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Development of Sensory Quality and Shelf Life of Dried Noodles Using Catfish Flour and Mocaf: An Alternative Supplementary Feeding Prototype

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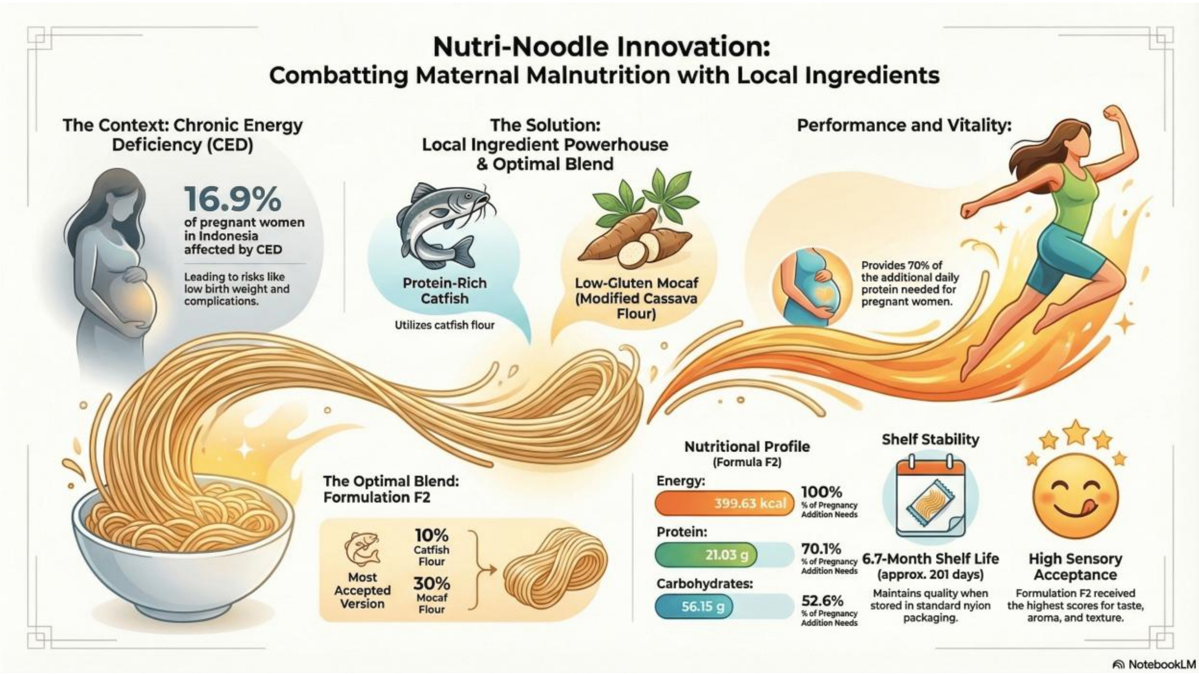
ABSTRACT

Chronic Energy Deficiency (CED) in pregnant women remains a substantial problem in developing countries, including Indonesia, year by year. The main cause of CED is insufficient intake during pregnancy. One effective solution is providing additional food, such as supplementary feeding (*pemberian makanan tambahan*/PMT), to pregnant women. It is important to develop innovative PMT options that can serve as alternatives to combat CED. This research aimed to replace traditional ingredients with catfish and Mocaf flour for sensory testing and to evaluate the shelf life of dry noodles as an alternative PMT for pregnant women with CED. The study used a laboratory experimental approach with a Completely Randomized Design (CRD) . This study tested four formulations combining mocaf, catfish, and wheat flour: F0 (0%:0%:100%), F1 (20%:5%:70%), F2 (30%:10%:60%), and F3 (35%:15%:50%). Sensory evaluation analysis used a Likert Scale, with 25 semi-trained panellists, with scale of 1-4. Data were analyzed using ANOVA followed by Duncan's post hoc test with SPSS version 23. The results indicated that the substitution significantly affected color preference ($p < 0.05$). The optimal formulation was F2, with 10% catfish flour and 30% Mocaf flour. Most variables, such as taste, aroma, and texture, suggest that F2 is preferred more than the other formulas. Based on the results of the nutritional value calculations for the selected Formula F2, it has nutritional content including energy of 399.63 kcal, carbohydrates of 56.15 g, fat of 10.10 g, and protein of 21.03 g. The developed dry noodle prototype is a promising nutrient-enriched food product.

Key Messages:

- Dry noodles enriched with 10% catfish flour and 30% mocaf flourdemonstrated acceptable sensory properties and an improved nutritional profile, particularly in protein content, based on laboratory analysis. The product shows potential as a supplementary food prototype, pending further evaluation of its nutritional contribution per serving .
- The selected formulation exhibited an estimated shelf life of approximately seven months. It achieved overall sensory acceptability within the acceptable range, with favorable scores for taste and texture, indicating good panelist acceptance.

GRAPHICAL ABSTRACT



INTRODUCTION

CED in pregnant women is a nutritional problem that occurs quite often in various developing countries, including Indonesia. CED in Indonesia is included in one of the triple burden problems faced by pregnant women, with the root causes including socio-economic nutritional deficiencies, lack of antenatal care (ANC) visits, lack of knowledge about intake during pregnancy, indifference to pregnancy conditions, health services, availability of food, and additional food (1,2).

In 2023, the prevalence of CED in pregnant women was 16.9% (3). This represents a decrease compared to 2018, when it was 17.3% (4). However, this decline has not yet reached the target set by the Indonesian Ministry of Health, which is to reduce the prevalence of CED in pregnant women by 10%. In the *Sustainable Development Goals* (SDGs) 2015-2030, the national target for CED pregnant women is 5%, and the target for non-CED pregnant women is 95% (5).

CED has a high risk of reducing the health of pregnant women and fetuses and can contribute to pregnancy complications, premature birth, low birth weight, a high risk of death in children, and result in non-communicable diseases in adulthood (6). A critical step in preventing CED is meeting adequate energy and protein needs during pregnancy. Providing additional food to pregnant women has been proven to increase body weight (7). PMT aims to improve the nutritional status, which can be enhanced with locally available, nutrient-rich ingredients (8). Therefore, it is essential to create food innovations, such as dry noodles, that can meet these nutritional needs practically and affordably.

Dried noodles are a popular food product among Indonesians because they are easy to consume and have a relatively long shelf life (9). Noodles are a very popular processed food product in Indonesia, consumed by people of all ages, from children to adults (10,11). Noodles are often used as a substitute for rice because of their convenience, affordability, and popularity. This is very beneficial from the perspective of diversifying food consumption, as food consumption is no longer solely dependent on rice (10,12). In addition, the high dependence on wheat flour in Indonesia presents an opportunity for substitution with local alternatives (13). However, conventional dry noodles are generally made from wheat flour, which has limited nutritional content, especially in protein and fiber. To increase the nutritional content of dry noodles, more nutritious raw materials, such as catfish flour and mocaf (flour from cassava that has been processed into low-gluten flour), must be substituted.

Catfish flour is rich in protein, essential amino acids, and omega-3, which help improve food products' nutritional quality (14,15). Mocaf is also a good source of carbohydrates and can potentially

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increase the fiber content of food products (16). Therefore, substituting catfish flour and mocaf in dry noodle formulations is expected to influence sensory characteristics (such as taste, texture, and color) as well as shelf-life properties, which were evaluated in the present study.

However, developing dry noodles made from catfish flour and mocaf also requires evaluating several key factors, such as consumer acceptance of sensory changes and the shelf life of the dry noodles. Therefore, this study aims to explore the potential of replacing traditional ingredients with catfish flour and mocaf to improve sensory quality and shelf life of dry noodles. In addition, the nutritional value of the selected formulation was calculated based on proximate composition analysis to describe its energy and amcronutrient content without implying direct nutritional or clinical effects in pregnant women with chronic energy deficiency (CED).

METHODS

This study used a laboratory experimental approach with a Completely Randomized Design (CRD) to compare dry noodle formulations containing mocaf, catfish, and wheat flour. The main research included sensory and shelf life assessments. Sensory testing is an assessment method used to assess the taste, color, aroma, and texture of a food product. It also plays an important role in product development. This study used the primary substituted ingredients of catfish, mocaf, and wheat flour. The researchers processed the catfish and mocaf flours separately. The first variable was the concentration of mocaf (0, 20, 30, and 35%), while the second was the concentration of catfish flour (0, 5, 10, and 15%) and the third was the concentration of wheat flour (100, 70, 60, 50%).

Mocaf flour

The mocaf flour was processed in several steps (17). Cassava tubers were stripped, washed, and cut. For fermentation, the cassava was soaked in water containing 10 mL of lactic acid bacteria culture per liter. The mixture was covered with plastic in a container. Fermentation continued for 72 h, with water changes occurring every 24 h After fermentation, the cassava slices were removed and thoroughly rinsed with water. The slices were then dried in a food dehydrator (GETRA Brand Type ST-32) at 60 °C for 10 h. Once dry, the cassava slices were ground into flour using a food chopper (Mitochiba Brand type CH200) and sifted through an 80-mesh sieve.

Catfish Flour

Processed the catfish flour by cutting, washing, and drying (18). The catfish were cleaned and then blanched for 15 min to help retain their texture and color while removing microorganisms. Afterwards, they were dried at 55–60 °C for 24 h. The dried fillets were then finely ground, passed through a 60-mesh sieve, and stored in airtight containers to preserve their freshness and nutritional content for later use.

Formulation of noodle products

Noodle products were prepared according to the procedure (19). Mocaf flour, catfish flour, wheat flour, salt, eggs, CMC, and cooking oil were mixed (Table 1). This dough is then put into a noodle maker to form noodles with a thickness of 1.5 mm. The noodles weighed 60 g each and were placed into round molds. The following process is steaming at a temperature of 100^{0}C for 10 min. After boiling, the noodles are dried using a food dehydrator (GETRA Brand Type ST-32) at 60^{0}C for 12 h. The final step is to package the finished noodle product.

Table 1. Dry noodle formulation ingredients formulation

Ingredients	F0	F1	F2	F3
Mocaf Flour (%)	0	20	30	35
Catfish Flour (%)	0	5	10	15
Wheat Flour (%)	100	70	60	50
Salt (g)	1	1	1	1
Egg (g)	25	25	25	25
CMC (g)	0.25	0.25	0.25	0.25
Cooking oil (g)	5	5	5	5

F0 = control, F1-3 = Formulation Group

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Sensory Analysis

Sensory analysis uses human senses as a tool to gauge product acceptance. In this study, a hedonic test was conducted to gather panelists' opinions on whether they liked or disliked the product. Sensory evaluation analysis used a Likert scale, with a 1-4 scale. Scale one is very dislike, two is dislike, three is like, and four is very like. The panel consisted of 25 female consumer panelists. The panelists in this study were 30 untrained female panelists/consumer panelists. However, after data cleaning, five panelists were incomplete, so the total number of panelists was 25. Panelists participating in the sensory evaluation were required to meet several inclusion criteria: they were willing to participate and available during the assessment period, in good health at the time of testing, and neither hungry nor overly satiated. In addition, panelists had no known allergies to, and were familiar with, the ingredients used in the formulations. Drinking water was provided and consumed between sample evaluations to cleanse the palate and minimize carry-over effects. During the hedonic test, panelists used a Likert scale form. The main goal of sensory testing is to evaluate consumer preferences for dry noodle products, compare acceptance levels among different formulations, identify sensory traits that most influence acceptance, and support product development and improvement. Through hedonic testing, researchers can gain insights into how potential consumers respond to the dry noodle products under development, which can inform formulation adjustments when needed and ultimately increase product acceptance in the community.

Proximate Analysis

Proximate analysis was performed on the selected noodle formulation that received the highest overall acceptance in the sensory evaluation. The study included determining the energy value and the total fat, protein, and carbohydrate contents. Total fat content was measured using the Soxhlet extraction method, while protein content was determined by the Kjeldahl method based on total nitrogen analysis. Carbohydrate content was calculated using the difference method, by subtracting the sum of moisture, ash, protein, and fat contents from 100%. The product's energy value was subsequently calculated based on the measured macronutrient composition.

Shelf Life Analysis

Testing with an accelerated storage shelf-life test (ASLT) involves storing products in environmental conditions that can accelerate the decline in product quality. Approaches used to determine shelf life include measuring critical water content, initial water content, isothermic sorption curves, and others (20).

$$\Theta = \frac{ln\frac{(Me-Mi)}{(Me-Mc)}}{\frac{k}{x}(\frac{A}{Ws})\frac{Po}{b}}$$

Note: Θ = estimated shelf life (days), Me: product equilibrium water content (g H2O/g solids), Mi= initial water content of the product (g H2O/g solids), B= the slope of the isothermic sorption curve, Mc= critical water content (g H2O/g solids), k/x = permeability of packaged water vapor (g/m3.hari.mmHg), A= outer surface of the packaging (m2), Ws= dry weight of packaged product (g solids), Po= saturated vapor pressure (mmHg)

The initial moisture content of the noodles was measured using the oven-drying method. An empty container was first dried in an oven at 110 °C for 30 min, then cooled in a desiccator for 10 min, and weighed. Two grams of the sample were placed into the pre-weighed container. The sample was then dried in the oven at 110 °C for one hour. After drying, the container and sample were cooled in a desiccator for 10 min and reweighed. This process was repeated until a constant weight was reached. The moisture content was calculated based on the weight loss, which is the difference between the initial weight of the sample before drying and its final weight after drying. The results were expressed on a dry weight basis. The moisture content was calculated using the following formula:

$$\text{Water content (g } H_2O\text{/g solids)} = \frac{W3}{W1}$$

Information:
W1 : sample weight before drying (g)
W2 : sample weight after drying (g)
W3 : W1 - W2
bk : dry weight

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Equilibrium Water Content (Me) and Determination of Isothermic Curves (b)

Equilibrium moisture content is the amount of water retained in a product when it has reached a stable state at a given water activity (Aw). This value is determined by comparing the moisture levels of the sample before and after conditioning with a saturated salt solution. The calculation involves assessing the relationship between the wet and dry masses of the sample at both the initial and equilibrium stages.

Dry Weight of Packaged Products (Ws)

The product's dry weight was measured using a tool, based on the net weight of 80 grams stated on the package. The packaging had dimensions of 24 x 14 cm^2, resulting in a surface area of 336 cm^2 or 0.366 m^2, and was made of nylon. The water vapor permeability value of this nylon packaging reached 0.053 g/m^2.day.mmHg, while the saturated vapor pressure (P_0) value was recorded at 49.157 mmHg (21). The results of the variable data calculations are presented in Table 5.

Data analysis

The collected data were analyzed statistically through ANOVA using SPSS version 23. Duncan's New Multiple Range Test was applied to distinguish between mean values, with significance determined at the 5% confidence level.

CODE OF HEALTH ETHICS

This research has passed ethical review by the Universitas Esa Unggul Ethics Commission No. 0923-10.001 /DPKE-KEP/FINAL-EA/UEU/X/2023.

RESULTS

Sensory Test

Sensory evaluation was conducted using a 4 point hedonic scale, where 1 = very dislike, 2 = dislike, 3 = like, and 4 = very like. The results of the sensory test show that the one-way ANOVA revealed no significant difference in the taste variable ($p>0.05$). Catfish flour was added at levels of 5, 10, and 15% in F1, F2, and F3, respectively. . The mean taste scores ranged from 2.2 to 2.6, indicating acceptability within the transition from dislike to like. The average score trend indicates that F2 has the highest taste score at 2.6 (like) compared to the other formulas.

Table 2 shows a significant difference in the color variable ($p<0.05$), with F0 having the highest score of 2.8 and F3 the lowest at 2.2. These findings suggest that the substitution of catfish flour and mocaf influenced color perception, with panelists showing a preference for noodles without substitution (figure 1).

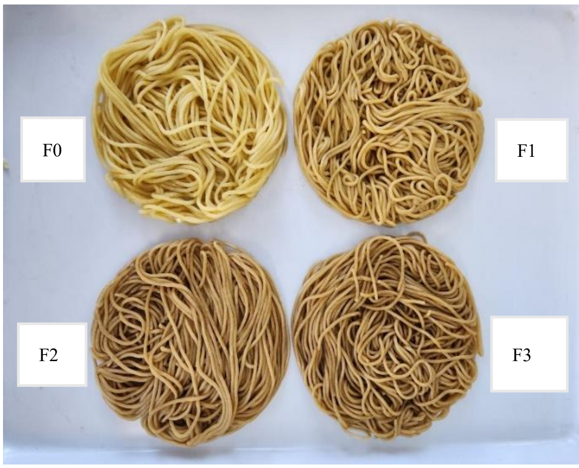

Figure 1. Raw Dried Noodle Products

The evaluation of aroma preference in this study showed no significant differences among the various formulations (p<0.05). The levels of mocaf flour and catfish flour used did not affect the aroma of

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the dry noodle products. Including catfish flour did not produce a fishy odor, resulting in similar average scores across the aroma evaluations. However, there is a tendency for F2 (10% concentration of catfish flour) to have the highest score, which is 2.5 (Like). The assessment of texture preference levels also did not reveal a significant difference between formulations (*p*> 0.05), indicating that all formulas had similar textures on a scale of 2-3. Nevertheless, F2 (10% catfish meal concentration) tends to have the highest score.

The best formula was chosen based on sensory tests of product preference; most variables, such as taste, aroma, and texture, suggest that F2 is preferred more than the other formulas. Based on the results of the nutritional value calculations for the selected Formula F2, it has nutritional content including energy of 399.63 kcal, carbohydrates of 56.15 g, fat of 10.10 g, and protein of 21.03 g.

Table 2. Hedonic Test of Dried Noodle Products

Variable	Mean ± SD				p-value[a]
	F0	F1	F2	F3	
Flavor	2.5±0.6[a]	2.6±0.7[a]	2.6±0.7[a]	2.4±0.6[a]	0.704
Color	2.8±0.6[b]	2.4±0.7[a]	2.4±0.7[a]	2.2±0.6[a]	0.008*
Aroma	2.3±0.6[a]	2.5±0.7[a]	2.5±0.6[a]	2.4±0.6[a]	0.488
Texture	2.6±0.8[a]	2.4±0.7[a]	2.8±0.5[a]	2.4±0.7[a]	0.102
All	2.5±0.65	2.4±0.7	2.6±0.62	2.3±0.62	

Different letters in the same column indicate significant differences (α = 0.05)

Shelf-life Test

The storability test results in this study used the ASLT method by considering initial water content measurements, critical water content measurements, isothermic sorption curves, and saturated vapor pressure. The results of the shelf life test show that the water content of the dry noodles obtained is approximately 0.055 g H2O/g solids, which meets the quality requirements for dry noodles as specified in SNI 01-2974-1996, namely a maximum water content of 8% or all treatments meeting the maximum standards. The water content in dry noodles can be seen in Table 3.

Table 3. Initial water content of noodles

Sample	Water Content (g H_2O/g solids)
Repetition 1	0.053
Repetition 2	0.057
Average	0.055 (bk)

The Aw value is determined using a saturated salt solution. Table 4 presents the results of calculating the equilibrium water content (Me). The isotherm was generated using six saturated salt solutions. A total of 2 g of the sample, which will be tested for shelf life, is placed in a cup, then stored in a desiccator containing a saturated salt solution, and weighed periodically (every 3 h) until a constant weight is reached. Samples that reach a constant weight are measured for their water content (dry basis). Additionally, an isotherm sorption curve can be created by plotting each desiccator's water content against activity or relative humidity (RH).

Table 4. Equilibrium Water Content in Various Types of Salt

Saturated Salt Solution	%RH	AW	Gram H_2O/Gram Solids
NaOH	6	0.06	0.041
MgCl	32	0.32	0.077
K_2Co_3	44	0.44	0.093
NaCl	75	0.75	0.137
BaCl	90	0.9	0.170

The equilibrium moisture content of the sample is measured at different water activities (A_w) and plotted to create an isotherm, as shown in Figure 2, which displays the curve for dry noodles. Figure 2

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illustrates a positive linear relationship between Aw and equilibrium water content, which can be seen from the equation on the graph. The coefficient of determination (R2) value is 99.36%, indicating that this linear relationship is strong. It can be concluded that as the Aw value increases, the equilibrium water content also increases.

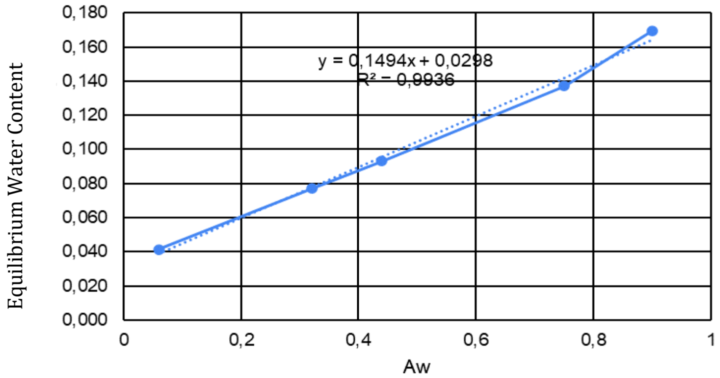

Figure 2. Isothermic sorption curve of dried noodles

The equilibrium moisture content (Me) was determined using a linear regression equation derived from the Aw–Me relationship (y = 1.494x + 0.0298), which represents the linear region of the moisture sorption isotherm. In this study, the slope of the regression line corresponds to the parameter **b**, as defined in the Methods section. As a result, the equilibrium water content (Me) was found to be 0.164 g H2O/g solids.

Table 5. Data on known variables

Information	Value	Unit
Me	0.164	gH_2O/g solids
Mi	0.055	gH_2O/g solids
b	0.149	
Mc	0.142	gH_2O/g solids
k/x	0.053	g/m^3.hari.mmHg
A	0.036	m^2
Ws	80	g solids
P0	49.157	mmHg

With the following calculations:

$$\theta = \frac{ln\frac{(Me-Mi)}{(Me-Mc)}}{\frac{k}{x}(\frac{A}{Ws})\frac{Po}{b}}$$

$$\theta = \frac{ln\frac{(0,164-0,055)}{(0,164-0,142)}}{0,053(\frac{0,036}{80})\frac{49,157}{0,149}}$$

$$\theta = \frac{1,5790}{0,0078}$$

θ =201,226 days (6.7 months)

The shelf life of dry noodles is calculated under 90% relative humidity (RH) conditions. This condition was chosen to obtain the most pessimistic calculation data and to anticipate the worst storage conditions. The results of calculating the shelf life of dry noodle products in nylon packaging indicate 201 days (<7 months).

DISCUSSION

Justification and Potential Benefits

PMT for Pregnant Women is a recommended solution to overcome CED. Pregnant women are declared CED if they have a pre-pregnancy Body Mass Index (BMI) or in the 1st trimester (<12 weeks) of

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<18.5 kg/m2, while they are declared at risk of CED if they have an Upper Arm Circumference (MUAC) <23.5 cm (22).

The recommended PMT for CED pregnant women is complete ready-to-eat food or snacks that are rich in animal protein sources by paying attention to balanced nutrition, using fresh food ingredients (without artificial preservatives), and limiting consumption of sugar, salt, and fat (GGL) with energy of 510-530 kcal and protein 23-27 g (22). The dry noodle innovation is an appropriate alternative as an additional food source, particularly for pregnant women.

Noodles are a popular snack in Asia and Southeast Asia, including Indonesia. They are processed foods enjoyed by many Indonesians (23). Noodles serve as an alternative food to rice (24). This is supported by research results showing no significant differences in taste variables (p>0.05). However, catfish meal was added at 5, 10, and 15 ratios. In this study, the acceptance of taste was almost the same across the different formulas. All panelists liked the noodles' taste.

Formulation F2 recorded the highest average taste score (2.6), which lies between the “dislike” (scale 2) and “like” (scale 3) categories and is closer to the “like” category on the 4-point hedonic scale, compared to other formulas. Formula 2, which the panelists preferred, performed better in taste, texture, and aroma assessments. . Based on the Nutritional Adequacy Intake (AKG), the F2 formula, as the chosen formula, contributes 16.5% to the total daily energy needs of pregnant women, 23% to protein, 14.8% to Kh, and 16.3% to fat. Meanwhile, based on the recommendations for additional nutritional needs for pregnant women, namely for energy +300 kcal, protein +30 g, fat +2.3 g, and carbohydrates +40 g (25)The nutritional value of the F2 formula as an additional food for pregnant women is 100% energy, 70.1% protein, 100% fat, and 52.6% carbohydrates. This suggests that the developed noodle product may serve as a supplementary food for pregnant women, given its nutritional composition.

Although statistically, increasing the amounts of catfish flour and Mocaf did not significantly change aroma and texture, the panelists still rated formula two most favorably, with an average rating of 2.5 for aroma and 2.8 for texture. The more catfish flour added, the less favorable the panelists' assessment of the noodle product, as the fish's fat content affects aroma and texture. The panelists felt that the ratio of catfish flour to Mocaf in formulation 2 was appropriate, as it did not produce a fishy aroma and had quite a favorable texture.

Unlike the taste, aroma, and texture variables, the panelists in this study preferred the color of the noodles without adding mocaf flour or catfish flour. This is because people tend to prefer bright yellow noodles. In contrast, the formula with added brownish catfish flour showed that higher concentrations led to greater dislike among consumer panelists. The preference for bright-colored noodles, such as those commonly found in instant noodles, results in a lack of acceptance for darker colors in noodles (26). This aligns with previous research showing that the more fish meal added to dry noodles, the darker the noodles become, and consequently, the lower the preference (23). Besides sensory tests, another crucial aspect studied in this research was the shelf life of dry noodles. Although the formulation aimed to improve overall sensory quality, the results indicate that color acceptability decreased with the addition of catfish flour and Mocaf. This finding highlights a limitation of the formulation, as visual appearance plays an important role in consumer acceptance. Further optimization may be required to improve color while maintaining nutritional quality.

One factor that significantly impacts shelf life is critical water. Critical water content is the level at which the product becomes unacceptable to consumers in terms of sensory quality. The sample is left open in a closed room with a humidifier for a specific period until it shows undesirable changes in sensory quality. Samples are tested regularly for organoleptic (texture and aroma) quality every hour. Based on organoleptic tests, the critical water content of the dry noodles was 0.1417 (bk). After 8 h of testing in a humid room, the panelists detected a change in the sample: the dough aroma decreased, and the texture became increasingly brittle and easily broken with each passing hour. The point at which the sample can no longer be accepted or has experienced rejection is at the 7th h, so the critical water content of the sample is recorded at that time, at RH 52%.

The shelf life of the dry noodles was estimated using the equation described in the methods section and calculated to be 201.226 days, equivalent to approximately 6.7 months. The estimation was performed

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at a relative humidity (RH) of 90%, a condition commonly used in Accelerated Shelf Life Testing (ASLT) to simulate extreme or worst-case storage conditions for dry foods sensitive to moisture. In ASLT, elevated RH is deliberately applied to promote moisture uptake and accelerate quality degradation, enabling shelf-life to be conservatively predicted. This approach is particularly appropriate for dry, cereal-based products, whose stability is strongly affected by environmental humidity (27–29). In addition, RH levels near 90% are relevant to storage conditions in tropical regions, where ambient humidity is often high. Similar high-humidity ASLT conditions have been widely reported in recent studies evaluating the shelf life of low-moisture and cereal-based foods (30,31). The Accelerated Shelf Life Testing (ASLT) method predicts a product's shelf life by subjecting it to conditions that accelerate quality degradation. This process typically involves assessing factors such as critical moisture content, initial moisture levels, isotherm sorption curves, and other related parameters (20).

Critical water content is the level at which the product is no longer acceptable to consumers based on sensory perception. Samples are stored in a room for a specific duration. Periodically, trained panelists test both samples and controls for sensory evaluation. The quality parameters tested depend on the type of product being examined. Testing is discontinued if the panelist rejects the sample (20).

Shelf life analysis showed that dry noodles made with catfish flour and selected mocaf (F2) can be stored for up to 6.7 months. Moisture content is a key factor in the shelf life of dried noodles. High moisture levels can increase packaging permeability, making it more prone to microbial growth and ultimately reducing shelf life (32). According to the Standarisasi Nasional Indonesia (SNI) quality 1, the ideal water content for dry noodles is a maximum of 8% (33).

This study has limitations because it analyzes noodles solely as an alternative supplementary food prototype for pregnant women. This practice was recently implemented among women of childbearing age (WUS) as panelists. Further research is needed to ensure this prototype can be used as an alternative PMT for pregnant women with CED, with educational support. Local food-based supplementation, when combined with culturally appropriate nutrition education, represents a feasible and sustainable strategy for inclusion in community-level stunting prevention and antenatal care programs in Indonesia and similar contexts (34).

CONCLUSION

The present study found that dry noodles formulated with 10% catfish flour and 30% mocaf flour (F2) were generally well accepted by the panellists and had an estimated shelf life of about 6.7 months under accelerated storage conditions. The addition of catfish flour improved the nutritional profile, particularly by increasing protein content, while preserving acceptable sensory quality.

Overall, the developed dry noodle prototype is a promising nutrient-enriched food product. Nevertheless, further research is needed to more thoroughly assess its acceptability, nutritional adequacy, safety, and effectiveness before it can be recommended as a food supplement, especially for undernourished pregnant women.

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CONFLICTS OF INTEREST

The authors declare no conflict of interest.

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REFERENCES

1. Kementerian Kesehatan RI. Petunjuk teknis makanan tambahan balita dan ibu hamil. Jakarta Direktorat Gizi Masy Kementrian Kesehat Republik Indones [Internet]. 2023;6(August):78–81. Available from: https://kesmas.kemkes.go.id/assets/uploads/contents/others/20230516_Juknis_Tatalaksana_Gizi_V18.pdf
2. Zewude et al. Undernutrition and associated factors among pregnant women in ethiopia. A systematic review and meta-analysis. Front Nutr. 2024;11.
3. Kementerian Kesehatan RI. Survei Kesehatan Indonesia (SKI). Jakarta Kemenkes RI; 2023.
4. Balitbang Kemenkes RI. Riset Kesehatan Dasar (Riskesdas). 2018.
5. Kementerian Kesehatan RI. Rencana strategi kementerian kesehatan tahun 2015-2019. Jakarta Kemenkes RI; 2015.
6. Thornburg, K.L., & Valent A. Maternal malnutrition and elevated disease risk in offspring. Nutrients. 2024;16(16):1–16.
7. Rahmah et al. The effect of supplementary feeding on body weight of pregnant women who have chronic energy deficiency in indonesia. J Aafiyah Heal Res [Internet]. 2022;3(1):44–51. Available from: https://www.neliti.com/publications/558045/
8. Septiyanti; Patimah, Sitti; Bur N. Penja Fish Flour Cookies : Nutritional Composition and Sensory Acceptability as a Local Food-Based Intervenstion for Child Undernutrition. J Heal Nutr Res. 2025;4(3):950–9.
9. Winarti et al. Karakteristik mie kering dengan substitusi tepung gembili dan penambahan plastiziser GMS (Gliserol Mono Stearat). Agrointek. 2017;11(2):53.
10. Fetowin MM, Kamo MC, Putri NP, Demena SP, Astuti NB. Formulasi Mie Kering Bahan Dasar Ikan Kembung dan Bayam Hijau sebagai Pangan Balita Stunting. J Ris Ilmu Kedokt. 2025;4(1):392–402.
11. Al-adawiyah W, Sekarini DA, Pengolahan P, Laut H, Barat D, Riau P, et al. FORTIFIKASI IKAN KEMBUNG (Rastrelliger Kanagurta) TERHADAP. 2022;2022(SemanTECH):137–47.
12. Faridah A, Widjanarko B. Penambahan Tepung Porang Pada Pembuatan Mi Dengan Substitusi Tepung Mocaf (Modified cassava FLOUR) [Addition of Porang Flour in Noodle as Mocaf Substitution (Modified cassava Flour)]. J Teknol dan Ind Pangan. 2014;25(1):98–105.
13. Hassan T, Buy I, Mata M. Effect of Sorghum Flour and Anchovy Meal Substitution on Organoleptic Properties of Biscuits. J Heal Nutr Res. 2024;3(3):185–91.
14. Kusharto et al. Invensi Guru Besar Menuju Inovasi Produktif: Seri Pangan Sehat Alami. Bogor - Indonesia: Penerbit IPB Press; 2017.
15. Nastiti, A.N., & Christyaningsih J. Pengaruh substitusi tepung ikan lele terhadap pembuatan cookies bebas gluten dan kasein sebagai alternatif jajanan anak autism spectrum disorder. Media Gizi Indones. 2019;14(1):35.
16. Anindita et al. Pembuatan MOCAF (Modified Cassava Flour) dengan kapasitas 91000 ton/tahun. J Tek ITS. 2020;8(2):F170–5.
17. Harna et al. The development of cookies from modified cassava flour with Soy Isolate Protein (ISP) substitution as an alternative supplementary food for pregnant women with CED. Int J Curr Sci Res Rev. 2023;06(02):1752–8.
18. Agustia et al. Development of mocaf-wheat noodle product with the addition of catfish and egg-white flours as an alternative for high-animal-protein noodles. J Apl Teknol Pangan. 2019;8(2):47–51.
19. Aliya et al. Peningkatan kadar gizi mie kering berbasis pangan lokal fungsional (mocafle noodle to increase the nutritional level of dry noodles as fuctional local food based). Indones J Hum Nutr. 2016;3(1):32–41.
20. Asiah et al. Pendugaan umur simpan produk pangan. 2018. 1–124 p.
21. Kurniawan et al. Stabilitas beras analog berdasarkan pola kadar air kesetimbangan. J Pangan. 2021;30(2):87–98.
22. Kementerian Kesehatan RI. Maternal Nutrition In Indonesia: Lanscape Analysis And Recommendations. Jakarta Kemenkes RI; 2023.

https://doi.org/10.56303/jhnresearch.v5i1.1085

23. Irsalina et al. Karakteristik fisiko-kimia dan sensori mie kering dengan penambahan tepung ikan motan (thynnichthys thynnoides). J FishtecH. 2016;5(1):32–42.
24. Effendi et al. Sifat fisik mie basah berbahan dasar tepung komposit kentang dan tapioka physical properties of wet noodle based on potato and tapioca composite flour. J Agroindustri. 2016;6(2):57–64.
25. Kementrian Kesehatan RI. Peraturan Meteri Kesehatan Republik Indonesia Nomor 28 tahun 2019 Tentang Angka Kecukupan Gizi Yang Dianjurkan Untuk Masyarakat Indonesia. Indonesia; 2019.
26. Elwin et al. Kajian substitusi sebagian tepung terigu dengan tepung ubi jalar dalam pembuatan mie kering untuk mendukung diversifikasi pangan lokal. J Trit. 2022;13(1):43–51.
27. Kar S. Shelf life prediction of dried garlic powder under accelerated storage conditions. J Food Sci Technol [Internet]. 2023;60(3):996–1005. Available from: https://doi.org/10.1007/s13197-022-05431-2
28. Athapattu SP, Rajapaksha S, Chamara HKBS, Kumari DWMMM. Storage Stability and Sensory Properties of Soft-Dough Biscuits Incorporated with Hard-Dough Biscuit Powder. Sri Lankan J Agric Ecosyst. 2024;6(1):36–51.
29. Pui LP, Abdul L, Saleena K, Ghazali HM. Storage stability and anti-caking agents in spray-dried fruit powders : A review. Foods Raw Mater. 2024;12(2):229–39.
30. Baributsa D, Baoua IB. Hermetic bags maintain soybean seed quality under high relative humidity environments. J Stored Prod Res [Internet]. 2022;96(October 2021):101952. Available from: https://doi.org/10.1016/j.jspr.2022.101952
31. Asmarasari SA, Azizah N, Sutikno S, Puastuti W, Amir A. A review of dairy cattle heat stress mitigation in Indonesia. Vet World. 2023;16(May):1098–108.
32. Shahabinejad et al. Functional instant noodle formulation for emergency conditions: Sensory and stability characteristics. Food Sci Nutr. 2024;12(7):4605–14.
33. Badan Standarisasi Nasional. Standar Nasional Indonesia (SNI) Mi kering. SNI 01-3551-2000 Indonesia; 2000.
34. Dasmasela MK, Dewi M, Ekayanti I. Local Food-Based Supplementation and Behavior Change Communication Improve Mid-Upper Arm Circumference (MUAC) in Pregnant Women : A Community-Based Intervention Study. J Heal Nutr Res. 2025;4(3).

https://doi.org/10.56303/jhnresearch.v5i1.1085