nutrición clínica y Dietética Hospitalaria

Artículo Original

Nutr Clín Diet Hosp. 2025; 45(4):192-201
DOI: 10.12873/454diana

# Potential nutrient content of bilih fish (*Mystacoleucus padangensis*) oil supplementation in reducing the risk of stunting

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Recibido: 30/septiembre/2025. Aceptado: 11/noviembre/2025.

## ABSTRACT

Stunting is a chronic condition of malnutrition in children, indicated by a height-for-age measurement that is more than two standard deviations below the WHO growth standards. This study aims to develop a bilih fish oil supplement by analyzing the nutritional components of bilih fish oil supplement, extracting the oil, and evaluating the nutritional content of the resulting supplement.

**Method:** The bilih fish oil supplement was extracted using a wet rendering method. The analysis covered proximate components (moisture, ash, protein, fat), amino acids, fatty acids, and minerals such as Ca (Calcium), Se (selenium), Fe (iron), Mg (magnesium), Zn (zinc), along with Vitamin A.

**Result:** The findings showed that the bilih fish oil supplement contains moisture (52.43%), ash (0.83%), fat total (2.49%), protein (0.77 %), amino acid such as: L-Lysine (<336.07 mg/kg), L-Proline (463.97 mg/kg), L-Serine (835.35 mg/kg), L-Threonine (448.84 mg/kg), Ca (148.82 mg/100 g), fatty acid: omega-3 (0.2669%), EPA (0.0771%), DHA (0.1036 %), omega-6 (0.2105 %), AA (0.086 %), and omega-9 (0.4346%), minerals: Fe (0.41 mg/100 g), Mg (57.30 mg/100 g), Zn (0.11 mg/100 g), Vitamin A/Retinol (488.18 mcg/100 g).

**Conclusion:** The study concludes that a daily intake of 100 ml of the bilih fish oil supplement can provide approximately 14.9% of the daily energy needs. The bilih fish oil supplement offers a promising local dietary option to help reduce the risk of stunting in children.

## KEYWORDS

Analysis; Macronutrient; Micronutrient; Local food; Supplement.

## INTRODUCTION

The World Health Organization (WHO) defines stunting as a form of chronic nutritional deficiency in children. It is characterized by a height-for-age measurement that is more than two standard deviations below the WHO growth standards[1].

Globally, approximately 24% of boys and 22% of girls under five years old experience stunting, with the WHO aiming to reduce this rate to below 20% by 2030[1]. In Indonesia, the 2023 Health Survey reported a decline in stunting prevalence among toddlers to 21.3%, down from 30.8% in 2018[2]. Data from the 2024 Indonesian Nutrition Survey indicate that in West Sumatra, Solok district has the highest stunting rate at

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23.4%, followed by Tanah Datar (22.4%) and Sijunjung (22.2%), while Bukittinggi City has the lowest at 13.2%[3]. The National Medium-Term Development Plan targets a stunting prevalence of 14.2% by 2029[4].

According to the WHO/UNICEF framework, stunting results from a complex interplay of nutritional and non-nutritional causes. Immediate causes include inadequate intake of energy, protein, and micronutrients, along with frequent infections like diarrhea, respiratory tract infections, or parasitic diseases that hinder nutrient absorption and increase nutritional needs. Underlying causes involve suboptimal child feeding practices, limited access to nutritious food due to cost and low purchasing power, poor sanitation, lack of clean water, overcrowded living conditions increasing disease risk, and insufficient maternal knowledge about nutrition and childcare. Basic causes are structural issues such as poverty, gender inequality, rapid urbanization, and restricted access to health and social services, which compound the risk of stunting[5].

Research by Fikri *et al.*[6] emphasizes the importance of sufficient and appropriate protein intake for the growth of children affected by stunting. Similarly, Rimbawan *et al.*[7] showed that locally produced Ready-to-Use Therapeutic Food (RUTF) can provide a sustainable solution for managing severe acute malnutrition in toddlers. Additional findings by Sari *et al.*[8] reveal a significant link between insufficient protein consumption and stunting in children aged 24 to 59 months.

Stunting has both immediate and long-lasting effects. Short-term consequences include impaired brain development and reduced intelligence, while long-term effects affect cognitive abilities and immune system strength[1].

The Indonesian government has implemented strategies to accelerate stunting reduction through Presidential Regulation No. 72 of 2021, focusing on toddlers via five main pillars. The fourth pillar promotes food security and nutrition improvement at the individual, family, and community levels. One approach to strengthening food and nutrition security is by providing supplementary feeding using local foods [9].

Efforts to develop local food products based on bilih fish have been initiated. Bilih fish, endemic to Lake Singkarak in West Sumatra, contains various nutrients, including moisture (76.44%), ash (2.82%), total fat (3.11%), protein (15.65%), 17 amino acids, Ca (0.755 g), and Zn (38.46 ppm)[10], as well as fatty acids like omega-3 (0.553 g), EPA (0.207 g), DHA (0.237 g), omega-6 (0.252 g), and AA (0.096 g)[11].

Previous studies demonstrated that local food items, such as biscuits[12,11]. and nuggets, contribute positively to children's growth and development[13]. For example, chocolate-flavored biscuits enriched with 20 g bilih fish flour/formula, containing omega-3 fatty acids (EPA, DHA), omega-6, AA[11], and other nutrients (protein, fat)[10]. improved spatial memory, increased hippocampus neuron numbers[10,12], body weight, and tail length in rat[11]. Omega-3 and omega-6 fatty acids play a critical role in child development[14].

Given this, further research is necessary to explore the nutritional potential of bilih fish (Mystacoleucus padangensis) and its oil supplement to support toddlers' nutritional needs and prevent stunting. The research objectives are to produce bilih fish oil supplements and analyze the nutritional profile of bilih fish and its oil supplements, including proximate composition, complete amino acids, fatty acids, Ca, Fe, Se, Mg, Zn, and vitamin A.

## METHODS

### *Location, Study Design, and Duration*

This experimental research was carried out between July and September 2025. The extraction of bilih fish oil took place in the Vahana Laboratory at PT Novalindo Padang, West Sumatra, and the Department of Aquatic Product Technology, Faculty of Fisheries and Marine Science, IPB University. The formulation of the bilih fish oil supplement was conducted in the Veterinary Pharmacy Laboratory at IPB University. Nutritional analyses of dried bilih fish and the bilih fish oil supplement were performed at SIG SARASWANTI, Bogor, Inodonesia.

### *Bilih Fish Oil Supplement Preparation*

The bilih fish oil supplement was produced in emulsion form, using bilih fish sourced from depths of 100 to 300 yards in Lake Singkarak, West Sumatra[10,11]. The bilih fish is characterized by its flat and elongated body, ranging from 4 to 8.5 cm in length and weighing between 0.5 to 5.1 g. It inhabits clear river waters with relatively cool temperatures of 24°C to 26°C and prefers riverbeds made up of gravel or sand. The emulsion supplement included additional ingredients such as gum arabic, carboxymethyl cellulose (CMC), glycerin, and water.

The oil extraction from the bilih fish was performed using the wet rendering technique. First, the fish was dried, then ground and steamed, followed by pressing and centrifuging to separate the oil from fats and water[15]. The research procedure is illustrated in Figure 1. The oil yield was determined by the formula:

$$\text{Yield (\%)} = \frac{\text{Extracted fish oil (g)}}{\text{Weight of sample (g)}} \times 100\% \ ^{16}$$

### *Research Procedure*

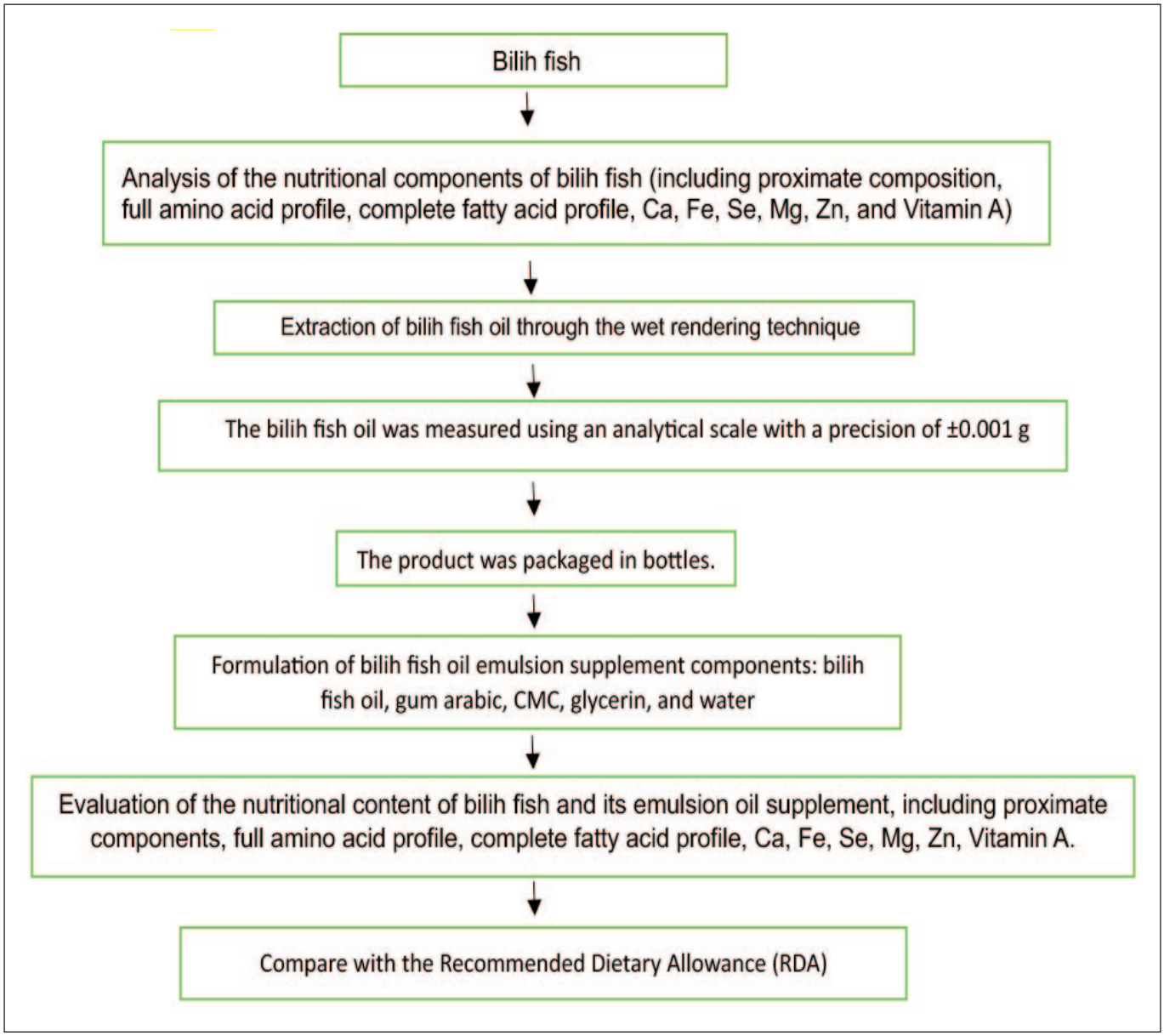


**Figure 1.** The research steps for producing bilih fish oil supplement

### *Nutrient Analysis*

The nutritional analysis of dried bilih fish and bilih fish oil supplements was carried out by measuring proximate components such as moisture content (using Karl Fischer method), ash, protein, and fat (gravimetric method); amino acids (UPLC-PDA); fatty acids (GC-FID); minerals including calcium, iron, magnesium, zinc (ICP-QES); selenium (ICP MS); and Vitamin A (HPLC-PDA). The carbohydrate content (%) was calculated as:

Carbohydrates (%) = 100 – (Moisture + Ash + Protein + Fat)[17].

## RESULTS

### *The Nutritional Composition of Bilih Fish Oil Supplement And Its Role In Fulfilling The Recommended Dietary Allowance (RDA) Requirements For Toddlers*

The bilih fish oil supplement showed nutrient contents as follows: moisture (52.43%), ash (0.83%), total fat (2.49%), protein (0.77%), amino acid such as: L-Lysine below 336.07 mg/kg, L-Proline 463.97 mg/kg, L-Serine (835.35 mg/kg), L-Threonine (448.84 mg/kg), Ca (148.82 mg/kg), fatty acid: Omega-3

(0.2669%), EPA (0.077 %), DHA (0.103 %), Omega-6 (0.210 %), AA (0.086 %), and 0mega-9 (0.438 %), minerals: Fe (0.41 mg/100g), Mg (57.30 mg/kg), Zn (0.11 mg/kg), Vitamin A/Retinol (488.18 mcg/100g). The nutritional analysis of these products was compared to the Recommended Dietary Allowance (RDA) values (Tables 1 and 2).

The energy values for fresh bilih fish (98.51 kcal), dried bilih fish (338.45 kcal), bilih fish flour (388.73 kcal), biscuits (518.09 kcal), and bilih fish oil supplement (199.41 kcal). The F20 biscuits, which are chocolate-flavored and contain 20 g of bilih fish flour per dough batch, have the highest energy content. Fatty acid composition (Table 2).

**Table 1.** Nutrient composition of fresh, dried, flour, and oil supplement of bilih fish

| No | Parameter | Unit | Fresh* | Dried | Flour* | Biscuit* | Oil supplement | Standard of RDA for 1-3 year olds/day* |
|---|---|---|---|---|---|---|---|---|
| 1 | Calories total | kcal/100g | 98.51 | 338.45 | 388.73 | 518.09 | 199.41 | 1,350 kcal |
| 2 | Calories from fat | kcal/100g | 27.99 | 85.77 | 134.73 | 250.29 | 22.41 | - |
| 3 | Moisture | % | 76.44 | 12.15 | 8.23 | 3.00 | 52.43 | 1,150 ml |
| 4 | Ash | % | 2.82 | 15.15 | 13.30 | 2.24 | 0.83 | - |
| 5 | Fat total | % | 3.11 | 9.53 | 14.97 | 27.81 | 2.49 | 45 g |
| 6 | Protein | % | 15.65 | 62.22 | 29.36 | 6.66 | 0.77 | 20 g |
| 7 | Carbohydrate | % | 1.98 | 0.95 | 34.14 | 60.29 | 43.48 | 215 g |
| **Asam amino** | | | | | | | | |
| 1 | L-Alanine | mg/kg | 8,163.41 | 30,949.82 | NA | NA | Nd | - |
| 2 | L-Arginine | mg/kg | 13,932.11 | 22,602.60 | NA | NA | Nd | - |
| 3 | L-Aspartic acid | mg/kg | 11,138.02 | 41,523.51 | NA | NA | Nd | - |
| 4 | Glycine | mg/kg | 12,709.54 | 31,772.58 | NA | NA | 326.15 | - |
| 5 | L-Glutamic acid | mg/kg | 19,668.98 | 62,434.28 | NA | NA | Nd | - |
| 6 | L-Histidine | mg/kg | 6,508.09 | 10,531.02 | NA | NA | Nd | - |
| 7 | L-Isoleucine | mg/kg | 6,076.52 | 10,972.60 | NA | NA | Nd | - |
| 8 | L-Cystine | mg/kg | 714.67 | 7,727.83 | NA | NA | Nd | - |
| 9 | L-Leucine | mg/kg | 12,340.47 | 30,702.06 | NA | NA | Nd | - |
| 10 | L-Lysine | mg/kg | 8,715.94 | 35,084.93 | NA | NA | <336.07 | - |
| 11 | L-Methionine | mg/kg | 5,252.85 | 9,976.24 | NA | NA | Nd | - |
| 12 | L-Tryptophan | mg/kg | 1,230.02 | 5,148.81 | NA | NA | Nd | - |
| 13 | L-Valine | mg/kg | 6,601.72 | 15,306.18 | NA | NA | Nd | - |
| 14 | L-Phenylalanine | mg/kg | 10,531.93 | 15,965.39 | NA | NA | Nd | - |
| 15 | L-Proline | mg/kg | 6,201.13 | 20,512.65 | NA | NA | 463.97 | - |
| 16 | L-Serine | mg/kg | 8,405.98 | 19,444.60 | NA | NA | 835.35 | - |
| 17 | L-Threonine | mg/kg | 9,209.59 | 14,892.09 | NA | NA | 448.84 | - |
| 18 | L-Tyrosine | mg/kg | 8,473.21 | 12,873.52 | NA | NA | Nd | - |

*Diana[10] and Diana et al.[11], *KEMENKES[18], NA = not analyzed, Nd = not detected, Biscuit: Chocolate-flavored biscuits prepared with the incorporation of 20 g bilih fish flour in each dough batch. RDA= Recommended Dietary Allowance.

**Table 1 continuation.** Nutrient composition of fresh, dried, flour, and oil supplement of bilih fish

| No | Parameter | Unit | Fresh* | Dried | Flour* | Biscuit* | Oil supplement | Standard of RDA for 1-3 year olds/day* |
|---|---|---|---|---|---|---|---|---|
| **Mineral** | | | | | | | | |
| 1 | Ca | mg/100 g | 755.38 | 2,845.02 | NA | 109.86 | 148.82 | 650 mg |
| 2 | Zn | mg/100 g | 3,846 | 9.76 | NA | 2,475 | 0,11 | 3 mg |
| 3 | Fe | mg /100 g | NA | 3.07 | NA | 5,096 | 0,41 | 7 mg |
| 4 | Se | mcg/100 g | NA | 78.82 | NA | NA | Nd | 18 mcg |
| 5 | Mg | mg /100 g | NA | 158.57 | NA | NA | 57,30 | 65 mg |
| **Vitamin** | | | | | | | | |
| 29 | Vitamin A (Retinol) | mcg/100 g | NA | 559.64 | NA | NA | 488.18 | 400 RE |

*Diana[10] and Diana et al.[11], *KEMENKES[18], NA = not analyzed, Nd = not detected, Biscuit: Chocolate-flavored biscuits prepared with the incorporation of 20 g bilih fish flour in each dough batch. RDA= Recommended Dietary Allowance.

**Table 2.** Fatty acid composition of fresh, dried, flour, biscuit, and oil supplement of bilih fish

| No | Parameter | Fatty Acids (%) | | | | | |
|---|---|---|---|---|---|---|---|
| | | Fresh* | Dried | flour* | Biscuit* | Oil supplement | Standard of RDA for 1-3 year olds/day |
| 1 | C 10:0 (Capric acid) | NA | Nd | Nd | 0.0761 | Nd | - |
| 2 | C 11:0 (Undecanoic acid) | NA | 0.0027 | Nd | Nd | Nd | - |
| 3 | C 12:0 (Lauric acid) | NA | 0.0235 | 0.0565 | 1.4829 | 0.0206 | - |
| 4 | C 13:0 (Tridecanoic acid) | NA | 0.0133 | Nd | Nd | Nd | - |
| 5 | C 14:0 (Myristic acid) | NA | 0.4772 | 0.6756 | 0.8158 | 0.1040 | - |
| 6 | C 14:1 (Miristoleic acid) | NA | 0.1648 | Nd | Nd | 0.0171 | - |
| 7 | C 15:0 (Pentadecanoic acid) | NA | 0.1238 | 0.1120 | 0.0126 | 0.0200 | - |
| 8 | C 15:1 (Pentadecenoic acid) | NA | 0.0674 | Nd | Nd | Nd | - |
| 9 | C 16:0 (Palmitic acid) | NA | 2,8577 | 3,8619 | 9,9081 | 0.6556 | - |
| 10 | C 16:1 (Palmitoleic acid) | NA | 1,0721 | 1,6870 | 0.0782 | 0.1799 | - |
| 11 | C 17:0 (Heptadecanoic acid) | NA | 0.2865 | 0.1763 | 0.0280 | 0.0414 | - |
| 12 | C 17:1 (Heptadecanoic acid) | NA | 0.0127 | 0.0454 | 0.0071 | 0.0220 | - |

*Diana[10] and Diana *et al.*[11]. *Kemenkes[18]. NA: Not Analyzed, Nd = not detected. Biscuit: Chocolate-flavored biscuits prepared with the incorporation of 20 g Bilih fish flour in each dough batch. RDA= Recommended Dietary Allowance.

**Table 2 continuation.** Fatty acid composition of fresh, dried, flour, biscuit, and oil supplement of bilih fish

| No | Parameter | Fatty Acids (%) | | | | | |
|---|---|---|---|---|---|---|---|
| | | Fresh* | Dried | flour* | Biscuit* | Oil supplement | Standard of RDA for 1-3 year olds/day |
| 13 | C 18:0 (Stearic acid) | NA | 1,1620 | 1,3719 | 1,8069 | 0.2396 | - |
| 14 | C 18:1 ω9C (C-Oleic acid) | NA | 1,0193 | 1,6551 | 11,4651 | 0.4346 | - |
| 15 | C 18:1 ω9T (T-Oleic acid) | NA | Nd | Nd | Nd | Nd | |
| 16 | C 18:2 ω6 (Linoleic acid / ω6) | NA | 0.3451 | 0.6000 | 3,4569 | 0.1239 | - |
| 17 | C 18:2 ω6C (C-Linoleic acid) | NA | 0.3451 | 0.6000 | 3,4569 | 0.1239 | - |
| 18 | C 18:2 ω6T (T-Linoleic acid) | NA | Nd | Nd | Nd | Nd | - |
| 19 | C 18:3 ω3 (Linolenic acid / ω3) | NA | 0.4109 | 0.3592 | 0.6460 | 0.0862 | - |
| 20 | C 18:3 ω6 (Linolenic acid / ω6) | NA | 0.0333 | 0.0647 | 0.0174 | Nd | - |
| 21 | C 20:0 (Arachidic acid/AA) | NA | 0.0658 | 0.0642 | 0.1243 | 0.0343 | - |
| 22 | C 20:1 (Eicocyanic acid) | NA | 0.0298 | 0.0267 | 0.1043 | Nd | - |
| 23 | C 20:2 (Eicosadienoic acid) | NA | 0.0415 | 0.0838 | 0.0067 | 0.1289 | - |
| 24 | C 20:3 ω3(Eicosatrienoic acid / ω3) | NA | 0.0350 | 0.0269 | Nd | Nd | - |
| 25 | C 20:3 ω6 (Eicosatrienoic acid / ω6) | NA | 0.0474 | 0.0734 | Nd | Nd | - |
| 26 | C 20:4 ω6 (Arachidonic acid/AA) | 0.0969 | 0.3447 | 0.4082 | 0.0134 | 0.0865 | - |
| 27 | C 20:5 ω3 (Eicosatpentaenoic acid / EPA) | 0.2074 | 0.3723 | 0.7327 | 0.0120 | 0.0771 | - |
| 28 | C 21:0 (Heneicosanoic acid) | NA | 0.0083 | 0.0070 | Nd | Nd | - |
| 29 | C 22:0 (Behenic acid) | NA | Nd | 0.0391 | 0.0373 | 0.091 | - |
| 30 | C 22:1 (Erucic acid) | NA | 0.0104 | 0.0075 | Nd | Nd | - |
| 31 | C 22:2 (Docosadinoic acid) | NA | Nd | 0.1015 | Nd | Nd | - |
| 32 | C 22:6 ω3 (Docosahexaenoic acid/DHA) | 0.2372 | 0.6257 | 0.5722 | 0.0108 | 0.1036 | |
| 33 | C 23:0 (Trichosanoic acid) | NA | Nd | 0.0090 | 0.0040 | Nd | - |
| 34 | C 24:0 (Lignoseric acid) | NA | 0.0268 | 0.0255 | 0.0237 | 0.0737 | - |
| 35 | C 24:1 ω9 (Nervonic acid) | NA | Nd | 0.0277 | 0.0100 | Nd | - |
| 36 | Omega 3 fatty acids | 0.5535 | 1,4439 | 1,6910 | 0.6694 | 0.2669 | 0.7g |
| 37 | Omega 6 fatty acids | 0.2523 | 0.7705 | 1,1463 | 3,4894 | 0.2105 | 7g |
| 38 | Omega 9 fatty acids | NA | 1,0297 | 1,6626 | 11,4666 | 0.4346 | - |

*Diana[10] and Diana *et al.*[11]. *Kemenkes[18]. NA: Not Analyzed, Nd = not detected. Biscuit: Chocolate-flavored biscuits prepared with the incorporation of 20 g Bilih fish flour in each dough batch. RDA= Recommended Dietary Allowance.

Omega-3 fatty acid values for fresh bilih fish (0.553 %), dried bilih fish (1.44%), bilih fish flour (1.691%), biscuits (0.669%), and bilih fish oil supplement (0.2669%). Different methods of processing bilih fish are illustrated in Figures 2 to 7, and the bilih fish oil supplement (Figure 7).

Fatty acid sea fish such as salmon, mackerel, sardines, and tuna are the richest sources of omega-3[19]. Omega-3 fatty acids are present in various other seafood, including salmon, mackerel, herring, cod liver oil, squid, and lobster. The nutritional value of fish depends on factors such as its source, species, living environment, processing techniques, and the type of food itconsumes[20].

**Figure 2.** Fresh bilih fish. (Diana[10]).

**Figure 3.** Dried bilih fish.

**Figure 4.** Bilih fish flour. (Diana[10]).

**Figure 5.** Biscuit. (Diana[10]).

**Figure 6.** Bilih fish oil.

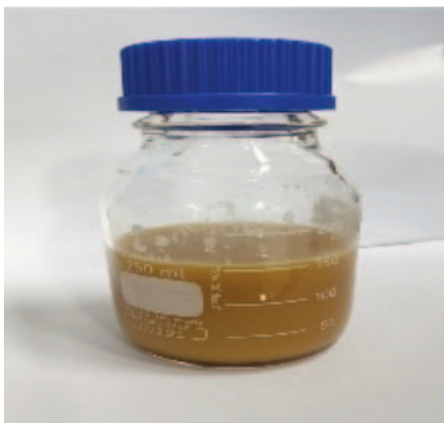

**Figure 7.** Bilih fish oil supplement.

## DISCUSSION

### *The Nutritional Composition of Bilih Fish Oil Supplement and Its Role in Fulfilling The Recommended Dietary Allowance (RDA) Requirements for Toddlers*

Bilih fish, a traditional local food from West Sumatra, is rich in high-quality protein, amino acids, fatty acids, and various essential minerals. The oil extracted from bilih fish contains abundant essential fatty acids and fat-soluble vitamins, making it a valuable complement to meet the nutritional needs of young children (Tables 1 and 2). Regular consumption of bilih fish oil supplements at an appropriate dosage can help fulfill toddlers' energy requirements based on the Recommended Dietary Allowance (RDA)[18].

These findings suggest that bilih fish and its processed products hold great potential as nutritious local food sources to support stunting reduction programs[12,11,13]. Bilih fish oil supplements represent one example of a locally processed food. A daily intake of 100 ml of bilih fish oil supplement can provide approximately 14.9% of the daily energy needs of children. Thus, bilih fish oil supplements can serve as a promising local food alternative to help lower the risk of stunting.

Studies on other local food sources, such as pangus fish oil extracted using the wet rendering technique, have also identified the presence of essential fatty acids[15].

This is in line with the findings of Hidayaturrahmah *et al.*[21], who reported that patin fish oil produced through a similar extraction process contains fatty acids vital for growth and overall health benefits.

Evidence from other research also indicates that improvements in stunting and underweight conditions occurred only in children who received lipid-based nutrient supplementation (LNS)[22]. Furthermore, Reski *et al.*[23] found that a three-week supplementation with catfish (Pangasius hypophthalmus) oil promoted weight gain and decreased hs-CRP levels in malnourished Wistar rats, although it did not significantly affect TTR levels. These outcomes are linked to the omega-3 fatty-acids (EPA and DHA), which enhance appetite through serotonin regulation and demonstrate anti-inflammatory activity by suppressing pro-inflammatory cytokine production via GPR120 receptor activation.

### *Key Nutrients for Stunting Prevention*

Macronutrients and micronutrients both play critical roles in preventing stunting, as outlined by Goudet *et al.*[5] and other reviews. Energy and protein are vital for body tissue development; chronic energy deficiency leads to protein being used for energy rather than growth, impairing height increases. Essential amino acids like lysine, methionine, and tryptophan support growth hormone and IGF-1 synthesis.

Among micronutrients, zinc is crucial for bone growth, immune defense, and DNA and protein synthesis. Zinc deficiency is a major risk factor for stunting. Iron (Fe) supports brain development and oxygen transport; its deficiency can cause anemia, reduce appetite, increase susceptibility to infection, and stunt growth. Deficiencies in Fe and Zn correlate strongly with stunting[24].

Vitamin A maintains epithelial and immune health. Deficiency increases children's vulnerability to disease and the risk of stunting. Calcium and vitamin D are essential for bone mineralization, and insufficient intake combined with limited sunlight exposure in crowded areas can hinder bone growth. Iodine is also critical; deficiency during pregnancy can cause congenital hypothyroidism, affecting the child's growth and development. Additionally, omega-3 fatty acids, EPA, DHA, omega-6, AA, vitamin B12, and folate are involved in cell division, brain development, and metabolism; shortages can worsen growth impairments[22,24].

The findings indicate that iron (Fe) and vitamin A are key nutrients influencing stunting among Indonesian children aged 6–59 months. A lack of iron results in reduced hemoglobin (Hb) and ferritin levels, which are associated with impaired linear growth, while insufficient vitamin A, reflected by low retinol concentrations, likewise contributes to growth inhibition in children[25].

Sihombing *et al.*[26] showed that catfish extract contains 4.97% water, 8.91% ash, 29.87% fat, 48.85% protein, 7.40% carbohydrates, 0.12% total polyphenols, and exhibits antioxidant activity with an $IC_{50}$ value of 4.9724%. The study concludes that catfish extract has promising potential to enhance the nutritional status of toddlers suffering from stunting.

## CONCLUSION

Bilih fish oil supplement offers a comprehensive nutrient profile of macro- and micronutrients. It's a fish oil supplement that supports the fulfillment of toddlers' RDA, particularly for protein, fat, essential amino acids (L-Lysine, L-Proline, L-Serine, L-Threonine), Ca, Fe, Mg, Zn, Vitamin A / Retinol, and various fatty acids (omega-3, EPA, DHA, omega-6, AA, omega-9). The bilih fish oil supplement shows promise as a local food-based strategy for stunting prevention.

## ETHICS APPROVAL

The study protocol was reviewed and approved by the Ethics Committee of the School of Veterinary Medicine and Biomedical Sciences at IPB University, Bogor, Indonesia. The approval was granted under the number 361/KEH/SKE/IX/2025.

## FUNDING

This study was funded by the Directorate of Research and Community Service, Directorate General of Research and De-

velopment, Ministry of Higher Education, Science, and Technology (DPPM KEMDIKTISAINTEK) under the Regular Fundamental Research program. The funding is covered by research contract number 060/C3/DT.05.00/PL/2025 for the fiscal year 2025.

## ACKNOWLEDGMENT

The author wishes to convey heartfelt thanks to the Directorate of Research and Community Service, Directorate General of Research and Development (DPPM KEMDIKTISAINTEK). The author also gratefully acknowledges the contributions of all individuals and institutions that supported the completion of this study.

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