



Hedonic Evaluation and Chemical Characterization of Catfish Pulpety as an Alternative Animal Protein Food for the Prevention of Stunting in Toddlers Aged 1–3 Years

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Article Info

Article history:

Received 20 December 2025

Received in revised form 7

January 2026

Accepted 3 February 2026

Keywords:

Stunting

Animal Protein

Catfish

Pulpety

Toddlers

Abstract

Inadequate intake of animal protein during critical periods of growth is a major contributor to stunting, while access to high-quality animal protein sources is often constrained by economic limitations. Catfish (*Clarias sp.*), as an affordable yet nutrient-dense source of animal protein, offers considerable potential for development into an innovative food product aimed at stunting prevention. This study aimed to develop a catfish-based pulpety product as a safe, nutritious, and acceptable alternative source of animal protein for toddlers to support stunting prevention. A quasi-experimental study employing a Completely Randomized Design (CRD) was conducted with 30 untrained panelists. Three pulpety formulations were prepared using different ratios of chicken meat to catfish meat: Formula I (control), Formula II (1:3), and Formula III (1:1). Hedonic testing was performed to evaluate acceptability across the three formulations, followed by chemical composition analysis of the most preferred formula. The results indicated that Formula III was the most favored, providing 214.78 kcal of energy, 5.92 g of protein, 4.54 g of fat, and 10.05 g of carbohydrates per 100 g. Duncan's multiple range test revealed a statistically significant difference only in the texture parameter ($p = 0.004$). Overall, the catfish pulpety demonstrated adequate energy, protein, and fat content for stunting prevention, along with acceptable organoleptic properties, highlighting its potential as a functional food alternative for inclusion in national stunting prevention programs.

Introduction

Children in Indonesia are at significant risk of malnutrition. A child's physical growth and development are greatly influenced by the first 1000 days of life, which begins at conception and continues until the child reaches two years of age. This period is known as *the golden age* because it is a crucial phase that determines a child's physical, brain, and mental health development, which has a long-term impact into adulthood (Ilmiyani et al., 2025; Tendean et al., 2025); Rochat & Redingeri, 2021; Awwaluddin et al., 2023; Vergunst & Berry, 2022; Parajuli & Prangthip, 2025).

Stunting is a chronic nutritional problem that remains a serious challenge for Indonesia in its efforts to improve the quality of human resources. Stunting is defined as a condition in which a child's height or length according to age is below minus two standard deviations ($-2SD$) from the median length or height of children of the same age according to the standard (Anggraini

et al., 2025); Asif et al., 2022; Hashemi et al., 2021; Tao et al., 2022; Scheffler & Hermanussen, 2022).

The first short-term impact that can arise is impaired brain development, which has implications for decreased cognitive function and educational achievement in the long term. The second impact is *intrauterine growth restriction* (IUGR), which contributes to stunting or chronic physical growth retardation (Gantenbein & Kanaka-Gantenbein, 2022; Nyofane, 2024). Meanwhile, the third short-term impact includes changes in metabolic programming, which has the potential to increase the risk of metabolic degenerative diseases in the future, such as hypertension, diabetes mellitus, obesity, coronary heart disease (CHD), and stroke (Fawaz Bilqisthi & Falah, 2025; Silveira Rossi et al., 2022; Caturano, 2024; Janssen, 2021; Tirandi et al., 2022).

Children in Indonesia are at significant risk of malnutrition. Global data estimates that around 155 million children under the age of five are stunted (Suratri et al., 2023; Wicaksono et al., 2021; Suryana & Azis, 2023; Rizky Maulidiana & Sutjiati, 2021). The highest prevalence is recorded in Asia, with around 86.5 million children affected. This condition indicates the heavy burden of nutritional problems that remain a major challenge in the region (Huang et al., 2021; Han et al., 2022).

Meeting the nutritional needs of infants is not only determined by the quantity of food provided, but also by the quality and type of nutrients consumed. Protein is one of the essential nutrients that plays an important role in supporting early childhood growth (Pinto et al., 2023; Abbas & Karim, 2023; Sawitri & Mayulu, 2024; Sitorus & Salsabila, 2024). Essential amino acids, such as lysine, which is abundant in fish, contribute to the optimal absorption of other nutrients. Adequate protein intake is very important for tissue formation, strengthening the immune system, and brain development in infants and toddlers. Fish, as a high-quality source of animal protein, provides additional nutritional benefits due to its complete nutritional composition, including lysine content that supports the efficiency of nutrient absorption by children's bodies (Lamato & Zamli, 2025).

One of the main factors causing stunting is a lack of animal protein intake during the critical period of a child's growth, especially during the first 1000 days of life. Animal protein has advantages over plant protein because it contains a complete profile of essential amino acids and has high biological value to support optimal growth and development. Research shows that toddlers who do not consume animal protein have a higher risk of stunting, while the more diverse the sources of animal protein consumed, the lower the chance of stunting in toddlers. The Indonesian government has set the theme "Animal Protein Prevents Stunting" for National Nutrition Day 2023, which demonstrates a strong commitment to promoting animal protein consumption as a strategy to prevent stunting (Noorwahyuni et al., 2025).

On the other hand, access to quality animal protein sources is often constrained by economic factors, especially for families with low socioeconomic status. Catfish (*Clarias sp.*) is a promising alternative source of animal protein because it is affordable yet rich in nutrients. Based on data from the 2017 Food Composition Table (DKBM), catfish contains 18 grams of protein per 100 grams of material, 3 grams of fat, 237 milligrams of omega-3 fatty acids, 337 milligrams of omega-6 fatty acids, and 5.6 grams of iron. The protein in catfish contains essential amino acids such as lysine, methionine, and leucine, which are even higher than milk and meat. In addition, catfish are easy to farm and have high production rates in Indonesia, ensuring their sustainable availability (Fitriahadi et al., 2025).

Despite its good nutritional content and affordable price, catfish consumption among toddlers still faces several obstacles. The soft texture of catfish meat, which still contains fine bones, can make it difficult for toddlers to consume. In addition, monotonous processing methods often reduce children's acceptance of catfish. Therefore, innovation is needed in processing

catfish into food products that are not only safe for toddlers to consume but also attractive in terms of appearance and taste. One alternative processing method that can be developed is pulpety, a processed meat product that has a soft texture, is easy to digest, and can be shaped according to children's preferences (Pamungkas et al., 2025).

The development of catfish pulpety products as an alternative source of animal protein has great potential in supporting stunting prevention programs in Indonesia. Catfish pulpety can be formulated by adding other nutritious ingredients to increase its nutritional density, thereby optimally meeting the nutritional needs of toddlers. The pulpety processing, which involves grinding the fish meat, can eliminate the problem of small bones, which is often a concern for parents when feeding fish to toddlers. In addition, pulpety can be made in various attractive shapes and flavors to increase children's acceptance.

Based on this background, several issues that need to be addressed in this study are how to develop an optimal catfish pulpety formulation with high protein content and organoleptic characteristics that are acceptable to toddlers, how the processing affects the nutritional content and food safety of catfish pulpety products, and how catfish pulpety products can be used as a functional food alternative to support the prevention of stunting in toddlers. This study aims to develop catfish pulpety as a safe, nutritious, and acceptable alternative source of animal protein for toddlers. Specifically, this study aims to determine the optimal formulation of catfish pulpety with high protein content, analyze the physicochemical and organoleptic characteristics of catfish pulpety products, evaluate the microbiological safety and shelf life of the product, and assess the potential of catfish pulpety in meeting the daily protein requirements of toddlers for stunting prevention. The benefits of this research are expected to contribute to the development of innovative catfish-based food products as a practical solution to increase animal protein intake in infants. For the community, this research can provide alternative nutritious food products at affordable prices that are accessible to various economic groups. For the government, this research can support the national stunting prevention program through the diversification of local food products based on Indonesia's natural resources. For the food industry, this research can be a reference in the development of processed fish products that have high added value and a clear target market.

The novelty of this research lies in the development of a pulpety product specifically formulated for toddlers using catfish as the main ingredient. So far, there has been no comprehensive research on the development of catfish pulpety specifically designed for the prevention of stunting in toddlers. This research also integrates aspects of nutrition, food safety, and product acceptability into one holistic study. In addition, this research promotes the concept of sustainable use of local resources to address national nutrition issues, thus having broad implications for food security and the community's economy.

Methods

The research was conducted at the Food Nutrition Laboratory of the Rajawali Health Institute, starting with product development. After three formulations were created, a hedonic test was conducted at the Rajawali Health Institute's Organoleptic Laboratory. This research is a quasi-experimental study with a completely randomized design (CRD) on product innovations made from local fish. The study began with the organoleptic quality of three pulpety formulations with different ratios of chicken and catfish meat. Formula I was made with 100% chicken meat, formula II was made with a 1:3 ratio, and formula III was made with a 1:1 ratio.

Table 1. Composition of the Three Pulpety Formulas

Food Ingredient Name	Unit	Formula I (g)	Formula II (g)	Formula III (g)
Chicken meat	g	800	200	400

Catfish meat	g	0	600	400
Bread flour	g	40	40	40
Egg	g	100	100	100
Granulated sugar	g	25	25	25
Salt	g	15	15	15
Pepper	g	5	5	5
Garlic	g	20	20	20

The procedure for making catfish pulpety involves blending all the ingredients and shaping them into small balls. The mixture is then steamed to cook it. Each stage of the process is presented in a flow chart for each stage.

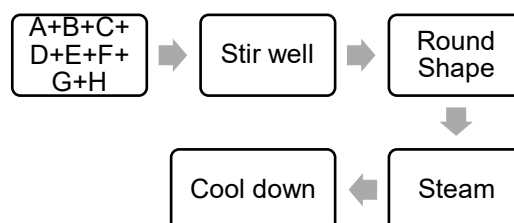


Figure 1. Pulpety Production Process

Description:

A = Chicken meat

B = Catfish meat

C = Bread flour

D = Eggs

E = Granulated sugar

F = Salt

G = Pepper

H = Garlic

The hedonic test was conducted by 30 students from the Rajawali Health Institute's Nutrition Undergraduate Program as untrained panelists. Panelists were asked to use their abilities to distinguish the taste, aroma, texture, and color of food products being tested. Hedonic testing is a commonly used method to measure the level of preference for food products. This level of preference is measured using a hedonic scale, where respondents give ratings based on their level of satisfaction or liking for the product being tested¹⁷. The hedonic scale used includes "love it, like it, somewhat like it, dislike it, hate it."

This method allows data to be collected in a more structured manner, where each respondent provides a numerical rating that reflects their level of preference or liking for the food product being tested. These scores can then be processed and analyzed to evaluate the overall level of preference, as well as to see variations in preference among the trained panelists involved

in the study. By using this scoring scale, more measurable data can be generated and used to support more in-depth statistical analysis of the hedonic test results.

The differences in organoleptic tests between formulations were analyzed using a One Way ANOVA test, followed by a Duncan test. The selection of this statistical test was adjusted to the number and nature of the data measurements obtained.

After pulpety obtained the highest average score based on the hedonic test results, the next stage in this study was to conduct laboratory analysis to determine the nutritional content, including energy, fat, protein, and carbohydrates. Laboratory testing was carried out at the Food Technology Laboratory of Pasundan University, with a third party selected based on facility qualifications and competencies in accordance with applicable standard operating procedures (SOPs). All analysis procedures were carried out systematically and referred to laboratory SOPs to ensure accuracy and consistency of results. The involvement of a credible third party with adequate facilities ensured that the analysis process was carried out professionally. The results of this analysis are expected to provide detailed information on the nutritional composition of the best *pulpety*, which can then be used to support understanding of the nutritional value of the product and its potential in supporting healthy consumption patterns.

Result and Discussion

Organoleptic Test Results

Color Attributes

The organoleptic test results for the color parameter showed that Formula II (1:3 ratio) received the highest acceptance with 50% of panelists giving a "Like" rating. Formula I (control) received a "Like" rating from 37% of panelists, while Formula III (1:1 ratio) received a "Like" rating from 33% of panelists. Overall, no panelists gave a "Strongly Dislike" rating for any of the three formulas.

Aroma Attributes

The aroma parameter showed that Formula II had the highest level of acceptance, with 73% of panelists liking the aroma of the product. Formula III received a "Like" rating from 53% of panelists, while Formula I received a "Like" rating from 50% of panelists. No panelists gave a "Strongly Dislike" rating for Formula II and Formula III, while Formula I received a "Dislike" rating from 3% of panelists.

Taste Attributes

The taste evaluation results show that Formula I (control) obtained the highest acceptance level with 67% of panelists stating that they liked the taste of the product. Formula II received 53% of panelists who liked its taste, while Formula III received 43% of panelists who stated they liked it. For the "Very Like" category, Formula III received the highest percentage at 33%, followed by Formula II at 23%, and Formula I at 13%.

Texture Attributes

The texture parameter showed different results compared to the other parameters. Formula III received the highest acceptance rate for the "Very Like" category with a percentage of 43%. Formula I and Formula II obtained the same percentage for the "Like" category, 40% and 37% respectively. Formula III also had the lowest percentage for the "Dislike" category, 7%, compared to Formula I at 17% and Formula II at 3%.

Statistical analysis results showed a significant difference ($p < 0.05$) in the pulpety texture made with variations in chicken and catfish meat mixtures. To determine more specific differences between treatments, a further test was conducted using Duncan's Multiple Range Test (DMRT).

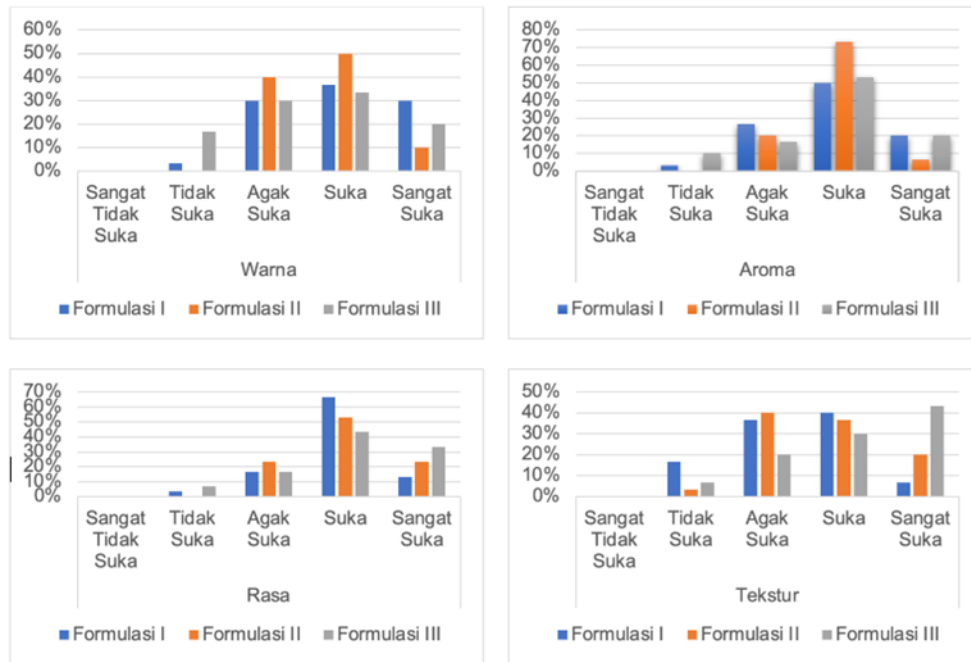


Figure 2. Color, Aroma, Taste, and Texture Attributes

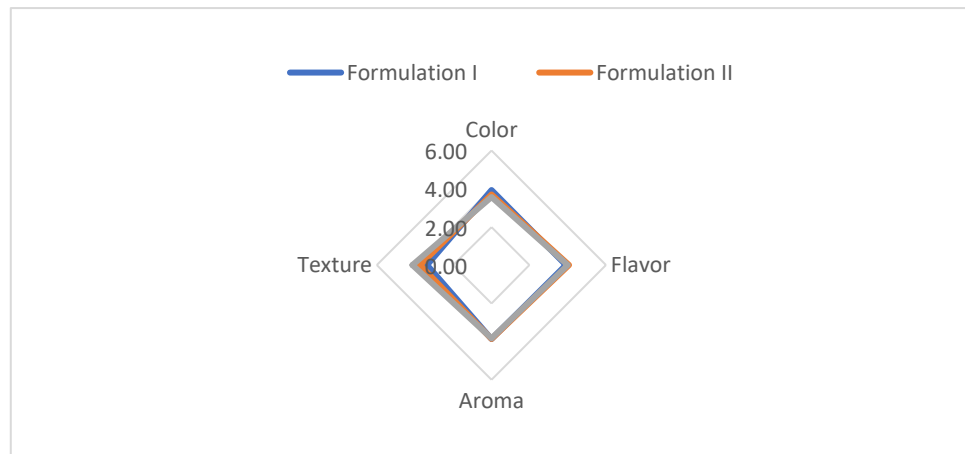


Figure 3. Spider web graph results

Based on the results of the analysis using the DMRT follow-up test, it was found that formulation III, which contained a balanced mixture of chicken and catfish meat at a ratio of 50%:50%, provided the best results in terms of texture. This formulation obtained the highest average score of 1.94, which statistically showed a significant difference compared to other formulations. This finding indicates that the combination of these two types of meat can contribute positively to the texture characteristics of catfish pulpety products, possibly due to the combination of soft chicken meat fibers and the unique protein content of catfish. Meanwhile, for other organoleptic attributes such as color, aroma, and taste, the analysis results show that there are no significant differences between the tested formulations ($p>0.05$). This indicates that variations in the proportions of chicken and catfish meat in the formulation do not have a significant effect on the panelists' perception of the color, aroma, or taste of the final product.

Table 4. Hedonic Test Results for Catfish Pulpety

Formulation	Color	Aroma	Taste	Texture
I	3.93±0.87 ^a	3.87±0.78 ^a	3.90±0.66 ^a	3.37±0.85 ^a
II	3.70±0.65 ^a	3.87±0.51 ^a	4.07±0.69 ^a	3.73±1.83 ^{ab}

III	3.57±1.01 ^a	3.83±0.87 ^a	4.00±0.91 ^a	4.13±1.94 ^b
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Note:

Numbers represent the mean ± standard deviation

Different superscript letters indicate significant differences (p<0.05)

Chemical Properties Analysis

The chemical properties tested in this study consisted of energy, protein, fat, and carbohydrates. The following are the results of the chemical property analysis that has been carried out. The chemical property testing of pulpety was carried out on formulation III as the best formulation based on the hedonic test results that were most preferred by the panelists overall. Table 3 shows that pulpety per 100 g meets the criteria as a snack food with energy of 22% of the RDA.

Table 3. Chemical Properties of Catfish Pulpety in Meeting the RDA for Children Aged 1-3 Years

Nutritional Content	RDA for Ages 1-3 Years	10-15% RDA	Results per 100 g (5 pieces)	% of Daily Value
Energy (kcal)	1350	135 – 202.5	214.78	15.9
Protein (g)	20	2–3	5.92	29.6
Total fat (g)	45	4.5–6.75	4.54	10.09
Carbohydrates (g)	215	21.5 – 32.25	10.05	4.67%

Based on the table above, it can be seen that the laboratory test results show that 100 grams of catfish pulpety contains 214.78 kcal of energy, or 15.9% of the daily requirement for toddlers aged 1-3 years. The protein content is 5.92 grams, or 29.6% of the RDA, and the fat content is 4.54 grams, or 10.09% of the RDA. The fat content in the pulpety is 10.05 grams or 4.67%. This indicates that catfish pulpety can meet the energy, protein, and fat requirements of toddlers aged 1-3 years (10-15% of the RDA) but does not meet their carbohydrate requirements.

Hedonic Test

Color Attribute

Color plays a significant role in determining whether a product is accepted or not, as it is the first visual aspect observed and can shape the initial perception of panelists. In the pulpety products produced, there were no significant color differences among the three formulas because the colors of chicken and catfish meat are almost similar, namely yellowish white (Bruce-Vanderpuije et al., 2025; Liang et al., 2025).

This insignificance indicates that differences in ingredient composition in each formulation do not significantly affect the visual perception of panelists. In processed fish products, color is influenced by the type of fish meat, additives such as eggs or flour, and cooking methods. Catfish meat has a yellowish-white color similar to chicken, making it visually acceptable to consumers (Wahidah et al., 2025).

Aroma Attribute

The consistency of scores for the aroma attribute of the pulpety product indicates that the aroma of the product is fairly consistent across formulations. The aroma of processed fish products is greatly influenced by the freshness of the raw materials and thermal treatment, as well as the presence of spices or additional seasonings.

Taste Attributes

The taste aspect, which is a crucial factor in determining the level of liking for the product, showed high average values in all three formulations (3.90–4.07). Formulation II showed the highest score (4.07 ± 0.69), but this was not statistically significant. This indicates that all formulations have a taste that is acceptable and liked by the panelists. The combination of catfish raw materials and seasonings is believed to provide a good flavor profile, close to the characteristics of conventional meat products.

Texture Attribute

Unlike other attributes, texture showed significant differences between formulations ($p < 0.05$), especially between Formulation I (3.37 ± 0.85) and Formulation III (4.13 ± 1.94). Formulation III received the highest score, indicating that the composition of ingredients in this formulation produced a product with a more preferred texture. Texture is greatly influenced by the binder ratio (such as eggs or flour), moisture, and processing methods. These results highlight the importance of adjusting the formula to achieve optimal texture.

Overall, all three formulations showed good acceptance by the panelists. However, Formulation III stood out in terms of texture, which was the main advantage in the evaluation of this product. A good flavor combination and preferred texture are important criteria in the development of competitive fish-based food products in the market.

Chemical Properties Analysis

The development of catfish pulpety formulations in this study shows very promising results in efforts to create alternative protein-rich food products for the prevention of stunting in toddlers. Based on the results of the study, the three formulations developed showed different characteristics, with Formula II (a ratio of chicken meat to catfish of 1:3) showing the best performance in certain organoleptic aspects. This is in line with other studies that emphasize the importance of processing catfish as an alternative complementary food for optimizing nutrition in the treatment of stunted toddlers, where creativity in processing can increase product acceptance by toddlers (Khan et al., 2025; Li et al., 2025).

Other studies indicate that complementary foods for breastfeeding (MP-ASI) based on local animal-based foods must have adequate protein content to support optimal growth in infants and prevent stunting. In this context, all pulpety- s developed have met the required protein content standards (Cardoso et al., 2025).

Energy

The energy content of 214.78 kcal per 100 g is equivalent to 15.9% of the RDA for children aged 1–3 years (RDA: 1350 kcal). This indicates that consuming 5 *pulpety* pieces can provide a significant energy contribution for one main meal or two light snacks. The energy in this product comes from a combination of carbohydrates, protein, and fat, which have a balanced proportion for young children (Nakamura et al., 2025).

Protein

The protein content of 5.92 g contributes 29.6% to the RDA (RDA: 20 g), indicating that this product has a high protein content. This is very important for young children, as protein plays a role in growth, muscle development, and the immune system. This protein content comes from the main ingredient, catfish, which is known as a high-quality source of animal protein with a good essential amino acid profile (Kujawska et al., 2025; Leanza et al., 2025).

Fat

The fat content of 4.54 g (10.09% of the RDA of 45 g) indicates that this product is still within the ideal range of fat consumption for children, especially when considering the possible

contribution of healthy fats from catfish, such as omega-3 fatty acids. A sufficient amount of fat is needed for brain development and the absorption of fat-soluble vitamins in children (Soengas et al., 2025; Vijayan et al., 2025).

Carbohydrates

The carbohydrate content of 10.05 g only meets approximately 4.67% of the total daily requirement (RDA: 215 g). The low proportion of carbohydrates indicates that this product is not a primary source of carbohydrates; however, this can be considered an advantage for children who tend to consume excessive carbohydrates from other staple foods. Therefore, this *pulpety* can be combined with other complex carbohydrate sources in the daily menu.

Conclusion

This study demonstrates that African catfish (*Clarias gariepinus*) *pulpetti* products exhibit a high level of organoleptic acceptability and favorable chemical characteristics, supporting their potential as a source of animal protein. Hedonic testing revealed variations in panelists' preferences across formulations: Formula II was the most preferred in terms of flavor and aroma, Formula I was most favored for taste, and Formula III was preferred for texture. Nevertheless, variations in the proportion of chicken meat and catfish in the formulations did not significantly affect panelists' perceptions of color, aroma, or taste of the final product, indicating that all formulations remained within an acceptable sensory range.

The chemical composition analysis showed that catfish *pulpetti* can provide approximately 10–15% of the recommended dietary allowance (RDA) for children aged 1–3 years in terms of energy, protein, and fat. However, it does not meet carbohydrate requirements at a comparable level. Therefore, this product is more appropriately positioned as a source of animal protein and supplementary energy rather than as a primary source of carbohydrates.

Accordingly, catfish *pulpetti* has strong potential to be developed as a nutritious local food innovation that can be utilized as a supplementary or complementary food in toddler nutrition intervention programs, particularly to enhance animal protein intake. Future studies are recommended to examine shelf life, food safety, and the long-term effects of regular consumption on the nutritional status and growth of toddlers through longitudinal designs.

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