Bole Mortel Formulation of Catfish, Soybean Tempeh, Chicken Meat, and Carrot as Alternative Additional Food for 12-59 Months Old Toddler

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ABSTRACT	ARTICLE DETAILS
Childhood, particularly toddlerhood, is a period of rapid growth. Feeding difficulties are a common challenge faced by most parents, which can lead to nutritional deficiencies in children. One approach to improving children's dietary habits, with the goal of enhancing community nutrition, especially for toddlers, is to utilize local food ingredients in the form of alternative complementary foods. This study focused on Bole Mortel, a traditional food with a specially formulated recipe for toddlers aged 12-59 months. This research employed functional foods based on local ingredients, namely catfish, soybean tempeh, chicken, and carrots, as the primary raw materials. The study utilized a quantitative approach with an experimental design, employing a Completely Randomized Design (CRD) to assess the impact of catfish and soybean tempeh substitution on the nutritional quality, protein quality, and organoleptic properties of Bole Mortel. The study involved one factor, catfish and tempeh substitution with four different formulations. Each formulation was evaluated for preference by 30 semi-trained panelists and subjected to a descriptive analysis by 10 trained panelists. The results demonstrated that the nutritional quality of Bole Mortel in each formulation met 10-15% of the nutritional requirements for children aged 12-59 months. Theoretical digestibility and Net Protein Utilization for all formulations >90%. Moreover, the amino acid score for all formulations was 100. The proportion of catfish and soybean tempeh did not significantly influence taste, aroma, color, or texture. The P3 formulation, with a catfish : soybean tempeh ratio of 30:70, exhibited the highest preference and was deemed the most suitable. Toddlers aged 12-23 months can consume 60 grams (approximately 4-5 pieces) of Bole Mortel, while those aged 25-59 months can consume 80 grams (approximately 6-7 pieces). These serving sizes can fulfill 10-15% of a toddler's daily nutritional needs according to age, as outlined in the 2023 Technical Instructions for Providing Additional Food.	**Published On:** **31 January 2025** **Available on:** **https://ijmscr.org/**

KEYWORDS: Bole Mortel, Catfish, Soybean Tempeh, Alternative Additional Food, Toddlers.

I. INTRODUCTION

The prevalence of underweight in 2022 in children under 5 years of age globally is 12,6% or equivalent to around 84,5 million children (WHO, 2023). The Indonesian Nutritional Status Study (SSGI) in 2022 showed that the incidence of underweight increased by 0,1% from 17,0% in 2021 to 17,1% in 2022 (BKPK, 2022). Meanwhile, based on the 2023 Indonesian Health Survey, the prevalence of toddlers with underweight nutritional status was 12,9% (SKI, 2023). Based on this, prevalence of underweight toddlers in Indonesia is higher than the prevalence of underweight toddlers globally.

According to the 2020 Minister of Health Regulation, underweight is known as a low body weight that has a calculation of body weight according to age as its indicator (Permenkes, 2020). Underweight that is not treated early will cause the body to experience continuous energy or protein intake deficiencies (Dipasquale et al., 2020). If this continues for a long time, the body will fall into more chronic malnutrition such as stunting. Stunting itself is a condition of chronic malnutrition that describes stunted growth due to long-term malnutrition (Latifah, 2024).

Difficulty feeding children is a problem felt by most parents. Forms of behavior that are often experienced such as

being naughty when eating, being picky about food or only wanting certain foods, taking a long time to chew or keep it in the mouth, vomiting food, having no appetite, closing the mouth (Rifani & Ansar, 2021). Based on research conducted by Rahmi (2020), it is known that children who experience difficulty eating in the high category are at 2 times the risk of malnutrition. One effort to improve food consumption patterns that aims to improve nutrition in the community, especially toddlers, is by utilizing local food ingredients, namely chicken, catfish, tempeh, and carrots.

One of the sources of protein used in making Bole Mortel is catfish. The advantage of catfish compared to other animal products is rich in leucine and lysine. Leucine is an essential amino acid that is essential for children's growth and maintaining nitrogen balance. Meanwhile, lysine can support growth and development in children, improve immune function, and is useful for the metabolism of fatty acids into energy (Audia, 2017).

Tempeh is a fermented food made from soybeans or other types of beans using the fungus *Rhizopus oryzae*. Several studies have shown that tempeh nutrients are easier to digest, absorb, and utilize by the body. This is because the mold that grows on soybeans hydrolyzes complex compounds into simple compounds that are easily digested by humans (Asbur & Khairunnisyah, 2021). Based on this, the author wants to develop the Bole Mortel formula as an alternative functional food in the form of nutritious toddler snacks to prevent weight loss in toddlers aged 12-59 months.

II. OBJECTIVE

The objective of this research was to determine the nutritional quality (energy, protein, fat, carbohydrate, and zinc), protein quality (digestibility quality, amino acid score, limiting amino acid and NPU), and organoleptic quality of Bole Mortel. In addition, the purpose of this study was to determine the best treatment and analyze the serving size of Bole Mortel for toddlers aged 12-59 months. Also, to develop the Bole Mortel formula as an alternative additional food to prevent weight loss in toddlers aged 12-59 months.

This research will be useful as alternative local food additives that can be accepted and implemented in the community while overcoming nutritional problems in Indonesia.

III. MATERIALS AND METHOD

This research is quantitative research with experimental method using Completely Randomized Design (CRD) to analyze the effect of catfish and soybean tempeh substitution on nutritional quality, protein quality, and organoleptic quality of Bole Mortel. This research was conducted from March to November 2024 at the Food Technology Laboratory of Health Polytechnic of Health Ministry Malang.

The materials used in this research are catfish meat, chicken meat, soybean tempeh, carrots, chicken eggs, tapioca flour, garlic, onions, sesame oil, sugar, salt, wonton skin, and cooking oil. While the tools used are digital scales, basin, wok, spatula, oil drain, spoon, fork, knife, cutting board, blender, chopper, plate, pot, and stove. The steps of the formulation process,
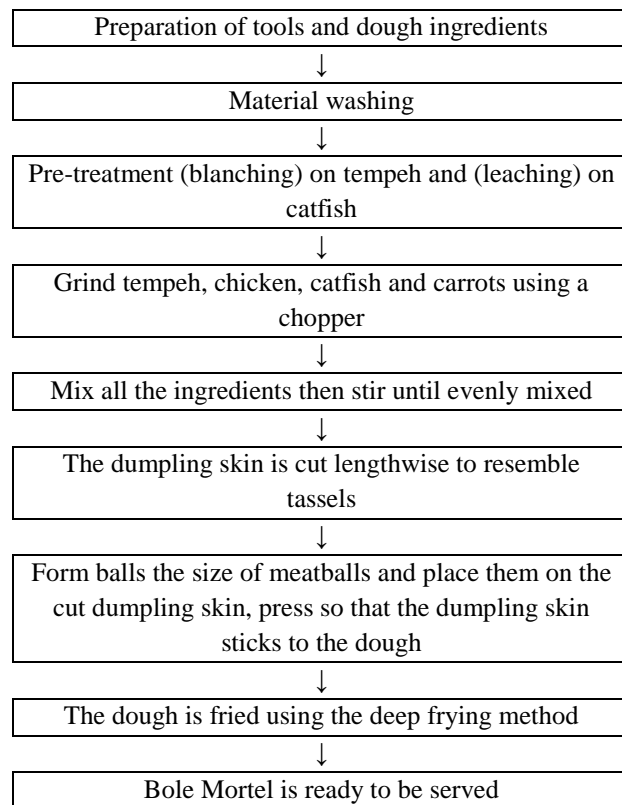
Preparation of tools and dough ingredients
↓
Material washing
↓
Pre-treatment (blanching) on tempeh and (leaching) on catfish
↓
Grind tempeh, chicken, catfish and carrots using a chopper
↓
Mix all the ingredients then stir until evenly mixed
↓
The dumpling skin is cut lengthwise to resemble tassels
↓
Form balls the size of meatballs and place them on the cut dumpling skin, press so that the dumpling skin sticks to the dough
↓
The dough is fried using the deep frying method
↓
Bole Mortel is ready to be served

Figure 1. Formula Processing Procedures

Calculation of nutritional quality (protein, fat, carbohydrate and zinc) was conducted by calculated value method. Energy values were processed using the atwater method. Protein quality analysis used the determination of protein content, amino acid score, theoretical digestibility, and net protein utilization. The panelists used for the organoleptic test were 30 semi-trained panelists. The descriptive test used 10 trained panelists who have sensory acuity, and know the product standards used as a comparison. The best formulation was processed using the effectiveness index method.

Data processing to determine differences in the level of panelist preference of each formulation was analyzed with Kruskal Wallis and Mann Whitney statistics at the 95% confidence level. Instruments for processing and analyzing research data using the SPSS for windows 25.0 program at the 95% confidence level, microsoft word, microsoft excel, and scientific calculator.

IV. RESULTS

A. *Energy and Nutritional Value of each Treatments*

Bole Mortel is food product based on chicken meat with substitutions of catfish and soybean tempeh. This product is

made into small rounds similar to meatballs. And, coated with dumpling skin that is cut like tassels. Bole Mortel products are the development of food formulas from school snack trends that children like, namely rambutan shrimp balls.

Nutritional quality analysis is an evaluation of the nutritional content of food products to ensure quality and safety for consumers. This evaluation includes determining the levels of protein, fat, carbohydrates, vitamins and minerals (Egayanti et al., 2019). The nutritional value of Bole Mortel is presented in Table 1.

Table 1. Nutritional Content of Bole Mortel in 100 grams of each Formulation

Variable	Formulation % (Catfish : Tempeh)			
	P0 (100 : 0)	P1 (70 : 30)	P2 (50 : 50)	P3 (30 : 70)
Energy (kcal)	255,7	261,1	264,7	268,5
Protein (g)	8,9	9,1	9,3	9,5
Fat (g)	13,7	13,8	14	14,1
Carbydrate (g)	24,4	25	25,4	25,9
Zinc (mg)	0,3	0,3	0,4	0,4

Table 1 showed that the more proportion of soybean tempeh makes higher energy, protein, fat, carbohydrate and zinc values contained in Bole Mortel. The highest energy, protein, fat, carbohydrate and zinc values were found in formulation 3 with the ratio of catfish: soybean tempeh (30 : 70). While the lowest value is found in formulation P0 with the ratio of catfish: soybean tempeh (100 : 0) or without the addition of soybean tempeh. The increased energy value, protein, fat, carbohydrate and zinc levels in Bole Mortel indicate that the more soybean tempeh substitution will increase the nutritional content of Bole Mortel.

In 100 grams of catfish contains 17,7 grams of protein, 4,8 grams of fat, and 0 grams of carbohydrates (Astawan, 2008; Primawestri et al., 2023). Meanwhile, 100 grams of soybean tempeh contains 20,8 grams of protein, 8,8 grams of fat, 13,5 grams of carbohydrates, and 1,7 mg of zinc (Indonesia, 2020). Therefore, the more soybean tempeh substitution will increase the value of energy, protein, carbohydrates, fat, and zinc in Bole Mortel.

Energy is essential component in the growth and development of toddlers. Adequate energy intake is essential to support physical activity, body tissue growth, and metabolic function in toddlers (Syarfaini et al., 2022). Protein is an essential molecule consisting of amino acids and plays an important role in various biological functions of the body, including the formation of tissues, enzymes, and hormones (Sholikhah & Dewi, 2022). Adequate protein intake is essential for optimal growth and development in toddlers, as protein deficiency can lead to growth disorders such as stunting (Gama & Adelina, 2024).

Adequate fat intake can prevent the risk of underweight in toddlers, which is often associated with inadequate energy and protein intake (Kumala et al., 2023). In addition, adequate fat intake is associated with good nutritional status in toddlers, thus preventing underweight (Listyawardhani & Yunianto, 2024). Adequate carbohydrate intake is essential to support physical activity and organ function in children aged 2-5 years (Abdullah, 2023). Adequate carbohydrate intake is essential to support physical activity and organ function in children aged 2-5 years (Abdullah, 2023). Adequate carbohydrate intake can also prevent wasting or significant weight loss in toddlers. In addition, there is a relationship between carbohydrate intake and the incidence of wasting in children aged 0-59 months in Takalar Regency (Syarfaini et al., 2022).

Zinc is involved in biochemical processes that support cell growth, cell division, cell differentiation, and tissue maturation (Virayanti et al., 2020). Zinc deficiency can contribute to impaired growth and development in toddlers. The benefits of zinc for toddlers are significant, especially in preventing and overcoming nutritional problems such as stunting and protein energy deficiency (Dewi et al., 2022). The results of the nutritional value analysis showed that the more proportion of soybean tempeh, the higher the zinc content contained in Bole Mortel.

Zinc from animal sources has higher bioavailability, making it easier to be absorbed by the body (Nugraheni et al., 2020). In contrast, zinc from vegetable sources tends to be bound to phytate, which inhibits zinc absorption in the digestive tract (Nugraheni et al., 2020). Phytate binds to zinc and forms insoluble complexes, reducing the availability of zinc for absorption by the body (Nugraheni et al., 2020). However, the fermentation process by the fungus *Rhizopus oligosporus* in making tempeh can reduce phytate levels in soybeans, which can inhibit the absorption of minerals such as zinc (Marco et al., 2021; Ray & Joshi, 2014). With the reduction of phytate, the bioavailability of zinc in tempeh increases, making the absorption of zinc by the body more efficient.

B. Protein Quality Analysis

Protein quality analysis is the evaluation of protein quality in food ingredients, which includes the determination of protein content, amino acid score, theoretical digestibility quality, and net protein utilization.

Table 2. Protein Quality of Bole Mortel for each Treatment Level

Formulation % (Catfish : Tempeh)	Limiting Amino Acid	Amino Acid Score	Theoritical Digestibility Quality	NPU
P0 (100 : 0)	-	100	94,24	94,24
P1 (70 : 30)	-	100	93,65	93,65
P2 (50 : 50)	-	100	93,28	93,28
P3 (30 : 70)	-	100	92,93	92,93

Table 2 showed that the digestibility and theoretical NPU of Bole Mortel from the four formulations ranged from 92,93-94,24%. This showed that the digestibility and theoretical NPU of the product were relatively high. While the amino acid score at all four levels of treatment reached 100%. This shows that the four formulations of Bole Mortel have amino acid scores that are included in the high category.

Table 2 showed that the more proportion of soybean tempeh in Bole Mortel, the NPU value and digestibility of the product decreases. The highest theoretical digestibility and NPU were found in the P0 formulation with the ratio of catfish: soybean tempeh (100 : 0) or without the addition of soybean tempeh. While the digestibility quality and the lowest theoretical NPU were found in the P3 formulation with the ratio of catfish : soybean tempeh (30 : 70). However, the value of digestible quality and NPU of the product is not much different, which is in the range of >90. This is because the product contains other main ingredients such as chicken meat and egg white which can improve the quality of protein in Bole Mortel.

The results of protein quality analysis showed that the more proportion of soybean tempeh in Bole Mortel, the NPU value and digestibility of the product decreased and vice versa. Based on Hardinsyah and Drajat (1992), the digestibility quality of catfish is higher than soybean tempeh which is 94. While the quality of digestibility in soybean tempeh is 90. Animal protein generally contains all essential amino acids in a balanced proportion, so it is considered a high-quality protein (Purwanti & Habibie, 2021).

The fermentation process by *Rhizopus* increases the availability of free amino acids in tempeh, so the protein quality is almost animal protein (Utari et al., 2011). Protease enzymes produced during fermentation convert complex proteins into simpler peptides and amino acids, making them easier for the body to digest (Hesa & Murtini, 2019). Based on this, tempeh not only provides significant amounts of protein but also in a more easily digestible form than other plant proteins.

C. Hedonic and Descriptive Analysis

Organoleptic quality referred to the quality of a product assessed based on human senses, including aspects such as taste, aroma, color, and texture (Astuti et al., 2024). Organoleptic quality test is a method of assessing product quality based on human sensory responses, such as sight, smell, taste, and touch (Sumarlina et al., 2024).
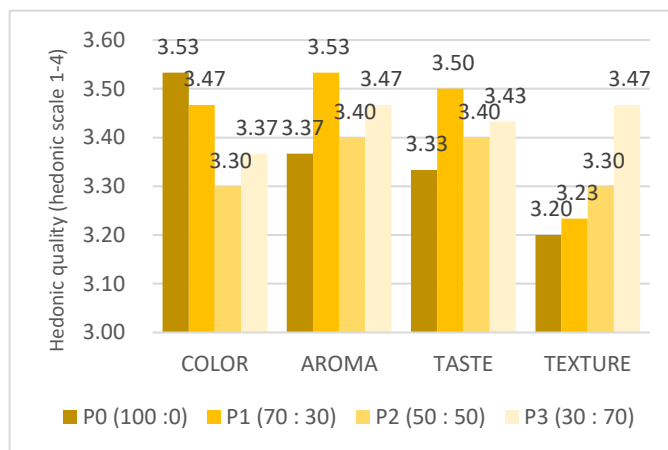
Description :
P0 = Formulation Proportion (%) Catfish: Soybean Tempeh (100 : 0)
P1 = Formulation Proportion (%) Catfish: Soybean Tempeh (70 : 30)
P2 = Formulation Proportion (%) Catfish: Soybean Tempeh (50 : 50)
P3 = Formulation Proportion (%) Catfish: Soybean Tempeh (30 : 70)

Figure 2. Level of Panelist Preference for Hedonic Quality of Bole Mortel

Figure 2 showed that the average level of panelist preference for the color of Bole Mortel was highest in the P0 formulation with the ratio of catfish : soybean tempeh (100 : 0) or without the addition of tempeh at 3,53. The results of Kruskall-Wallis analysis at the 95% confidence level showed that there was no significant difference (p=0,279) in the level of panelist preference for the color of Bole Mortel. This is because the ingredients used in each formulation have almost the same color. Catfish is separated from its skin so that it can produce the same color as soybean tempeh and chicken meat in Bole Mortel products. Color has an important role in attracting attention and affecting food preferences, especially in toddlers and children (Nisma et al., 2022).

Aroma is the sensation produced by volatile compounds that are inhaled through the nose, both directly and during the process of chewing food (Carolin et al., 2023). The average level of panelist preference for the aroma of Bole Mortel was highest in formulation P1 with the ratio of catfish: soybean tempeh (70 : 30) of 3,53. The results of Kruskall-Wallis analysis at the 95% confidence level showed that there was no significant difference (p=0,306) in the level of panelist preference for the aroma of Bole Mortel produced. This is because to reduce the fishy aroma of catfish, The aroma and languorous taste of tempeh are pre-treated. The catfish was leaching for 10 minutes and blanching soybean tempeh at 90°C for 10 minutes. So it is anticipated that the pre-treatment can reduce the fishy and languorous aroma in Bole Mortel products.

Leaching using salt water and ice cubes is an effective method to reduce the bad smell of catfish. The process of soaking catfish in salt solution can reduce the water content in fish meat, so that the fishy aroma is reduced and the resulting aroma is preferred by consumers (Suryaningrum et al., 2013). Blanching, or a short heating process, has an

important role in improving the organoleptic quality of tempeh. This process inactivates enzymes and microorganisms that can cause bad aroma in tempeh, so the aroma of tempeh becomes cleaner and more favorable to consumers. In addition, blanching also helps maintain the color of tempeh, making it more visually appealing (Suhendra, 2014).

Taste is sensation captured by the sense of taste through papillae on the tongue, which allows individuals to distinguish various types of flavors such as sweet, salty, sour, bitter, and umami (Azis & Mariyatur, 2024). The average level of panelist preference for the taste of Bole Mortel was highest in formulation P1 with the ratio of catfish: soybean tempeh (70 : 30) of 3,57. The results of Kruskall-Wallis analysis at the 95% confidence level showed that there was no significant difference (p=0,446) in the level of panelist preference for the taste of Bole Mortel produced. The addition of catfish in food products can increase the savory taste (umami) that is preferred by consumers. Ladu sala cake with the addition of catfish has a very savory taste and is liked by panelists (Dirmayani et al., 2022). Meanwhile, the addition of soybean tempeh to tempeh nuggets with a formulation of 25% tempeh and 25% chicken meat has a savory taste that is liked by panelists (Pujilestari et al., 2020). Based on this, the addition of catfish and tempeh can improve the taste of the product.

Texture is important sensory characteristic in food quality assessment, as it can affect consumer acceptability of the product (Suseno et al., 2007). The average level of panelist preference for the texture of Bole Mortel was highest in the P3 formulation with the ratio of catfish : soybean tempeh (30 : 70) of 3,43. The results of Kruskall-Wallis analysis at the 95% confidence level showed that there was no significant difference (p=0,446) in the level of panelist preference for the texture of Bole Mortel produced. This is because pre-treatment has been carried out on food ingredients in an effort to remove mucus from catfish and get a soft texture from tempeh in Bole Mortel products. So that it can increase panelist preference for the texture of Bole Mortel.

Research by Asben, et al. (2023) showed that pretreatment with the blanching method explained that the tempeh produced by blanching heating was not solid or could be said to be mushy because it was difficult to penetrate the tools used. Factors that affect texture measurement are the water content found in food, the higher the water content, the more soft the sample will be (Asben et al., 2024). Based on Figure 2 in each Bole Mortel formulation, the average hedonic quality value is 3, which means that the product is liked and accepted by the panelists.
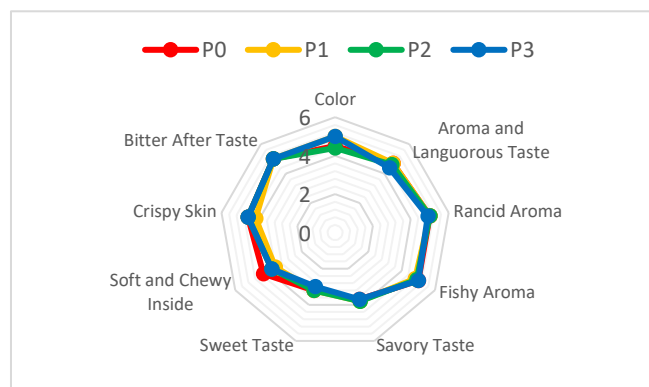
Description :
P0 = Formulation Proportion (%) Catfish: Soybean Tempeh (100 : 0)
P1 = Formulation Proportion (%) Catfish: Soybean Tempeh (70 : 30)
P2 = Formulation Proportion (%) Catfish: Soybean Tempeh (50 : 50)
P3 = Formulation Proportion (%) Catfish: Soybean Tempeh (30 : 70)

Figure 3. Bole Mortel Descriptive Analysis Results

Based on Figure 3, it is known that there are 9 quality attributes in the development of the Bole Mortel formula, namely color, aroma and languorous taste, rancid aroma, fishy aroma, savory taste, sweet taste, soft and chewy inside, crispy skin, and bitter after taste.

The results of descriptive analysis on the organoleptic quality attributes of the product are known that the color of Bole Mortel in each formulation has relatively the same results, which are golden brown yellow outer skin, has a weak song aroma, has no fishy and rancid aroma, savory taste, weak sweet taste, no bitter taste in the product, as well as, has a soft and slightly chewy texture on the inside, has a crispy outer skin, and no bitter after taste. With the result that, Bole Mortel products in each formulation can be accepted by consumers.

D. Best Treatment
Table 3. List of Values for Determining the Best Formulation

Formulation % (Catfish : Tempeh)	Result Value	Ranking
P0 (100 : 0)	0,11	IV
P1 (70 : 30)	0,50	III
P2 (50 : 50)	0,54	II
P3 (30 : 70)	0,87	I

Based on the results presented in table 3 in determining best treatment, the highest value of results is obtained with the amount of 0,87 in the P3 formulation, namely the formulation with the proportion (%) of catfish: soybean tempeh (30 : 70) which is declared as the best treatment that can be accepted by respondents. The ranking of the best to worst treatment is from P3, P2, P1, and P0. Based on this, it can be concluded that the more soybean tempeh substitution, the more the panelist's preference increases. The content of nutritional values according to serving size and descriptive

analysis of organoleptic quality in the best formulation of Bole Mortel presented in table 4.

Table 4. Serving Size of Bole Mortel Formulation 3 according to Age

Nutrition Quality	Nutrient Value	Requirement	Fulfillment (%)
	12-23 months		
Serving	60 grams (4-5 pieces of Bole Mortel)		
Energy (kcal)	161,1	137,5	117,2
Protein (g)	5,7	4,5	126,7
Fat (g)	8,5	7	121,4
Carbydrate (g)	15,5	14,125	109,7
Zinc (mg)	0,3	0,3	100,0
Nutrition Quality	Nutrient Value	Requirement	Fulfillment (%)
	24-59 months		
Serving	80 grams (6-7 pieces of Bole Mortel)		
Energy (kcal)	214,8	175	122,7
Protein (g)	7,6	6	126,7
Fat (g)	11,3	9,5	118,9
Carbydrate (g)	20,7	16,4	126,2
Zinc (mg)	0,4	0,5	80,0
AAS (%)	100		
Limiting Amino Acid	-		
DQ (%)	92,93		
NPU (%)	92,93		
Organoleptic quality	The color of Bole Mortel in formulation 3 is golden brown yellow outer skin, has a weak song aroma, does not have a fishy and rancid aroma, savory taste, weak sweetness, there is no bitterness in the product, Bole Mortel in formulation 3 has a soft texture and is slightly chewy inside, has a crispy outer skin, and there is no bitter after taste. With the result that, the Bole Mortel product in the formulation can be accepted by consumers		

CONCLUSION

The nutritional quality of Bole Mortel products in each formulation, including the values of energy, protein, fat, carbohydrates, and zinc, has met 10-15% of the requirements of children aged 12-59 months based on the PMT Technical Guidelines in 2023. The protein quality of Bole Mortel products in each formulation, specifically theoretical digestibility and net protein utilization (NPU), showed a

value of > 90. Also, the amino acid score showed a value of 100. The proportion of catfish and soybean tempeh did not provide significant differences in taste, aroma, color, and texture. Descriptive analysis of the organoleptic quality attributes of Bole Mortel products in each formulation, such as golden brown yellow outer skin, has a weak languorous aroma, does not have a fishy and rancid aroma, savory taste, weak sweetness, no bitterness in the product, has a soft and slightly chewy texture inside, has a crispy outer skin, and no bitter after taste. The highest level of preference and the best formulation of Bole Mortel products is found in the P3 formulation with the proportion (%) of catfish : soybean tempeh (30 : 70) as a dietary formula development product in the form of alternative additional food for toddlers aged 12-59 months with a total score (Nh) of 0,87. The serving size of the best formulation of Bole Mortel is found in the P3 formulation with the proportion (%) of catfish: soybean tempeh (30 : 70) for toddlers aged 12-23 months of 60 grams or 4-5 pieces and 25-59 months of age of 80 grams or 6-7 pieces. The serving size can fulfill 10-15% of the needs of toddlers according to age in a day based on the PMT Technical Guidelines in 2023. Based on the results of the research, chemical quality analysis needs to be carried out in the form of water content and ash content. Also, test the storability of the product.

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