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Acceptability of Chicken Liver, Egg, and Coconut Milk Enteral Formula (HATASA) as an Alternative for Managing Wasting in Toddlers

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Abstract

Introduction: Wasting *in toddlers remains a significant problem affecting growth and development, requiring affordable and nutritionally adequate interventions such as enteral formulas based on local food ingredients.* ***Objective:*** *This study aimed to evaluate the acceptability of an enteral formula made from chicken liver, eggs, and coconut milk as an alternative for managing* wasting *in toddlers.* ***Method:*** *A combination of true experimental and quasi-experimental research with a completely randomized design was conducted from July to August 2025 using three formulations (F1, F2, F3). Chicken liver flour was produced through drying at 90°C for 3 hours, followed by grinding and sieving. Organoleptic testing involved 15 untrained panelists using a 7-point hedonic scale, and data were analyzed using Kruskal-Wallis and Mann-Whitney tests.* ***Result and Discussion:*** *The shrinkage of chicken liver into flour reached 86.7% and 93.05%. Osmolality values ranged from 258-296 mOsm/kg, lower than the commercial product (491 mOsm/kg), while moisture content ranged from 3.76-4.02%, comparable to the commercial product (3.77%). Flow rate ranged from 0.56-1.20 sec/ml. Color values showed l* 31.4-39.9, a* 3-3.45, and b* 7.8-10.4 with no significant differences ($p>0.05$). Organoleptic results indicated that Formula 1 had higher preference scores (color 5.73, aroma 4.80, overall 4.73) compared to other formulas, although taste, texture, and overall aspects showed significant differences ($p<0.05$). Higher chicken liver content tended to reduce acceptability, particularly in taste.* ***Conclusions****: The best formula was F1 (20 g chicken liver flour and 20 g egg flour), which showed the highest overall acceptability and comparable physical characteristics.*

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Introduction

Nutritional status is a condition resulting from the balance between nutrient intake from food and the body's nutritional requirements (Supariasa *et al*., 2012). Wasting is one of the nutritional status categories in toddlers. To assess the nutritional status of children under five, body weight and height measurements are converted into standardized values (Z-scores). One of the indices used is weight-for-length (W/L) or weight-for-height (W/H) to classify severe malnutrition (< -3 SD), wasting (-3 SD to < -2 SD), normal nutrition (-2 SD to +1 SD), risk of overnutrition (> +1 SD to +2 SD), overnutrition (> +2 SD to +3 SD), and obesity (> +3 SD) (Ministry of Health, 2020). The prevalence of wasting in Indonesia is 6.4% (95% CI 6.2-6.5), while in Central Java Province it is 5.5% (95% CI 5.2-5.9). The proportion of nutritional status (W/L) among children aged 0-59 months shows 6.9% (95% CI 6.7-7.1) in males and 5.8% (95% CI 5.6-6.0) in females (SKI, 2023).

Factors contributing to wasting in toddlers include infectious diseases (Bili *et al*., 2020; Azrimaidaliza *et al*., 2022), maternal knowledge (Bili *et al*., 2020; Pibriyanti, 2022; Faridi *et al*., 2023), parenting practices (Faridi *et al*., 2023; Alkhair *et al*., 2023), levels of energy and protein intake (Bili *et al*., 2020; Faridi *et al*., 2023; Alkhair *et al*., 2023), and family income (Azrimaidaliza *et al*., 2022). Research by Oktavia *et al*. (2017) also shows a relationship between family economic status and the adequacy of energy and protein intake in toddlers. Similarly, Azrimaidaliza *et al*. (2022) found that poor dietary patterns are significantly associated with wasting ($p = 0.036$; POR = 5.997; CI = 1.127-26.153). In addition, parental strategies to encourage children to eat are associated with weight-for-age ($r = 0.35$, $p = 0.028$) (Polanunu *et al*., 2020).

Wasting in children is not a new issue. Children experiencing nutritional problems may face impaired growth and development in the future. One effort to reduce wasting is nutritional therapy through enteral feeding. Enteral food is a liquid form of nutrition that can be administered orally or via a feeding tube as long as the digestive tract functions properly. The administration of Modisco to toddlers has been shown to increase body weight in children with wasting and severe malnutrition. The use of skim milk as a base ingredient in enteral formulas is relatively expensive; therefore, there is a need to develop enteral products using locally available, affordable, and nutritionally rich food sources. The development of the HATASA product aims to meet the nutritional needs of toddlers using accessible and economical local ingredients, namely chicken liver, eggs, and coconut milk.

Chicken liver is a commonly available food source in the community. According to the Indonesian Food Composition Table (TKPI, 2017), 100 grams of chicken liver contains 261 kcal of energy, 27.4 grams of protein, 16.1 grams of fat, and 1.5 grams of carbohydrates. Analysis of average micronutrient requirements (iron, zinc, vitamin A, folate, and vitamin B12) indicates that several animal-based foods are relatively affordable due to their high nutrient bioavailability, including chicken liver, ruminant liver, fresh milk, and eggs. Chicken liver from adult chickens tends to be dark brown, while that from newly hatched chickens appears yellowish or sometimes whitish due to fat accumulation during yolk absorption (Yaxshiyeva, 2022). The provision of chicken liver has been proven effective ($p = 0.000$) in increasing average hemoglobin levels (Nurlinda *et al*., 2022).

Based on the Indonesian Food Composition Table (TKPI, 2017), 100 grams of chicken eggs contain 154 kcal of energy, 12.4 grams of protein, 10.8 grams of fat, and 0.7 grams of carbohydrates. Hypothesis testing using a paired t-test showed the effect of egg protein intake on weight gain in severely malnourished toddlers. Furthermore, the Mann-Whitney test showed differences between carbohydrate intake and egg protein intake in influencing weight gain among malnourished toddlers. One method of producing egg flour is through drying, which involves reducing water content through evaporation. Research by Ndife *et al*. (2010) shows that egg drying methods include spray drying, pan drying, and freeze drying.

According to the Indonesian Food Composition Table (TKPI, 2017), 100 grams of coconut milk contains 324 kcal of energy, 4.2 grams of protein, 34.3 grams of fat, and 5.6 grams of carbohydrates. The nutritional content of coconut milk powder shows protein at 8.24%, fat at 38.21%, carbohydrates at 46.83%, and ash content at 2.66%. Chicken liver flour and egg flour are innovative products that have undergone drying processes to reduce moisture content, extend shelf life, and retain their nutritional value. Based on the above description, this study aims to evaluate the acceptability of an enteral formula made from chicken liver, eggs, and coconut milk as an alternative for managing wasting in toddlers.

Method

The study conducted was a combination of true experimental and quasi-experimental research using a completely randomized design (CRD). The formula development stage was a true experimental study, while the organoleptic testing stage was quasi-experimental. There were three treatments, namely F1, F2, and F3. The study was conducted from July to August 2025. The preparation of the enteral formula was carried out in the Food Science Laboratory, while organoleptic testing was conducted in the Organoleptic Laboratory of Universitas Muhammadiyah Surakarta. This study received ethical approval from the Health Ethics Committee of the Faculty of Medicine, Universitas Muhammadiyah Surakarta with approval number 5857/B.1/KEPK-FKUMS/IX/2025.

The equipment used for producing chicken liver flour included a gas stove, spoon, digital scale, food thermometer, pan, cutting board, knife, grinder, sieve shaker, 80-mesh sieve, and dehydrator. The equipment used in the preparation of the enteral formula included a digital scale, pan, basin, measuring cup, blender, whisk, sieve shaker, and 80-mesh sieve. The ingredients used in the preparation of the enteral formula were chicken liver flour, egg flour, coconut milk powder, chocolate full cream milk, granulated sugar, maltodextrin, canola oil, and vanilla.

Fresh chicken liver samples were obtained from Kleco Market and Superindo Supermarket, cleaned under running water, and then soaked in lime juice for 2 minutes. The chicken liver was boiled with added spices such as ginger, lemongrass, and kaffir lime leaves for 20 minutes at 100°C. After draining, the chicken liver was thinly sliced and then dried using a dehydrator at 90°C for approximately 3 hours. Once dried, it was ground into powder using a grinder and then sieved using an 80-mesh sieve shaker for 3-5 minutes (modified from Rahmawati & Rohmansyah, 2024).

The samples evaluated were the prepared enteral formulas, and a hedonic (organoleptic) questionnaire was provided for panelists to assess characteristics including color, aroma, taste, texture, and overall acceptance using a scale of 1-7 (1: strongly

dislike, 2: dislike, 3: somewhat dislike, 4: neutral, 5: somewhat like, 6: like, and 7: strongly like). The panelists in this study were 15 untrained individuals. Data analysis was conducted using the Kruskal-Wallis test ($\alpha = 0.05$) because the data were not normally distributed. If significant differences were found, the Mann-Whitney U test was performed to identify differences between treatments.

Table 1
Formulation of enteral product based on chicken liver, egg, and coconut milk (HATASA)

Ingredients (grams)	F1	F2	F3	Unit
Chicken liver flour	20	30	25	g
Egg flour	20	10	15	g
Chocolate full cream milk	85	85	85	g
Coconut milk powder	30	30	30	g
Granulated sugar	30	30	30	g
Maltodextrin	20	20	20	g
Canola oil	20	20	20	ml
Vanilla	2	2	2	g

Table 2
Market review of enteral and commercial formulas per serving

Formula	Serving Size	Price per Formula	Price per Serving
Formula 1	38 g	Rp 27.296	Rp 4.572
Formula 2	38 g	Rp 24.442	Rp 4.094
Formula 3	38 g	Rp 25.869	Rp 4.333
Commercial	45 g	Rp 70.810	Rp 17.224

Table 3
Nutritional values of enteral and commercial formulas per serving

Formula	Serving Size (g)	Energy (kcal)	Protein (g)	Fat (g)	Carbohydrates (g)
Formula 1	38	173.3	5.8	7.6	16.2
Formula 2	38	171.8	4.9	7.9	16.2
Formula 3	38	172.6	5.3	7.7	16.2
Commercial	45	200	6	7	30

Result and Discussion

1. Result

Chicken Liver Flour

Table 4
Percentage shrinkage of chicken liver into chicken liver flour

Raw Weight (grams)	Cooked Weight (grams)	Flour Weight (grams)	Residue (grams)	% Shrinkage of Chicken Liver into Flour
1200	625	194.5	6.8	86.7%
1410	831	270.6	4.2	93.05%

Osmolality, Flow Rate, and Moisture Content

Table 5
Results of osmolality, flow rate, and moisture content tests of HATASA enteral and commercial products

Formula	Osmolality	Flow Rate (65 cm tube, 50 ml)	Moisture Content (%)	ρ-value
Formula 1	296 mOsm/kg	1.20 sec/ml	4.02	0.392
Formula 2	258 mOsm/kg	0.71 sec/ml	3.80	
Formula 3	273 mOsm/kg	0.56 sec/ml	3.76	
Commercial	491 mOsm/kg	0.94 sec/ml	3.77	

Color Measurement

Table 6
Results of color measurement of HATASA enteral and commercial products

Formula	Color Measurement					
	l*		a*		b*	
	1	2	1	2	1	2
F1	32.9	29.9	2.8	3.9	12	8.8
Mean ± SD	31.4 ± 2.1213		3.35 ± 0.7778		10.4 ± 2.2627	
F2	30.7	32.2	3.6	3.3	7.1	8.5
Mean ± SD	31.45 ± 1.0607		3.45 ± 0.2121		7.8 ± 0.9899	
F3	35.6	44.2	2.8	3.2	8.2	11
Mean ± SD	39.9 ± 6.0811		3 ± 0.2828		9.6 ± 1.9799	
Komersial	52.6	53.6	4.1	5.0	10.9	10.2
Mean ± SD	53.1 ± 0.7071		4.55 ± 0.6364		10.55 ± 0.4950	
ρ-value	0.112		0.177		0.367	

Organoleptic Test

The organoleptic test used five assessment aspects: color, aroma, taste, texture, and overall acceptability, using a 7-point scale where each parameter was scored as follows: strongly like (7), like (6), somewhat like (5), neutral (4), somewhat dislike (3), dislike (2), and strongly dislike (1).

Table 7
Organoleptic test results of HATASA enteral and commercial products

Formula	Color	Aroma	Taste	Texture	Overall
Formula 1	Like	Somewhat like	Neutral	Somewhat like	Somewhat like
Formula 2	Somewhat like	Somewhat like	Neutral	Somewhat like	Neutral
Formula 3	Somewhat like	Somewhat like	Somewhat like	Somewhat like	Somewhat like
Commercial	Like	Somewhat like	Like	Like	Like

Based on Table 7, the organoleptic results show that HATASA enteral Formula 1 was more preferred by panelists compared to Formula 2 and Formula 3. In terms of aroma and texture, all three formulas received the same rating, namely somewhat like. For taste, panelists rated Formula 3 higher (somewhat like) compared to Formula 1 and Formula 2, which were rated neutral. In terms of overall acceptability, Formula 1 and Formula 3 were rated somewhat like, while Formula 2 was rated neutral.

Table 8
Statistical results of organoleptic test of HATASA enteral and commercial products

Formula	Mean ± SD				
	Color	Aroma	Taste	Texture	Overall
Formula 1	5.73 ± 1.100	4.80 ± 1.373	4.27 ± 1.223[a]	4.80 ± 0.862[a]	4.73 ± 0.961[a]
Formula 2	5.40 ± 1.298	4.80 ± 1.265	4.40 ± 1.352[a]	4.78 ± 1.100[a]	4.53 ± 1.125[a]
Formula 3	5.20 ± 1.373	5.07 ± 1.280	4.67 ± 1.234[a]	4.80 ± 1.082[a]	4.87 ± 1.060[a]
Komersial	5.73 ± 0.704	5.40 ± 0.910	5.73 ± 0.884[b]	5.67 ± 0.976[b]	5.67 ± 0.816[b]
ρ-value	0.687	0.463	0.005’	0.043’	0.017’

Based on the organoleptic test results above, the color aspect (ρ-value = 0.687) and aroma aspect (ρ-value = 0.463) showed no significant differences. Meanwhile, the taste aspect (ρ-value = 0.005), texture aspect (ρ-value = 0.043), and overall aspect (ρ-value = 0.017) showed significant differences. The over all preference level from untrained panelists (n = 15), covering color, aroma, taste, texture, and overall acceptability, indicated that the most preferred formula was Formula F1 (20 g chicken liver flour and 20 g egg flour). The overall preference results are presented in Figure 1.

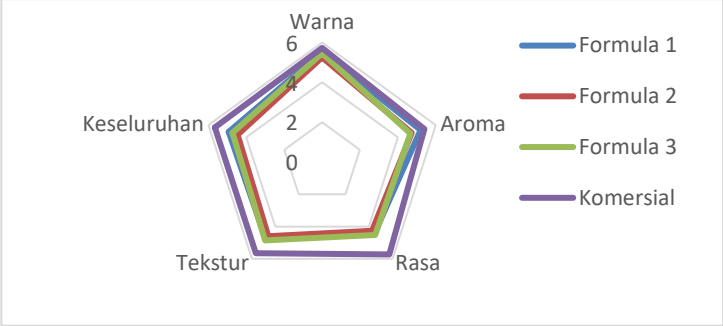

Figure 1. Radar chart of panelists’ organoleptic evaluation

2. Discussion

Chicken Liver Flour

Chicken liver was dried using a dehydrator at 90°C for approximately 3 hours. The results of this study indicate differences in the yield of chicken liver flour. In the first processing, the raw chicken liver weighed 1200 grams. After processing and sieving, 194.5 grams of chicken liver flour were obtained, with a shrinkage percentage of 86.7%. In the second processing, 1410 grams of chicken liver were used. After processing and sieving, the weight decreased to 270.8 grams, with a shrinkage percentage of 93.05%.

This differs from a study conducted by Rakhman & Adi (2023), where chicken liver was washed and boiled for approximately 20 minutes. The drying process was carried out at 60°C for 4 hours. The dried chicken liver was then ground using a blender and sieved through a 70-mesh sieve to obtain a fine texture of chicken liver flour.

Osmolality, Flow Rate, and Moisture Content

The osmolality test results of HATASA enteral showed that Formula 1 had an osmolality of 296 mOsm/kg, Formula 2 of 258 mOsm/kg, Formula 3 of 273 mOsm/kg, and the commercial product of 491 mOsm/kg. The recommended osmolality range is 300-450 mOsm/kg, indicating that the HATASA enteral formulas are still below the

recommended level. Substitution of sugar with maltodextrin can reduce osmolality, as maltodextrin has lower osmotic pressure than sugar due to its water-binding properties. Lower osmolality may provide better gastrointestinal tolerance in toddlers, especially for children with wasting who often experience impaired digestive function and reduced appetite. Enteral formulas with moderate osmolality are considered more suitable to minimize the risk of diarrhea, bloating, and feeding intolerance during nutritional intervention (Sanz-Paris *et al*., 2019).

The flow rate test results showed that Formula 1 had a flow rate of 1.20 sec/ml, Formula 2 of 0.71 sec/ml, and Formula 3 of 0.56 sec/ml, while the commercial formula had a flow rate of 0.94 sec/ml. The flow rate test aims to determine the speed at which the enteral formula flows through a tube. Flow rate is related to viscosity. Based on these results, the viscosity of the HATASA enteral formulas could not be precisely determined, possibly due to limitations of the available laboratory equipment. Additionally, previous research indicates that higher viscosity results in a slower flow rate.

The moisture content test results showed that Formula 1 had a moisture content of 4.02%, Formula 2 of 3.80%, and Formula 3 of 3.76%. These results are similar to the commercial product (3.77%). Moisture content affects shelf life and the rate of deterioration. During the drying process, reduced moisture content inhibits microbial growth and enzymatic reactions, thereby extending shelf life (Basuki *et al*., 2020). Based on the Kruskal-Wallis test, the ρ-value for osmolality, flow rate, and moisture content was 0.392, indicating no significant differences. In addition, the nutritional composition of the HATASA formulas showed energy values ranging from 171.8-173.3 kcal and protein content ranging from 4.9-5.8 g per serving. These nutrients are important in supporting catch-up growth among toddlers with wasting, as adequate energy and protein intake contributes to weight gain, tissue repair, and improvement of nutritional status (Cooke *et al*., 2023).

Color Measurement

The l* value represents lightness, ranging from 0.0 (black) to 100.0 (white), and may exceed 100.0 in cases of specular reflection. The a* and b* values represent red-green and yellow-blue perceptions, respectively, with positive values indicating red (a*) and yellow (b*), and negative values indicating green (a*) and blue (b*). A value of 0.0 indicates a neutral (achromatic) stimulus (Purhita, 1968).

The results of color measurement showed that Formula 1 had an l* value of 31.4 (dark to light), Formula 2 of 31.45 (dark to light), Formula 3 of 39.9 (dark to light), and the commercial formula of 53.1 (slightly bright). For a*, Formula 1 had a value of 3.35 (red), Formula 2 of 3.45 (red), Formula 3 of 3 (red), and the commercial formula of 4.55 (red). For b*, Formula 1 had a value of 10.4 (yellow), Formula 2 of 7.8 (yellow), Formula 3 of 9.6 (yellow), and the commercial formula of 10.55 (yellow). Based on the Kruskal-Wallis test, the ρ-values for l*, a*, and b* were 0.112, 0.177, and 0.367, respectively, indicating no significant differences.

Organoleptic Evaluation

Color

The highest level of panelist acceptance for color was observed in the commercial formula. The color of HATASA enteral was influenced by variations in chicken liver and chocolate full cream milk. The results showed no significant differences in color acceptance among all formulas. Wahyuning Tyas *et al*. (2025) reported that substitution with chicken liver results in a darker, brownish color. The brown color in Formula 2 (30 grams of chicken liver flour) also influenced panelists' preference.

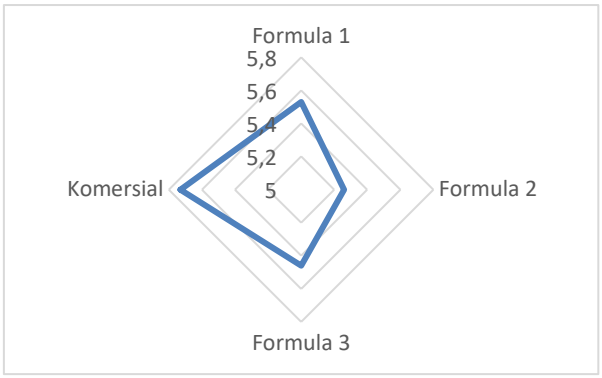

Figure 2. Radar chart of organoleptic color evaluation

Smell

Panelists rated the commercial formula highest in terms of aroma. Formula 3, with 25 grams of chicken liver flour and 15 grams of egg flour, received the lowest score among the formulas. Statistical analysis showed no significant differences in aroma acceptance among all formulas. Heating chicken liver and egg flour causes protein denaturation, releasing inorganic compounds that interact with other compounds such as fatty acids, producing a fishy and strong odor (Kerth, 2013 in Dalimunthe *et al*., 2024).

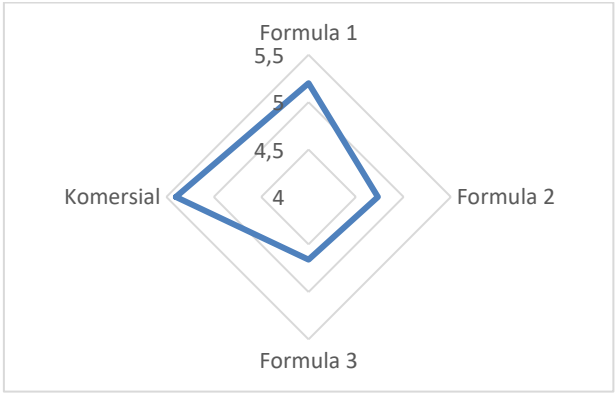

Figure 3. Radar chart of organoleptic aroma evaluation

Taste

The highest acceptance for taste was observed in the commercial formula, followed by Formula 3 (25 g chicken liver flour and 15 g egg flour). The results showed a significant difference in taste acceptance among the formulas. Formula 2, which contained the highest amount of chicken liver flour, had the lowest acceptance score. This is consistent with Thalia & Rohmansyah (2025), which found that formulas with higher

amounts of chicken liver tend to be less preferred by panelists. Taste acceptability is an important factor in nutritional interventions for toddlers with wasting because poor palatability may reduce food intake and affect compliance with enteral feeding programs. Although chicken liver contributes high-quality protein and micronutrients such as iron and vitamin A, excessive amounts may negatively affect taste acceptance due to its strong flavor. Therefore, balancing nutritional quality and sensory acceptability is essential in developing enteral products for toddlers (Xu & Yin, 2024).

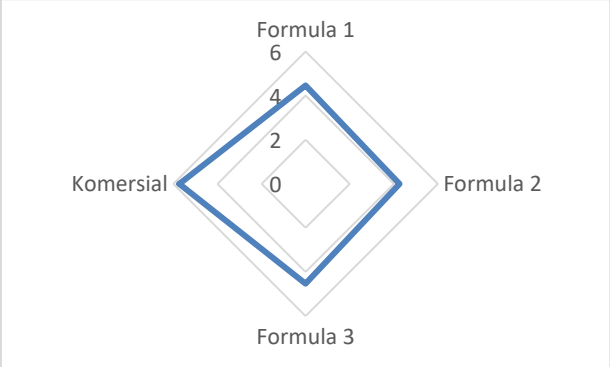

Figure 4. Radar chart of organoleptic taste evaluation

Texture

Panelists rated the commercial formula highest in texture, followed by Formula 3, Formula 1, and finally Formula 2. The results showed significant differences in texture acceptance among the formulas.

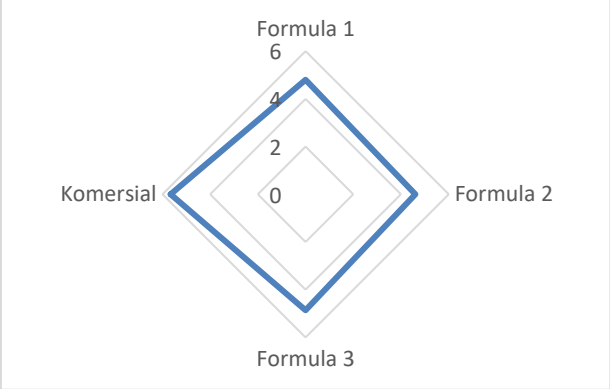

Figure 5. Radar chart of organoleptic texture evaluation

Over all Acceptability

The results showed that the highest over all acceptance was found in the enteral formula. The highest average panelist score was observed in Formula 1 (4.99). The overall acceptance of Formula 1, with a composition of 20 g chicken liver flour and 20 g egg flour, indicates that it is the best formula among the treatments. Therefore, the selected best formula is F1 (20:20).

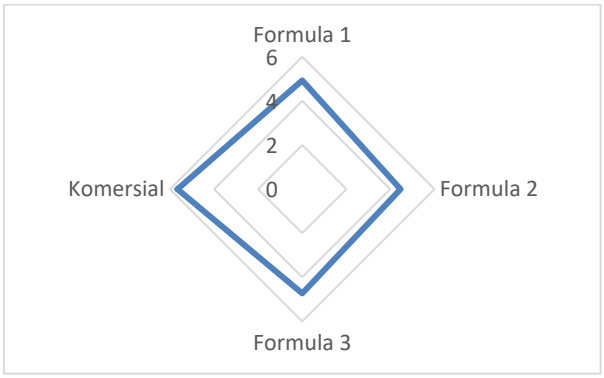

Figure 6. Radar chart of overall organoleptic evaluation

Conclusion

The determination of the best formula recommendation was based on the average total score of the organoleptic test. Enteral Formula 1, with a composition of 20 g chicken liver flour and 20 g egg flour, was the most preferred formula, achieving the highest average scores in three aspects (color, aroma, and overall). Therefore, it is the most recommended product. For future research, further studies are needed on the use of local food ingredients rich in energy and protein in enteral formulations as an alternative for addressing wasting in toddlers.

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