Nutritional and Organoleptic Analysis of Tilapia Roulade as A Local Complementary Food Innovation to Prevent Stunting in Toddlers

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Abstract: Fish was a valuable source of animal protein, rich in essential nutrients, and had great potential as a complementary food product. However, limited innovation in modified fish-based products contributed to the low acceptance of fish among children. This study was conducted to evaluate the nutritional content and organoleptic properties of tilapia (Oreochromis mossambicus) roulade as a locally based complementary food product. The nutritional composition of the tilapia roulade was analyzed using the Indonesian Food Composition Table (DKBM). Organoleptic evaluation was performed by panelists through a hedonic test, which assessed parameters including color, aroma, taste, texture, appearance, and overall acceptability. The analysis showed that each serving of tilapia roulade contained 162.7 kcal of energy, 9.96 g of carbohydrates, 15.1 g of protein, and 6.52 g of fat, along with a complete profile of vitamins. Results from the organoleptic test indicated a high level of acceptance across all sensory attributes. These findings suggested that tilapia roulade, as a locally sourced innovation, had strong potential as an acceptable and nutritious complementary food product to support stunting prevention efforts.

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1 INTRODUCTION

Child health and growth are key indicators of a country's social and economic development success. Malnutrition in children under five remains a major global problem, impacting the quality of human resources. Although stunting prevalence in Indonesia has declined over the past ten years, national survey data shows that stunting prevalence in 2013 reached 37.6% and decreased to 19.8% in 2024 (SSGI, 2024).

Stunting is a chronic malnutrition condition caused by growth failure in toddlers, starting from pregnancy through the first two years of life (SSGI, 2024). Stunting is also an indicator of nutritional status determined based on the Height/Age Index with a z-score <-2 SD (standard deviation) (Abimayu & Nurul, 2023). According to United Nations Children's Fund (UNICEF) in 2013 stated that nutritional status in children is influenced by direct and indirect factors. Factors that directly influence nutritional status in toddlers are food intake and infectious diseases suffered during infancy. Meanwhile, indirect factors include food availability at home, inappropriate parenting patterns, unclean

sanitation, and inadequate health services. Several studies related to stunting that can support this theory have been conducted in Indonesia. This is in line with research conducted by Nabuasa (2024) which stated a significant relationship between energy intake and infectious diseases with the incidence of stunting in children aged 24-59 months in North Biboki District, NTT. Therefore, stunting management is considered insufficient with a medical approach. Therefore, one of the interventions carried out by the Ministry of Health is the provision of a Complementary Feeding program.

Complementary feeding is a nutritional supplementation provided as additional food or nutrients, specifically for malnourished toddlers. Complementary feeding is divided into two types: counseling complementary feeding and recovery complementary feeding. Counseling complementary food is food provided to targets with the aim of maintaining normal nutritional status with a maximum period of one month. Meanwhile, recovery complementary food is provided to improve the nutritional status of target toddlers (Maria, et. al, 2025). Based on SSGI data (2024), the challenge faced regarding complementary feeding is the proportion of toddlers aged 6-59 months in Indonesia who receive complementary feeding but do not finish it, which is 31.4% of a total of 22,688 children. This can be used as a reference for the hypothesis that there are several factors that influence food preferences in children. Eating habits and food preferences begin to develop during childhood, shaped by various factors such as family environment, food availability, parenting styles, socioeconomic status, lifestyle factors, and early experiences with various flavors and aromas (Diana & Arimbi, 2025). Food

preferences in children, especially tastes such as sweet, salty, bitter, sour, and savory, will be formed during the introduction and administration of complementary foods starting at 6 months of age, depending on the type of food and how it is given during that period. Based on research conducted by Mutiara, et al. (2025) found that the habit picky eater, this occurred in 53.3% of the total sample of children, indicating the importance of diversifying the diet provided from an early age. Meanwhile, 26.7% of children who were accustomed to certain foods tended to refuse them.

Tilapia fish or Oreochromis massambicus is one of the commodities water fish bid various which is easy to live and adapt and can be bred in Conditions. Tilapia reproduces relatively quickly compared to other freshwater fish species, making it a popular aquaculture commodity. Despite its abundant availability, children's lack of interest in fish consumption presents a challenge for parents in providing fish-based foods. In addition to its high production, tilapia also boasts high nutritional value and relatively low price (Sihmawati, et. al, 2022).

Based on the statements above, the author is interested in conducting a study entitled "Nutritional and Organoleptic Analysis of Tilapia Roulade as a Local Complementary Food Innovation to Prevent Stunting in Toddlers". This study aims to provide formulations made from local food, especially tilapia fish, to readers while analyzing the nutritional content and acceptability of tilapia roulade products as one of the innovative products in the complementary food program.

2 METHOD

This experimental activity was conducted in April 2025. Data collection was carried out through cooking demonstration activities. The tools used in the process of making tilapia roulade wére a chopper, steamer, stove, knife, cutting board, spoon, basin, spoon and fork Meanwhile, the ingredients used were tilapia fillet meat, carrots, spring onions, garlic, shallots, lemon, tapioca flour, wheat flour, mushroom stock, salt, pepper, flavoring, nutmeg eggs, and cooking oil

The process of making tilapia roulade is carried out in three stages, namely making the skin roulade, making roulade filling, rolling roulade, and cooking roulade. Making roulade skin is done by making a liquid dough, where the eggs are beaten with a little flour and salt, then pour the egg mixture on a hot teflon that has been smeared with a little oil until it covers the bottom layer of the teflon then wait until the mixture is cooked and forms an omelette sheet. The next step is to make the roulade filling by finely grinding the tilapia fish fillet with garlic and shallots using a chopper. Once smooth, the fish mixture is mixed with eggs, tapioca flour, salt, pepper, sugar, spring onions, and grated carrots until smooth.

Next, the cooked roulade skin is placed on a cutting board lined with plastic wrap, then the fish mixture is spread evenly over the surface The roll is formed gently and glued with a little dough so that it does not come off easily After all the dough is wrapped the roulade is steamed for approximately 30 minutes until cooked, prick with a fork to ensure the dough is perfectly cooked. The cooked roulade is cooled first, then cut and served.

The nutritional content of tilapia roulade is obtained from calculations based on the DKBM, which is carried out in several stages. The calculation process begins by identifying all the ingredients used in the recipe. Each ingredient is weighed raw according to the recipe's measurements in grams. The nutritional value of each ingredient is calculated by multiplying the weight of the ingredient used (in grams) by its content. Nutritional value per 100 grams according to DKBM data, then divided by 100. All the calculated nutritional content of each ingredient is added together to obtain the total nutritional content of tilapia roulade in one recipe. The total nutritional content of the recipe is divided by the number of servings produced. The nutritional content

of each serving is then divided again by the number of roulade pieces per serving.

This study used a descriptive method with an organoleptic test approach to assess the quality of local food-based tilapia roulade. The organoleptic test was conducted by involving panelists who were asked to provide assessments on several quality parameters, namely color, aroma, taste, texture, appearance, and the overall product. Each assessment category has a clear description as a reference for the panelists. In terms of color, the assessment includes whitish yellow, pale yellow, bright yellow, to dark yellow. The aroma parameter was assessed from very fishy, fishy, slightly fishy, to not fishy. Taste was categorized as not savory, slightly savory, savory, and very savory. Texture was tested from rough, slightly rough, soft, to very soft. Appearance was assessed from messy/crumbled, slightly crushed, neat, to very neat. Meanwhile, the overall assessment was given based on the panelists' general impression of the product in the same category, ranging from dislike, slightly like, like to very like. The assessment was carried out using the scoring categories that have been determined in the table, where each parameter will be given four assessment categories, ranging from code A to D. The assignment of letter codes to each assessment aims to make it easier for readers to understand the results of the test to be carried out. Thus, code A indicates the lowest score, and code D indicates the highest/best score. Therefore, the higher the code, the lower the score. The panelists' assessment data will then be analyzed to determine the quality category of tilapia roulade that is most acceptable to consumers. The following table shows the organoleptic test parameters for tilapia roulaude.

Table 1. Organoleptic Test Parameters of Tilapia Roulade

Assess-ment Code		Organoleptic Test Parameters					
		Color	Aroma	Taste	Texture	Appearance	General impression
Assess-ment Category	A	Whitish yellow	Very fishy	Not savory	Rough	Messy/ crumbled	Dislike
	B	Pale yellow	Fishy	Slightly savory	Slightly rough,	Slightly crushed	Slightly like
	C	Bright yellow,	Slightly fishy	Savory	Soft	Neat	Like

Assess-ment Code	Organoleptic Test Parameters					
	Color	Aroma	Taste	Texture	Appearance	General impression
D	Dark yellow	Not fishy	Very savory	Very soft	Very neat	Very like

3 RESULT

Nutritional Content of Tilapia Roulade

This local MT-making experiment yielded 10 portions of tilapia roulade, each containing 4 pieces of roulade, approximately 1.5 cm wide. The nutritional content of the tilapia roulade is explained in the table below.

Table 2. Nutritional Content of Tilapia Roulade

Nutritions	Nutritions Content		
	Per Recipe (600 grams)	Per Portion (15 grams)	Per Pcs (3,75 grams)
Energy	1.627 kkal	162,7 kkal	40,7 kkal
Carbohydrates	99,6 gr	9,96 gr	2,49 gr
Protein	151 gr	15,1 gr	3,8 gr
Fat	65,2 gr	6,52 gr	1,63 gr
Calcium	922,45 mg	92,245 mg	23 mg
Iron	21,7 mg	2,17 mg	0,54 mg
Potassium	2.119,2 mg	211,92 mg	52,98 mg
Phosphor	2.339,5 mg	233,95 mg	58,5 mg
Vit. A	274 mcg	27,4 mcg	6,85 mcg
Vit. B1	1,21 mg	0,121 mg	0,03 mg
Vit. B2	2,1 mg	0,21 mg	0,05 mg
Vit. B3	12,32 mg	1,232 mg	0,308 mg
B-Carotene	2.860 mcg	286 mcg	71,5 mcg
Sodium	4.911 mg	491,1 mg	122,8 mg
Fiber	1,7 g	0,17 g	0,04 g

Based on the analysis of the nutritional content of tilapia roulade, one recipe contains 1,627 kcal of energy, with 99.6 grams of carbohydrates, 151 grams of protein, and 65.42 grams of fat. Calculated per serving, the energy yield is 162.7 kcal, while per piece only contains around 40.7 kcal. This indicates that tilapia roulade is a nutrient-dense food with a relatively moderate energy content, making it suitable as an alternative complementary food for toddlers.

From a mineral perspective, tilapia roulade contains quite a high amount of calcium, namely 922.45 mg per recipe or around 92.25 mg per serving, so it has the potential to support children's bone and tooth growth. Its iron content reaching 21.7 mg per recipe (2.17 mg per serving), which can help prevent the risk of anemia, in toddlers. In addition, the potassium content (2,119.2 mg per recipe) and phosphorus (3,239.5 mg per recipe) are also high, important for maintaining body fluid balance and

energy metabolism. For vitamins, tilapia roulade contains 274 mcg of vitamin A per serving, vitamin B1 (0.13 mg), vitamin B2 (0.21 mg), and vitamin B3 (2.98 mg), which play an important role in energy metabolism and nervous system health. The B-carotene content of 286 mcg per serving indicates that this product also has potential as a source of natural antioxidants. In terms of fiber content, tilapia roulade contains only 0.17 g per serving, making its contribution to the daily recommended fiber intake relatively low. However, because this roulade focuses on increasing animal protein and micronutrient intake, the addition of vegetables to the roulade acts as a source of fiber and micronutrients. Overall, the results of this study indicate that tilapia roulade is a local food product with a fairly complete nutritional content. With a moderate energy content per serving, tilapia roulade has the potential to be a healthy and nutritious complementary food to support the growth of toddlers and can be an alternative local food in efforts to prevent malnutrition.

Organoleptic Test Results of Tilapia Roulade

The organoleptic test was conducted by providing a form containing the acceptance level of the tilapia roulade, including aspects such as color, aroma, taste, appearance, and overall results. Before completing the form, panelists were given instructions on how to complete it correctly, emphasizing the importance of honesty. The following are the results of the organoleptic test conducted on 10 panelists, the target group for the tilapia roulade supplement.

Hedonic test has a different level of acceptance. In terms of color, panelists preferred code 0. C (Bright yellow) with 6 panelists, and code D (Dark yellow) with 4 panelists, while codes A (Whitish yellow) and B (Pale yellow) did not receive an assessment. For the aroma parameter, code D (Not fishy) received the highest assessment with a total of 9 panelists, followed by code C (Slightly fishy) with 1 panelist. As for taste, the sample with code D (Very tasty) received the highest rating with a total of 7

	Color	Aroma	Taste	Texture	Appearance	General impression
Code A	0	0	0	0	0	0
Code B	0	0	0	0	0	0
Code C	4	1	3	2	4	3
Code D	6	9	7	8	6	7
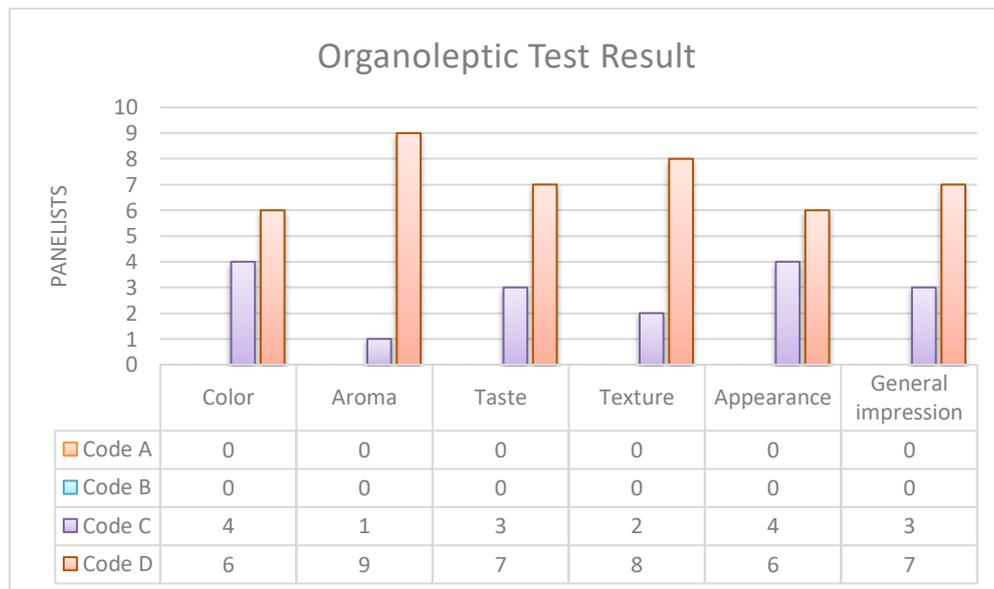
Graph SEQ Graph 1. Organoleptic Test Results of Tilapia Roulade

panelists, while code C (Savory) had 3 panelists, Meanwhile, codes A (Not savory) and B (Slightly saxory) did not receive a rating. Regarding the texture parameter, the highest rating was also given to code D (Very soft) with a total of 8 panelists, followed by code C (Soft) with 2 panelists. In terms of appearance, çode D (Very neat) received the highest rating (6 panelists), followed by code C (Neat) with 4 panelists. Meanwhile, for the hedonic test (overall level of liking), code D (Very like) received the highest score (7 panelists), followed by code C (Like) with 3 panelists, Based on these assessments, this indicates that tilapia roulade has a good level of acceptance in terms of color, aroma, taste, texture, appearance and overall results were high and liked by the panelists.

4 DISCUSSION

Complementary Food Provision is a government program to address the problem of malnutrition in toddlers by providing snacks containing nutrient-dense value while still paying attention to aspects of food quality and safety (Wati, 2020). In this research activity, the complementary food product provided to the target group was tilapia roulade. The selection of tilapia as the main raw material for roulade was based on field conditions in the local area, where tilapia is relatively cheap compared to chicken, non-allergenic, easily found in the market, has easy-to-clean bones, and is an innovative fish-based product to increase children's level of liking for marine harvests. The addition of vegetables to roulade is intended as a source of fiber, vitamins, and minerals and to increase the relatively low vegetable consumption in children. In addition, the choice of roulade products is considered more attractive than nugget products, both in terms of visual and nutritional value. The use of eggs as the outer layer of roulade also plays a role in the visual aspect and is an additional source of protein besides tilapia. This aligns with Darubekti's (2021) statement that complementary recovery foods are primarily made from local food sources. However, if local ingredients are limited, locally manufactured food products can be used, while still paying attention to safety aspects such as packaging and expiration date labels. Recommended snacks contain at least two protein sources, either animal or plant-based, as well as vitamins and minerals from vegetables or fruit.

This research activity is supported by research conducted by Edvina (2017) which showed a significant difference in body weight between before and after the complementary food program in children aged 6-59 months with an average increase of 1.11 kg. Tilapia roulade complementary food has dense nutritional content, especially in high protein content, namely 15.1 g/portion. The protein content of tilapia roulade is considered to be in accordance with the complementary food technical guideline of the Indonesian Ministry of Health (2018), where for malnourished toddlers, complementary food Recovery in the form of nutrient-dense snacks should contain around 350-400 kcal of energy and 10-15 g of protein per daily serving. Although the energy content of tilapia roulade is still less than the recommendation, one of the focuses of this research is the fulfillment of protein which plays a major role in improving nutritional status in children.

Protein is the most essential nutrient needed by toddlers to support their growth. Toddlers whose protein needs are not met through daily food consumption will have an impact on their nutritional

status which is getting worse (Wijayanti, 2017). This is supported by research conducted by Nabuasa (2024) which states there is a significant relationship between protein intake and the incidence of stunting in toddlers aged 24-59 months. Iron plays a very important role in supporting the growth and development of children, especially during the first 1,000 days of life. Iron functions as an essential component of hemoglobin which plays a role in transporting oxygen to all body tissues, including bone and brain tissue, thus supporting the process of linear growth and cognitive development. Iron deficiency in pregnant women increases the risk of anemia during pregnancy which impacts the oxygen supply to the fetus, so the fetus is at risk of being born with a low birth weight and less than optimal height. This condition contributes to an increased risk of stunting in toddlers. Furthermore, iron, along with vitamin A, will enhance the synergistic effect of iron in supporting growth, with vitamin A's role in cell differentiation and the immune system (Silaban et al., 2025). Calcium is an essential mineral involved in bone mineralization. Optimal bone mineralization is the primary foundation for linear growth in children during infancy. This finding is supported by research by Marsellinda et al. (2023) which showed that children with stunting had lower calcium intake than children without stunting. However, laboratory analysis is still needed to determine the actual macro and micronutrient content.

The product modifications in this activity are also considered to have an impact on the product's acceptance as a complementary food product. This is in line with research conducted by Faizul, et. al (2023) stated that the increase in food intake in children under 5 years of age was due to the modification of complementary food . Color is an important element that can influence consumers' initial impressions of a food product. Even though food has good taste and high nutritional content, an unattractive color appearance can reduce interest in consuming it. Conversely, colors that match consumer expectations can increase acceptance of the food (Fitriyatun & Putriningtyas, 2021). The color parameter for the tilapia roulade product showed that 4 panelists chose the color "bright yellow" and 6 panelists chose "dark yellow". The yellow color referred to in the tilapia roulade product is the wrapping/outermost layer of the roulade made from chicken eggs. Based on research conducted by Zurairah, et. al (2024) stated that the difference in yellow color in egg yolks is influenced by the xanthophyll carotenoid pigment. Meanwhile, for the aroma parameter, a total of 9 panelists chose "not fishy" and 1 panelist chose "slightly fishy". To reduce the fishy odor of tilapia, the meat is soaked in lemon juice for approximately 15 minutes. The D-limonene compound in lemons has antioxidant and antibacterial properties. Although this study did not explicitly examine the fishy odor of fish, its antibacterial properties may help suppress the activity of bacteria that cause odor in the product (Li Yuan, et al., 2019).

Based on the organoleptic test results, the taste aspect of tilapia roulade is considered to have a very savory taste. According to Pratama et al. (2018), the savory taste of tilapia fish comes from the protein content and natural flavoring compounds such as the amino acid glutamate and ribonucleotides. Meanwhile, the texture aspect obtained in tilapia roulade products tends to be soft, so it can be used as an innovative complementary food recipe for children. This is in accordance with the statement of

Wahyuni et al. (2023) that tilapia fish meat has a soft and tender texture, making it easy to process into various types of dishes, whether through steaming, frying, grilling, smoking, or processed into modern food products. Furthermore, the smooth fiber structure of tilapia meat makes this fish suitable for consumption by children, the elderly, and individuals with certain conditions who require soft-textured foods. Shape or appearance is the overall visual representation of a food product. This aspect plays a crucial role in attracting consumer attention. This is in line with the opinion of Holinesti and Dewi (2020), who stated that shape is a key aspect in increasing consumer interest in a food. Based on panelist interviews, the majority preferred steamed tilapia roulade. This is due to its more attractive appearance and lighter, less oily taste. The overall results of this study, using a hedonic test, found that tilapia roulade had an average preference score of 3.7 out of a maximum score of 4. The overall results were assessed based on all quality parameters, including color, aroma, taste, texture, and appearance. Therefore, tilapia roulade products were considered highly acceptable.

5 CONCLUSIONS

Based on the research results, the analysis of the nutritional content of tilapia roulade products has energy of 162.7 kcal, carbohydrates 9.96 gr, protein 15.1 gr, fat 6.52 gr per portion. Meanwhile, organoleptic test results covering color, aroma, taste, texture, appearance, and overall results showed high acceptability. This is evidenced by the large number of panelists who tended to choose the highest code. In other words, the higher the code given, the higher the acceptability score. With the high protein content of tilapia fish and the use of local ingredients, tilapia roulade has the potential to be an alternative nutrient-dense complementary food for toddlers. However, laboratory analysis is still needed to determine the actual macro and micronutrient content.

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