrate proportion, as part of the starch from MOCAF is replaced by the nutrients present in tempeh.

The total energy of mocaf-tempe noodles was higher than that of mocaf noodles but still lower than the commercial noodle. This finding is consistent with previous research, which showed that the substitution of tempe flour resulted in higher total calorie content in the final product [22]. The addition of tempe flour contributes to an increase in fat content, thereby raising the overall total energy of the product [8,17].

The nutritional comparison between the MOCAF–tempeh noodle formula and commercial noodles (both with a serving size of 69 g) reveals notable differences. The MOCAF–tempeh noodles provide slightly lower energy (284.6 kcal) compared with commercial noodles (301 kcal), which is consistent with their reduced carbohydrate content (47.2 g vs. 49.1 g). Interestingly, the protein content of MOCAF–tempeh noodles (9.08 g) is higher than that of commercial noodles (8 g), indicating that the substitution of MOCAF with tempeh effectively enhances the protein value of the product. Fat content in the MOCAF–tempeh noodles (6.61 g) is also slightly lower than in commercial noodles (7.3 g), suggesting a more balanced macronutrient profile. Overall, the MOCAF–tempeh noodles not only offer a modest reduction in energy and carbohydrate levels but also improve protein content, contributing to their functional value as a healthier alternative to conventional instant noodles.

Based on the serving size of instant noodles specified in the Regulation of the Head of the Food and Drug Monitoring Agency (BPOM) No. 26 of 2021 regarding Nutritional Information on Processed Food Labels, the serving size of instant noodles ranges from 50 to 120 g [24]. The addition of tempeh to MOCAF-based noodles improved the nutritional composition of the final product. Incorporation of tempeh also contributed to higher protein, fat, and energy levels, while reducing the proportion of carbohydrates, resulting in a more balanced and nutritious noodle product.

This study is limited by its laboratory-scale design and the use of specific raw materials, which may vary in quality. The nutritional evaluation was restricted to proximate analysis, without assessing bioactive compounds or glycemic response. Furthermore, feasibility for large-scale production and functional assessments were not conducted.

5 CONCLUSION

The addition of tempe to mocaf-based noodles significantly improved the nutritional quality of the final product. Mocaf-tempeh noodle exhibited higher protein, fat and total energy content compared to mocaf noodles without tempe while carbohydrate content decreased. The addition of tempe to mocaf-based noodles significantly improved the nutritional quality of the final product. Incorporating tempe into mocaf noodles allows for the production of a more balanced and nutritious instant noodle product that meets the Indonesian National Standard for protein content. This approach highlights the potential of using locally sourced, sustainable ingredients to enhance the nutritional profile of traditional and modern noodle products.

ACKNOWLEDGEMENTS

The author would like thank you to Faculty of Public Health and LPPM Universitas Andalas.

CONFLICT OF INTEREST

The authors declare that there is no conflict of interest regarding the publication of this paper.

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