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Chemical composition and amino acid profile of manyung fish (*Arius thalassinus*) from Subang, Indonesia

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ABSTRACT

Manyung fish (Arius thalassinus) is one type of giant catfish in tropical areas, including Indonesia. Generally, the A. thalassinus was processed as a salted or smoked fish in Indonesia. There was no report for the proximate, specific mineral, and amino acid composition of A. thalassinus from the Subang region in West Java. This study aimed to analyze the chemical composition of A. thalassinus meat from Subang, West Java, which includes proximate minerals and amino acid composition. The sampling of A. thalassinus was conducted in triplicates by purposive sampling based on the length and weight of the fish. Furthermore, the fish were analyzed for moisture, ash, protein, fat, calcium, iron, zinc, and total amino acids (after acid hydrolysis). The proximate composition of the fish meat consisted of moisture (76.27±0.31% wb), ash (1.32±0.09% wb), protein (21.01±0.22% wb), and fat (0.34±0.03% wb). In this meat, minerals of calcium (12.11±0.14 mg/100g), iron (0.67±0.01 mg/100g), and zinc (0.67±0.01 mg/100 g) were not potential as micronutrient sources. The amino acid composition of A. thalassinus consisted of isoleucine (57.24±0.44 mg/g), leucine (194.03±1.97 mg/g), threonine (118.01±0.75 mg/g), valine (0.55±0.12 mg/g), serine (68.75±0.03 mg/g), alanine (52.50±0.20 mg/g), aspartate (142.43±0.16 mg/g), cysteine (2.72±0.12 mg/g), glutamate (192.20±0.28 mg/g), glycine (7.45±0.39 mg/g), and proline (0.13±0.04 mg/g). The main chemical composition of manyung fish meat was a protein with leucine, threonine, aspartate, and glutamate as the main amino acids. The protein content, especially leucine and aspartate, and the calcium content in A. thalassinus meat, can potentially support children's growth.

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INTRODUCTION

There is currently a growing understanding of a healthy diet. A nutrient-rich diet is needed, especially during growth and development. At this phase, complete nutrition is needed, especially protein sources that contain complete essential amino acids (EAAs). Inadequate intake of EAAs was reported to cause stunted growth and development in children (Semba et al. 2016; Maulidiana and Sutjiati 2021). Fish is a food rich in protein, amino acids, omega-3, and minerals. The high nutritional content of fish can play a role in growth and development, especially in children. Furthermore, fish is increasingly being accepted for its nutritional quality.

One of the fish with an economical and nutritional potential is the Manyung fish (*Arius thalassinus*). *Arius thalassinus* is included in the Ariidae family, often called a sea catfish. *Arius thalassinus* is a marine fish commonly salted or smoked in West Java, Indonesia. The nutritional composition of *A. thalassinus* was 18.56% crude protein, 0.54% fat, 1.75% ash, and 79.15% moisture content (Abraha et al. 2017). In addition, Azmat et al. (2006) reported that *A. thalassinus* consisted of 220-250 ppm sodium, 190-240 ppm potassium, 120-160 ppm calcium, and 220-240 ppm magnesium.

Research on *A. thalassinus* that has been carried out is related to nutrition (Abraha et al. 2017) and mineral composition (Azmat et al. 2006). Research on the amino acid composition of *A. thalassinus* meat has not been widely carried out. There was no report for the fish from the Subang region in West Java, even for the proximate, specific mineral, and amino acid composition. Several studies were done on mineral content and amino acid composition in Ariidae family fish, such as *A. subrostratus* (Lilly et al. 2017; Ambily and Nandan 2018) *and A. muculatus* (Manikandarajan et al. 2014; Tenyang et al. 2014). Differences in habitats and species can cause differences in fish's proximate composition, mineral content, and amino acid profile. This study aimed to analyze the proximate composition, mineral content, and amino acid profile of the meat of *A. thalassinus* fish from Subang, West Java.

MATERIALS AND METHODS

Materials

The Manyung fish (*Arius thalassinus*) were obtained from Blanakan Fishing Port in Subang, West Java, from December 2020–January 2021. Sampling was carried out three times in that period, each used as a replication. The fish used in this study were 45±5 cm and 4000±500 g. The fish samples were kept in ice and transported to the laboratory in fish boxes. The fish samples were stored in a freezer at -18°C until analyzed. Chemicals used for proximate composition analysis, mineral analysis by flame-AAS, and total amino acid composition by HPLC-fluorescence were of analytical or standard grade from Merck (Germany).

Chemical composition/proximate analysis

The proximate composition analyzed in this study was moisture, ash, protein, and fat. Fish's moisture and ash content were analyzed using the gravimetric method (AOAC 2010). The protein content of fish was determined using DuMAster (Buchi D-480, Switzerland) by the Dumas combustion method (BÜCHI Labortechnik AG, manual user). The Soxhlet method determines the fat content (AOAC 2010).

Mineral analysis

Samples were prepared using the dry ash method (BSN 1998). Five grams of samples were ashed in a muffle furnace at 500°C overnight. The ash was dissolved in 100 ml of HNO_3 0.2%. The mixture solution was filtered through the Sartorius 393 filter paper. The Ca (calcium), Fe (iron), and Zn (zinc) content of fish was analyzed using flame atomic absorption spectrometry (AAS) (Agilent Technologies AAS-Duo type 240FS A, USA). The sample analysis was performed in triple. A set of standard solutions with serial concentrations of Ca, Fe, and Zn were used for calibration curves. The contents of Fe, Zn, and Ca were calculated using the respective equations of the standard curves.

Amino acid composition analysis

Samples were prepared to refer to Nurjanah et al. (2020) with modifications in the amount of HCl 6N, and the sample hydrolysis method referred to Badadani et al. (2007). Sample (0.1 g) and 5 ml of HCl 6N were added to the glass tube. Samples were hydrolyzed using an autoclave at 15 psi (121°C) for 1 hour. Hydrolysis samples were neutralized by NaOH 6 N to pH 7.00±0.50 and then diluted with distilled water up to 25 ml. Total amino acid contents were measured by high-performance liquid chromatography (HPLC) (Agilent 1260 Infinity II, USA Santa Clara) using a Zorbax Eclipse-AAA (4.6 × 150 mm, 3.5 µm) column. The operating conditions were as follows: 0.5 µL of sample injection volume, 2 ml/min of flow rate, 40°C of column temperature, and using a G1315A Fluorescence Detector (FLD). The mobile phase A used was a 40 mM Na_2HPO_4 buffer pH 7.8, and the mobile phase B used was a mixture of ACN:MeOH: water in a ratio of 45:45:10. Amino acid standards were also injected separately to quantify amino acids in the samples.

Statistical analysis

The data were analyzed using descriptive statistical analysis and calculated using Microsoft Excel 2010. The data used three replications for each analysis. The data are shown as mean and standard deviation.

RESULTS AND DISCUSSION

Chemical Composition of *A. thalassinus*

The composition of *A. thalassinus* is shown in Table 1. The dominant composition in *A. thalassinus* was moisture and protein content. The main composition of fish meat was about 95% water, protein, and fat, while the remaining 5% was a mineral component (Ambily and Nandan 2018). The composition of *A. thalassinus* in this study was similar to the research results by (Abraha et al. 2017) (Table 1), but the protein content was relatively higher. Ambily and Nandan (2018) reported that the moisture, protein, fat, and ash content of *A. subrotratus* were 80.46, 17.65, 1.83, and 1.24%, respectively. The research Lilly *et al.* (2017) reported that the composition of *A. subrotratus* was 79.1% (w.b) of moisture, 21.30% (w.b) of protein, 1.22% (w.b) of fat, and 1.99% (w.b) of ash. Other research on the composition of Arius genus fish showed that *A. muculatus* consisted of 76.48% (w.b) moisture, 64.24% (d.b) crude protein, 23.02% (d.b) fat, and 10.98% (d.b) ash (Tenyang *et al.* 2014). There is a difference in the results from this research compared to other research (Abraha et al. 2017; Ambily and Nandan, 2018; Lilly et al. 2017; Tenyang et al. 2014). The differences in results could be related to the type of fish, environmental conditions, and type of feed.

The protein content in *A. thalassinus* is high enough, so it has the potential to be used as a protein source for human consumption, especially for children. Protein plays a role in the growth and development of children. A day children aged 4-13 require 0.95 g/kg of protein (Hudson et al. 2021).

The protein content of giant catfish from Subang is higher than Eritrea, which is only 18.56% (Abraha et al. 2017). The high protein content in *A. thalassinus* can be made into fish protein hydrolyzate. The high protein content of hydrolyzed powder from catfish is due to the solubility of proteins during hydrolysis, the removal of insoluble and undigested non-protein substances, and some lipids after hydrolysis (Abraha et al. 2017). Mohanty et al. (2014) reported that fish protein is higher quality than other animal protein sources, such as beef and chicken.

The fat content of fish is influenced by fish movement activity and the type of feed consumed. An active fish has low fat and a high muscle/protein content. Januarita et al. (2022) reported that the type of fish affected the fish's chemical composition (moisture content, protein, and fat).

Table 1 The chemical composition of *A. thalassinus*

Parameter	*A. thalassinus*	(Abraha et al. 2017)
Moisture (%wb)	76.27±0.31	79.15
Ash (%wb)	1.32±0.09	1.75
Protein (%wb)	21.01±0.22	18.56
Fat (%wb)	0.34±0.03	0.54

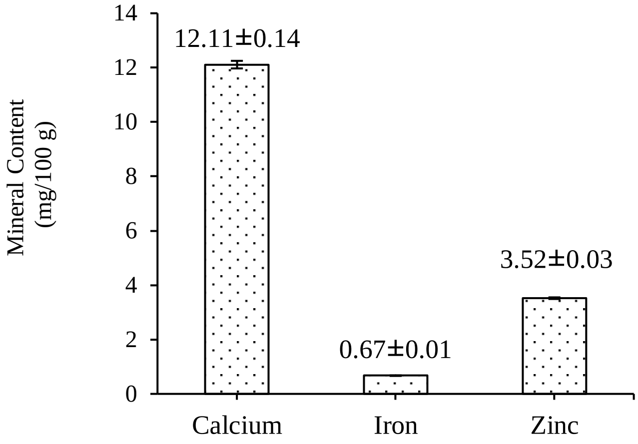

Figure 1 The mineral content of *A. thalassinus*

The mineral content of *A. thalassinus*

The *A. thalassinus* contained 12.11 calcium, 0.67 iron, and 3.52 zinc in mg/100 g (Figure 1). This result aligns with research by (Azmat et al. 2006) on the calcium content of *A. thalassinus*. The micronutrient content of *A. thalassinus* was 22-25 mg/100 g sodium, 19-24 mg/100 g potassium, 12-16 mg/100 g calcium, and 22-24 mg/100 g magnesium (Azmat et al. 2006). The previous study reported that the calcium, iron, and zinc contents of *A. muculatus* were 165.2, 0.91, and 1.46 mg/100 g, respectively (Manikandarajan et al. 2014). Other research reported that the calcium and zinc content of *A. muculatus* were 624 and 10.38 mg/100 g (Tenyang et al. 2014). According to the research results of *(*Lilly et al. 2017), the mineral content of *A. subrostratus* in mg/100 g was 30 for calcium, 0.30 for iron, and 0.41 for zinc. The type of fish, environmental conditions, and type of feed affect the mineral composition of fish.

Minerals are essential in maintaining body functions at the level of cells, tissues, organs, and body system functions. Calcium, zinc, and iron are essential minerals for humans. Calcium is the main mineral in the formation of bones and teeth. It also plays a role in nerve regulation and muscle function. Iron is the primary mineral of hemoglobin which plays a role in circulating oxygen to cells in the body. Zinc is a mineral that acts as an activator in nucleic acid synthesis. The recommended dietary allowance of calcium for children aged 4-8 years is 1000 mg/d (Zemel 2017). According to Aggarwal et al. (2012), calcium deficiency coupled with a deficiency in vitamin D causes rickets in children. Iron deficiency leads to anemia. A research study reported that maternal anemia in late pregnancy leads to a high risk of anemia in babies born (Ferguson 2016). Iron and zinc deficiencies were associated with anemia in children under 24 months. Palacios et al. (2019) reported that the risk of anemia increased in zinc-deficient infants. The mineral content in a fish is influenced by several factors, such as the type of fish species, the size of the fish, environmental water conditions, and feed consumption (Nurhayati and Zamzami 2014; Lall and Kaushik 2021; Januarita et al. 2022).

Amino acid profile of *A. thalassinus*

The amino acid profile *A. thalassinus* is shown in Table 2. The *A. thalassinus* meat was high in leucine, threonine, aspartic acid, and glutamic acid. The previous study reported that the *A. subrostratus* and *A. muculatus* are also high in leucine, aspartic, and glutamic acid (Tenyang et al. 2014; Ambily and Nandan 2018). According to Ambily and Nandan 2018, *A. subrostratus* contained 5.26 mg/g methionine, 8.56 mg/g threonine, 8.49 mg/g valine, 9.04 mg/g isoleucine, 15.67 mg/g leucine, 8.33 mg/g phenylalanine, 18.02 mg/g lysine, 11.42 mg/g arginine, 1.99 mg/g cysteine, 20.74 mg/g aspartic acid, 7.10 mg/g serine, 31.38 mg/g glutamic acid, 8.67 mg/g glycine, 11.28 mg/g alanine, 1.85 mg/g tyrosine, and 7.06 mg/g proline (calculation of percent amino acids compared to mg/g protein). The amino acid profile of *A. muculatus* consisted of 108.62 mg/g aspartic acid, 161.51 mg/g glutamic acid, 33.13 mg/g serine, 70.80 mg/g glycine, 48.11 mg/g histidine, 57.64 mg/g arginine, 35.41 mg/g threonine, 55.31 mg/g alanine, 72.30 mg/g proline, 22.52 mg/g tyrosine, 25.53 mg/g valine, 28.31 methionine, 93.02 mg/g isoleucine, 86.74 mg/g leucine, 31.70 mg/g phenylalanine, and 69.41 mg/g lysine (Tenyang et al. 2014).

Table 2 The amino acid profile of *A. thalassinus*

Parameter	*A. thalassinus*
Essential amino acids (mg/g)	
Isoleucine	57.24±0.44
Leucine	194.03±1.97
Threonine	118.01±0.75
Valine	0.55±0.12
Serine	68.75±0.03
Non-essential amino acids (mg/g)	
Alanine	52.50±0.20
Aspartate	142.43±0.16
Cysteine	2.72±0.12
Glutamate	192.20±0.28
Glycine	7.45±0.39
Proline	0.13±0.04

Amino acids are monomers that compose proteins. Amino acids are grouped into essential and non-essential amino acids. Amino acids are important biomolecules that regulate major metabolic pathways and serve as precursors for synthesizing important substances. The dominant essential amino acids in *A. thalassinus* meat were leucine (194.03 mg/g) and threonine (118.01 mg/g). In contrast, the dominant non-essential amino acids were aspartate (142.43 mg/g) and glutamate (192.20 mg/g). The content of these essential and non-essential amino acids was higher than that of *A. subrostratus* (Ambily and Nandan, 2018) and *A. muculatus* (Tenyang et al. 2014). The type of fish species affects the amino acid profile of fish (Januarita et al. 2022).

Leucine is an amino acid proven to be promising for increasing the growth and efficiency of food utilization in the human body (Duan et al. 2016). Gao et al. (2015) reported that oral administration of leucine improved growth hormone resistance in malnourished rats. The improvement of growth hormone resistance indicates increased growth in the malnourished rat. Threonine has a function for the synthesis of mucin protein which is necessary for maintaining intestinal immune function, inhibiting apoptosis, and stimulating lymphocyte proliferation (Li et al. 2007). D-aspartate functions as a neurotransmitter and plays a role in the performance of growth, reproduction, nerve, and endocrine mediation functions (Li et al. 2018). Glutamate is a neurotransmitter and inhibits T-cell response and inflammation (Li et al. 2007). Semba et al. (2016) and Maulidiana and Sutjiati (2021) reported that amino acid deficiency caused stunting in children. Therefore, amino acids, primarily essential amino acids, are necessary for body growth.

CONCLUSION

The *Arius thalassinus* meat from Subang, West Java, contained relatively high protein (21.01±0.22% wb) with some dominant essential amino acids (leucine and threonine), even though it has a less potency of calcium (12.11±0.14 mg/100g) source. The dominant amino acids in *A. thalassinus* meat were leucine (194.03 mg/g), threonine (118.01 mg/g), aspartate (142.43 mg/g), and glutamate (192.20 mg/g). The protein (leucine and aspartate) and calcium content in *A. thalassinus* meat have the potential to support growth, especially in children. Product development can be conducted to increase its consumption.

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