International Journal of Chemical and Biochemical Sciences
(ISSN 2226-9614)

Journal Home page: www.iscientific.org/Journal.html

Local Food Based Cookies Formulation High in Essential Amino Acids for Stunting Toddlers

Eliza Eliza[1], Mardiana Mardiana[1], Andi Eka Yunianto[2], Sumarman Sumarman[3]*

[1]*Poltekkes Kemenkes Palembang 30151, Palembang, Indonesia*
[2]*Medical Education Study Program, Faculty of Medicine, Universitas Lampung, Bandar Lampung 35145, Indonesia*
[3]*South Sumatra Provincial Health Office, Palembang 30126, Indonesia*

Abstract

Cookies are a type of dry cake made from soft dough whose main ingredient is wheat flour and is high in fat. The research aims to produce a local food-based cookies formulation high in essential amino acids for stunting children under five. This research was conducted in May – August 2023. The research design was experimental, using a completely randomized design. Formulate cookies by mixing snakehead fish 10g and 12g, while patin fish 10g and 12g. The DMRT test was used to analyze organoleptics. The proximate test used the A.O.A.C. method. LCMS was used to see the essential amino acid content of cookies. The acceptability test carried out, namely a hedonic test by 25 semi-trained panelists with the selected formula, F3, with a mixture of 12g of patin fish with indicators of color (p=0.005), aroma (p=0.119), taste (p=0.000), and texture (p=0.006). 100g of cookies contains 498.74 kcal, energy from fat 230.36, protein 12.49%, carbohydrates 54.61%, total fat content 25.60%, ash 1.92%, and water 5.40%. Cookies of the F3 formula were chosen by the panelists and evidently contain a high of 18 essential amino acids.

Keywords: Local food, cookies, essential amino acid, stunting, toodler

Full-length article **Corresponding Author*, e-mail: eliza_limar@yahoo.co.id

1. Introduction

Stunting is a problem of chronic malnutrition caused by a lack of nutritional intake for a long time, resulting in growth disorders in children, the child's height is shorter than the age standard[1,2]. According to the Indonesian Nutrition Status Survey (Survei Status Gizi Indonesia), in 2021, the prevalence of stunting in Indonesia was 24.4%, then in 2022, it will decrease to 21.6%[3]. Even though it has decreased, the prevalence of stunting has not yet reached the national Sustainable Development Goals (SDGs) target, namely reaching 14% by 2024 [4]. The impact of stunting is high morbidity and mortality in infants/children, low intellectual and cognitive abilities, quality of human resources, and the problem of degenerative diseases in adulthood[2]. Therefore, the problem of stunting in Indonesia must be addressed seriously. One of the risk factors for stunting is low consumption of animal protein[5,6]. Therefore, the problem of stunting in Indonesia must be addressed seriously. One of the risk factors for stunting is low consumption of animal protein[7]. Unfortunately, the proportion of animal protein sources in the daily diet in Indonesia is still low [8]. The program implemented by the government to handle the problem of malnutrition among children under five in Indonesia is the Recovery Supplemental Food Provision program, known as Program Pemberian Makanan Tambahan Pemulihan (PMT-P)[9,10]. Food products that are usually developed to improve the nutritional status of toddlers are usually biscuits and cookies[11,12]. Cookies are a dry food product popular among the public and made from soft dough whose main ingredient is wheat flour and is high in fat content[13,14].

Additional food formulations for stunted toddlers based on local food have been developed by adding fish meals and nuts to increase the essential amino acid content [15]. Ikan gabus (*Ophiocephalus striatus*) dan patin fish (*Pangasius sp.*) merupakan ikan yang kadar protein yang tinggi terutama albumin[16,17]. The addition of red bean flour (Phaseolus vulgaris L) also has a high protein content, namely 22.53% per 100g[18]. Besides that, Moringa leaves (*Moringa oleifera*) have a rich protein content of 22.99–29.36% per 100g of Moringa leaf flour [19,20]. Based on the description above, researchers are interested in making cookies based on local food made from wheat flour with the substitution of snakehead fish flour, patin fish flour, red bean flour, and moringa flour as a snack that can be used as an alternative to overcome the stunting problem in Palembang. This research aims to produce a local food-based cookies formulation high in essential amino acids for stunted children under five.

2. Materials and Methods

This research was carried out in May–August 2023. Determination of the formulation and process for making cookies was carried out at the Food Technology Science Laboratory, Nutrition Department, Health Polytechnic, Ministry of Health, Palembang. Proximate

levels, amino acid levels, and shelf life were analyzed at the PT. Saraswanti Indo Genetech-Laboratory, Bogor. Making products using a Completely Randomized Design (CRD) consisted of four treatments: F0, F1, F2, F3, and F4, with 3 repetitions. The ingredients used were wheat flour, snakehead fish flour, patin fish flour, red bean flour, moringa leaf flour, cornstarch, margarine, butter, chicken egg yolk, powdered milk, powdered sugar, palm sugar, vanilla, and baking powder.

2.1. Materials and tools

The main ingredients in making this cookies formulation were wheat flour, egg yolk, powdered sugar, margarine, milk powder, cornstarch, snakehead fish flour, patin fish flour, red bean flour, moringa leaf flour, and butter. The main ingredients were obtained from traditional markets in the city of Palembang. The food material used for the cookies formula was local food at affordable prices, easy to obtain according to people's purchasing power, and contains essential amino acids the body needs. The local food ingredients consisted of egg yolks, refined sugar, margarine, powdered milk, cornstarch, snakehead fish flour, patin fish flour, red bean flour, and moringa leaf flour. The materials needed for chemical analysis were $CuSO_4$, H_2SO_4, HCl, Na_2CO_3, petroleum ether, and NaOH. The materials for AW analysis were cookies; materials for the amino acid test: cookies, solution as stationary phase (methanol: THF: H_2O = 2:2:96), and solution as mobile phase (methanol: H_2O = 65:35). The equipment used to make cookies was a hand mixer, plastic spatula, baking sheet, electric oven, knife, and packaging sealer. The tools used for organoleptic testing were glasses, spoons, forks, serving plates, label paper, organoleptic test forms, and writing utensils. Total microbial test equipment: Erlenmeyer, Bekker glass, Petri dish, tube needle, retort, and volume pipette. Tools for making cookies: hand mixer, plastic spatula, baking sheet, electric oven, knife, and packaging sealer. Tools for proximate analysis (moisture, ash, fat, protein, and carbohydrate content). Tools used for proximate tests: Erlenmeyer, distillation flask, bracket glass, glass funnel, Bucher funnel, burette, separating funnel, long neck measuring flask, measuring cup, condenser, filler, measuring pipette, volumetric pipette, drop pipette, stirrer, tube reaction, spatula, desiccator, universal indicator, filter paper, tripod, wire mesh, test tube rack, clamp, stirrer, the crucible, evaporating dish, clamp and stand, heater, hot plate, oven, furnace, incubator. Tools for amino acid testing: a set of preparation tools and HPLC.

2.2. Process of making flour

The preparation of cookies began with the process of flouring several ingredients such as snakehead fish, patin fish, red bean flour, and Moringa leaf flour. All materials had been ground and sifted to the same size, 100 mesh. Making snakehead fish and patin fish flour was washing and weeding the fish, boiling at 100 ℃ for 30 minutes, drying in a cabinet dryer at 60 ℃, flouring, and sieving. Making red bean flour, including sorting, roasting at 80 ℃ for 15 minutes, milling, and sieving. Moringa leaf flour was made by washing, drying (in a Cabinet Dryer, 50 ℃), grinding, and sieving.

Making cookies

The procedure for making cookies based on local food high in essential amino acids for children under five was modified from Yulianto et al. 2022. The procedure for making this cookies product goes through several stages: making flour, mixing, molding, baking, cooling, and packaging. The basic recipe for making cookies was based on Yulianto et al. (2022)[21] (Table 1).

Tabel 1: Cookies recipes

Ingredients	Weight (g)
Flour	110
Egg yolk	40
Fine granulated sugar	150
Margarine	180
Milk powder	25
Cornstarch	65

The formulation of local food cookies containing essential amino acids for stunting toddlers was made based on the consideration that the formula can fulfill 10% of total energy and protein; besides that, the minimum protein value has a score of 75. The food ingredients used in the formulation of these cookies should be high in essential amino acids. The composition of the food formula used to make these cookies can be seen in Table 2. The process of making these cookies consisted of 3 mixing stages. The first mixture was food ingredients, including wheat flour, cornstarch, snakehead fish flour, patin fish flour, and Moringa leaf flour, which were mixed and stirred until homogeneous. The second mixture was margarine, powdered sugar, palm sugar, eggs, and powdered milk, which were beaten using a mixer until homogeneous. The third mixing was mixing the first and second ingredients until it became a smooth dough. After the cookies dough was smooth, it was molded onto a cake tin with a thickness of 1 cm and a size of 4 cm; then, the cookies were baked at 110 ℃ for 15 minutes. The cooked cookies were then removed from the oven and cooled to room temperature (26 ℃) for 30 minutes at room temperature. After the cookies have cooled, they were packaged using plastic packaging.

2.3. Organoleptic test

Organoleptic testing of cookies was carried out using 30 semi-trained panelists. The panelists were students of the nutrition department, Poltekkes Kemenkes Palembang, who have passed the organoleptic testing course. This organoleptic test used 5 hedonic scales, namely (1) very dislike, (2) dislike, (3) normal, (4) like, (5) like very much. Organoleptic tests included all product formulas' color, aroma, taste, and texture. The organoleptic test procedure was that the panelists were given a product sample to taste, and then, after tasting the product, the panelists drank water as a neutralizer.

2.4. Nutritional analysis of cookies

All cookies products are then subjected to proximate analysis (energy, carbohydrate, protein, fat, ash, and water content). Here, the analysis used: analysis of energy (calculation method), carbohydrates (by difference method), protein content (titrimetric method), fat content (Weilbull method), ash content (ashing method), and water content (thermogravi method) as well as amino acid content of selected products using UPLC (Ultra Performance Liquid Chromatography).

2.5. Data analysis

The organoleptic test data obtained from previous panelist measurements was tested using the ANOVA test, and if there were differences, a further Duncan test was carried out (DMRT with significance at <0.05.

Table 2: Determination of cookies formula

Ingredients	Weight (g)				
	F0	F1	F2	F3	F4
Flour	38	8	8	8	8
Cornstarch	8	8	8	8	8
Snakehead Fish Meal	-	12	10	-	-
Patin Fish Meal	-	-	-	12	10
Red bean flour	-	17	15	17	15
Moringa leaf flour	-	1	3	1	3
Egg yolk	5	5	5	5	5
Fine granulated sugar	26	26	26	26	26
Palm sugar	2	2	2	2	2
Margarine	22	22	22	22	22
Milk powder	10	9	11	9	11
Butter	10	10	10	10	10

3. Results and Discussion

Stunting is a nutritional issue that can increase mortality and morbidity rates in children, especially toddlers. Apart from that, stunting also has a negative impact on mental development and reduces intellectual capacity[22]. One of the factors causing stunting in toddlers is low protein intake, especially low protein quality. Stunted toddlers generally have lower protein intake compared to normal toddlers. One of the government's steps to overcome stunting is to provide additional food. Additional food has a significant impact on improving the nutritional status of stunted toddlers. This is based on previous research, which provided 40 g of additional food containing 11.4% protein for 30 days, which can significantly improve the nutritional status of toddlers[23].

3.1. Evaluation of organoleptic tests of cookies

Based on hedonic tests on color, aroma, taste, and texture, most panelists liked the formula mixed with patin fish flour compared to snakehead fish flour. Formula F3 is the best formula based on acceptability, chosen by most panelists with a mixture of 12 g of patin fish flour. Organoleptic results based on cookies' color, taste, and texture showed significant differences ($p<0.05$). The color and aroma of formulas F1, F2, and F3 are not significantly different from formula F0 but are different from formula F4. Based on the color of the cookies, the addition of snakehead fish flour is preferable to patin fish flour. Based on taste and texture, formulas F1 and F3 are not significantly different from formula F0, while F2 and F4 are significantly different. This is in accordance with previous research, which showed that giving snakehead fish and patin fish flour up to 20% -60% did not show a real difference in the color, aroma, taste, and texture of cookies[24,25]. Snakehead fish and patin fish flour have a white to light yellow color, so if made into cookies, it is attractive and will not affect the color of cookies in general, made from pure wheat flour[26,27]. This is also because the albumin content found in snakehead fish and patin fish is quite high, so it is good for making food products high in protein, especially cookies[16].

3.2. Results of analysis of the nutritional content of cookies

The laboratory analysis results show that the nutritional content per 100g of cookies in the 5 formulas shows that the highest total energy is in formula F2, namely 501.28 kcal, while the lowest is in formula F4. This also occurs when the energy from fat is highest in the F2 formula but the lowest in the F1 formula. The highest ash content was found in the F4 formula at 2.36%, while the lowest was in the F1 formula at 0.88%. The highest water content is in the F4 formula at 7.78%, while the lowest is in the F3 formula at 5.40%. The highest carbohydrate in the F0 formula is 63.22%, while the lowest is in the F1 formula, 52.01%. The highest total fat content was in the F3 formula at 26.74%, while the lowest was in the F1 formula, namely 24.39%. The highest protein content was found in the F2 formula at 15.60%, while the lowest protein content was in the F0 formula, namely 4.73%. The four formulas meet cookies standards according to the Indonesian National Standard known as SNI no. 01-2973-1992, based on calories, carbohydrates, fat, and protein, while those that do not meet a maximum water content of 5% and a maximum ash content of 1.5%[28].

Table 3: Evaluation of organoleptic properties

Indicator	Formula					p
	F0	F1	F2	F3	F4	
Color	3.83^{a}	3.97^{a}	$3.47^{a,b}$	3.87^{a}	3.17^{b}	0.005
Aroma	$3.67^{a,b}$	3.77^{a}	$3.60^{a,b}$	3.80^{a}	3.30^{b}	0.119
Taste	$3.80^{a,b}$	$3.67^{a,b}$	$3.37^{b,c}$	3.87^{a}	2.97^{c}	0.000
Texture	$3.73^{a,b}$	$3.57^{a,b,c}$	$3.40^{b,c}$	3.90^{a}	3.20^{c}	0.006

Note: Numbers followed by different letters on the same line indicate significant differences

Table 4: Results of nutrient analysis of cookies in 100 g

Parameter	Unit	F0	F1	F2	F3	F4
Total Energy	Kcal/100 g	493.14	489.89	501.28	498.74	481.97
Energy from fat	Kcal/100 g	221.36	219.47	240.62	230.36	220.55
Ash Content	%	0.88	1.92	2.20	1.92	2.36
Water content	%	6.59	6.09	5.91	5.40	7.78
Carbohydrate	%	63.22	52.01	52.71	54.61	53.24
Total Fat Content	%	24.60	24.39	26.74	25.60	24.51
Protein Content	%	4.73	15.60	12.46	12.49	12.12

Table 5 shows that the essential amino acid content in the selected product, namely formula F3, meets the requirements for use as additional food for children under five (especially children under five who are stunted). The limiting amino acid of the intervention product (cookies) is L-tryptophan, whose chemical score value is more than 75%[29]. This is in accordance with previous research that additional food added with fish meal and red beans has high levels of essential amino acids and can be used as additional food for stunting toddlers[15]. On an industrial scale, the higher amino acid content is generally due to a mixture of soy flour or other

legume flour[30,31]. The composition of the food ingredients used in cookies with a combination of snakehead and patin fish flour and red bean flour will have a significant effect on the value of protein and amino acid content[31–33]. Additional foods high in essential amino acids can improve nutritional status as well as serum glycerophospholipids and serum albumin in stunting children[34,35]. The limitation of this research is that product shelf-life testing, total microbial testing, also vitamin and mineral content analysis have not been carried out.

Table 5: Results of essential amino acid analysis of cookies in 100 g

Parameter	Unit	F3
L-Alanine	mg/g	563.691
L-Arginine	mg/g	636.455
L-Aspartic Acid	mg/g	1010.705
Glycine	mg/g	569.4805
L- Glutamic Acid	mg/g	1926.719
L-Histidine	mg/g	302.511
L-Isoleucine	mg/g	615.4135
L-Cystine	mg/g	236.927
L-Leucine	mg/g	998.743
L-Lysine	mg/g	609.476
L-Methionine	mg/g	200.3295
L-Tryptophan	mg/g	139.397
L-Valine	mg/g	649.4765
L-Phenylalanine	mg/g	637.2815
L-Proline	mg/g	584.9915
L-Serine	mg/g	662.3445
L-Threonine	mg/g	599.751
L-Tyrosine	mg/g	334.3795

4. Conclusions

The formulation of local food cookies with the addition of snakehead fish flour and patin fish flour significantly affected the cookies' color, taste, and texture. Organoleptic tests showed that the panelists preferred the F3 formula cookies based on color, aroma, taste, and texture by adding 12g of patin fish flour. The essential amino acid analysis results in the F3 formula have a high essential amino acid content, so this product is very good to give to stunted toddlers. Suggestion, local food ingredients have the potential to be developed as alternative additional food for children under five so that by formulating local food ingredients, other food products can be developed with a high content of essential amino acids.

Conflict of Interest

The authors declare no conflict of interest.

Authors' Declaration

The authors hereby declare that the work presented in this article is original and that any liability for claims relating to the content of this article will be borne by them.

Acknowledgments

The authors are grateful to Center for Research and Community Service, Health Polytechnic, Ministry of Health, Palembang, start-up research scheme in 2023.

References

[1] C. R. Titaley, I. Ariawan, D. Hapsari, A. Muasyaroh, and M. J. Dibley. (2019). Determinants of the stunting of children under two years old in Indonesia: A multilevel analysis of the 2013 Indonesia basic health survey. Nutrients. 11(5): 1106. doi: 10.3390/nu11051106.

[2] V. De Sanctis, A. Soliman, N. Alaaraj, S. Ahmed, F. Alyafei, and N. Hamed. (2021). Early and long-term consequences of nutritional stunting: From childhood to adulthood. Acta Biomed. 92(1): 1–12. doi: 10.23750/abm.v92i1.11346.

[3] MOH (Ministry of Health). (2022). Hasil Survei Status Gizi Indonesia. Jakarta: Ministry of Health of Republic of Indonesia.

[4] MOSS. (2021). National Strategy for Accelerating Stunting Prevention 2018-2024. Indonesia: Ministry Of State Secretariat Of The Republic of Indonesia. https://stunting.go.id/wakil-presiden-berikan-arahan-untuk-capai-target-penurunan-stunting/

[5] D. Headey, K. Hirvonen, and J. Hoddinott. (2018). Animal sourced foods and child stunting. Am. J. Agric. Econ. 100(5): 1302–1319. doi: 10.1093/ajae/aay053.

[6] Y. Kaimila, O. Divala, S. E. Agapova , K. B. Stephenson, C. Thakwalakwa, I. Trehan, M. J. Manary, and K. M. Maleta. (2019). Consumption of animal-source protein is associated with improved height-for-age Z scores in rural malawian children aged 12–36 months. Nutrients. 11(2): 1–21. doi: 10.3390/nu11020480.

[7] R. D. Semba, M. Shardell, F.A. S. Ashour, R. Moaddel, I. Trehan, K.M. Maleta, M. I.Ordiz, K. Kraemer, M.A. Khadeer, L. Ferrucci, an d M. J. Manary. (2016). Child Stunting is Associated with Low Circulating Essential Amino Acids. EBioMedicine. 6: 246–252. doi: 10.1016/j.ebiom.2016.02.030.

[8] A. R. Maulidiana and E. Sutjiati. (2021). Low intake of essential amino acids and other risk factors of stunting among under-five children in Malang City, East Java, Indonesia. J. Public health Res. 10(2): 220–226. doi: 10.4081/jphr.2021.2161.

[9] S. Maryam, W. L. Arisona, and S. Y. Nyeurmaha. evaluation of supplementary feeding (PMT). (2013). Journal for Quality in Women's Health. 5(2):201–212. https://doi.org/10.30994/jqwh.v5i2.171.

[10] N. Supriyatni, Andiani, S. Mansyur, and D. Merdekawati. (2020). Program Overview of the Supplementary Food Intervention for Chronic Energy Deficiency Pregnant Women and Thin Toddlers of South Halmahera Regency in Indonesia. 22(Ishr): 344–349. doi: 10.2991/ahsr.k.200215.066.

[11] F. Fatmah, N. Asiah, and E. Rekawati. (2022). Effect of orange almond potato cookies supplementation on the nutritional status of underweight preschool-aged children during COVID-19 pandemic. PLoS One. 17(4): 1–13. doi: 10.1371/journal.pone.0266023.

[12] Z. Nasution, I. Nurhayati, and Mahdiyah. (2022). The effectiveness of counseling and mung bean (*Vigna radiata L*) premix cookies as complementary food to prevent stunting. Curr. Nutr. Food Sci. 19(3): 317–323. doi:

10.2174/1573401318666220628102359.
[13] C. M. Mancebo, J. Picón, and M. Gómez. (2015). Effect of flour properties on the quality characteristics of gluten free sugar-snap cookies. LWT - Food Sci. Technol. 64(1): 264–269. doi: 10.1016/j.lwt.2015.05.057.
[14] B. Asefa, H. Assefa, G. Girma, H. Tsehanew, and F. Shemsadin. (2017). The physicochemical and sensory characteristic of cookies baked from wheat flour and mango pulp. Food Sci. Qual. Manag. 65(2000): 16–21, 2017.
[15] M. Darawati, A. E. Yunianto, T. H. Doloksaribu, and A. Chandradewi. (2021). Formulasi food bar berbasis pangan lokal tinggi asam amino esensial untuk anak balita stunting (Formulation of food bar based on local food and high essential amino acid for stunting toddler). AcTion Aceh Nutr. J. 6(2): 163–172. doi: 10.30867/action.v6i2.480.
[16] A. R. Romadhoni, E. Afrianto, R. I. Pratama, and R. Grandiosa. (2016). Extraction of snakehead fish [ophiocephalus striatus (bloch, 1793)] into fish protein concentrate as albumin source using various solvent. Aquat. Procedia. 7: 4–11. doi: 10.1016/j.aqpro.2016.07.001.
[17] M. Sa'ad and Muhtadi. (2023). Protein profiles of snakehead (*Channa striata*), Catfish (*Pangasius hypopthalmus*), and Mackerel (*Rastrelliger spp*.) and their effectiveness as antidiabetic agents. 3. Atlantis Press International BV. doi: 10.2991/978-94-6463-050-3_16.
[18] L. Ratnawati, D. Desnilasari, D. N. Surahman, and R. Kumalasari. (2019). Evaluation of physicochemical, functional and pasting properties of soybean, mung bean and red kidney bean flour as ingredient in biscuit. IOP Conf. Ser. Earth Environ. Sci. 251: 012026. doi: 10.1088/1755-1315/251/1/012026.
[19] S. Sultana. (2020). Nutritional and functional properties of moringa oleifera. Metab. Open. 8: 100061. doi: 10.1016/j.metop.2020.100061.
[20] E. González-Burgos, I. Ureña-Vacas, M. Sánchez, and M. P. Gómez-Serranillos. (2021). Nutritional value of moringa oleifera lam. leaf powder extracts and their neuroprotective effects via antioxidative and mitochondrial regulation. Nutrients. 13(7): 2203. doi: 10.3390/nu13072203.
[21] D. I. M. Yulianto. (2022). The effect of giving soy flour and yellow sweet potato flour biscuits on changing the weight of undernourished toddlers in sekip community health center Palembang. Media Kesehat. Politek. Kesehat. Makassar. 17(2): 206–214 . DOI: https://doi.org/10.32382/medkes.v17i2
[22] L. J. Utama, A. E. Yunianto, I. Shagti, J. Gressilda, and L. Sine. (2020). Impact of the covid-19 epidemic on eating habits and lifestyle : An East Nusa Tenggara survey. European Journal of Molecular & Clinical Medicine. 07(10): 162–171.
[23] K. D. Ariesthi, A. Pattypeilohy, H. N. Fitri, and A. Y. Paulus. (2021). Additional feeding based on local food to improve the nutritional status of tooddlers. J. Kesehat. Masy.17(1): 67–74. doi: 10.15294/kemas.v17i1.25862.
[24] E. P. Ganap, R. R. Amalia, P. A. Sugmana, and L. I. Hidayati. (2021). Nilai gizi dan daya terima cookies ikan gabus sebagai makanan tambahan untuk ibu hamil di Kabupaten Sleman, DIY(Nutritional value and acceptability of snakehead fish cookies as additional food for pregnant women in Sleman Regency, DIY). J. Kesehat. Reproduksi. 7(3): 133–140. doi: 10.22146/jkr.61004.
[25] A. A. Nurfajrina and W. Hastuti. (2021). Formulasi tepung mocaf dan tepung ikan patin terhadap kualitas dan nilai gizi cookies mocaf patin(Formulation of mocaf flour and catfish flour on the quality and nutritional value of mocaf catfish cookies). JGKJurnal Gizi dan Kesehat. 1(2): 95–103. doi: 10.36086/jgk.v1i2.1087.
[26] Mardiana and Fatmawati. (2014). Analisa tepung ikan gabus sebagai sumber protein (Analysis of snakehead fish meal as a source of protein). Octopus J. Ilmu Perikan. 4(1): 235–243.
[27] R. Tungadi and P. Wicita. (2020). Formulation, optimization, and characterization of snakehead fish (Ophiocephalus striatus) powder nanoemulgel. Brazilian J. Pharm. Sci. 56: 1–8. doi: 10.1590/s2175-97902019000417337.
[28] BSN. (2023). Cookies Quality Standards (SNI 01-2973-1992). Jakarta: Badan Standardisasi Nasional.http://sispk.bsn.go.id/SNI/DetailSNI/3324
[29] D. Muchtadi. (2010). Teknik Evaluasi Nilai Gizi Protein (Techniques for Evaluating the Nutritional Value of Protein). Bandung: Alfabeta.
[30] A. P. Paiva, M. de Fátima Píccolo Barcelos, J. de Abreu Ribeiro Pereira, E. B. Ferreira, S. Ciabotti. (2012). Characterization of food bars manufactured with agroindustrial by-products and waste. Food Science and Technology • Ciênc. agrotec. 36(3): 333–340. https://doi.org/10.1590/S1413-70542012000300009
[31] A. J. P. Nunes and K. Masagounder. (2023). Optimal levels of fish meal and methionine in diets for juvenile litopenaeus vannamei to support maximum growth performance with economic efficiency. Animals. 13(1): 20. doi: 10.3390/ani13010020.
[32] M. Nadeem, F. M. Anjum, M. A. Murtaza, and G. Mueen-ud-din. (2012). Development , characterization , and optimization of protein level in date bars using response surface methodology. Sci. J. 2012: 1–10. doi: 10.1100/2012/518702.
[33] E. Hendalia, F. Manin, Adriani, Mairizal, and A. R. Admiral. (2019). Composition and amino acid profile of fish meal processed using probiotics and prebiotic sources. IOP Conf. Ser. Earth Environ. Sci. 387(1): 11–15. doi: 10.1088/1755-1315/387/1/012007.
[34] M. Tessema, N. S. Gunaratna, I. D. Brouwer , K. Donato, J. L. Cohen, M. McConnell, T. Belachew, D. Belayneh, H. De Groote. (2018). Associations among high-quality protein and energy intake, serum transthyretin, serum amino acids and linear growth of children in Ethiopia. Nutrients. 10(11): 1776. doi: 10.3390/nu10111776.
[35] M. Yuristi, Kusdalinah, and E. Yuliantini. (2019). Intake of protein and calcium and serum albumin of stunted elementary school children in Bengkulu. Adv. Heal. Sci. Res.14: 224–228. doi: 10.2991/icihc-18.2019.49.