

Original Article

## Nutritional Contribution of *Awaous sp* Small Indigenous Fish Powder Important for the First 1000 Days of Life

Bahja<sup>1\*</sup>, Diah Ayu Hartini<sup>1</sup>, Ansar<sup>1</sup>

<sup>1</sup> Politeknik Kesehatan Kemenkes Palu, Palu, Central Sulawesi, Indonesia

(Correspondence author email, bundabije@gmail.com)

### ABSTRACT

Research facts prove that small-sized fish are essential nutrition during the first 1000 days of life. Central Sulawesi Province has an endemic small-sized marine fish species locally known as duo or penja fish (*Awaous sp*), which has not been studied for its bio-mineral content. This study aimed to analyze the moisture, ash, protein, calcium, iron, and zinc content in *Awaous sp* protein flour. This research was a descriptive laboratory study conducted at the Ilmu Bahan Makanan Laboratory Department of Nutrition Poltekkes Kemenkes Palu and PT. Saraswanti Indo Genetech Laboratory, Bogor, West Java, from January to September 2023. The sampling technique used purposive sampling, which involved purchasing fish from the local market in Palu city. *Awaous sp* protein flour had a moisture, ash, protein, Ca, Fe, and Zn content of 3.89%, 9.71%, 73.53%, 2316.88 mg/100g, 24.54 mg/100g, and 8.97 mg/100g, respectively. The contribution per serving of 145 grams of *Awaous sp* fish flour met the nutritional requirements (Recommended Dietary Allowances - RDA) for protein, Ca, Fe, and Zn per person per day for infants aged 6-11 months, children aged 1-3 years, pregnant women, and lactating women. *Awaous sp* protein flour had higher protein and Fe content compared to other small fish and had the potential to meet RDA requirements. Therefore, consuming *Awaous sp* protein flour as part of the daily diet can be a suitable strategy to address nutritional deficiencies during the first 1000 days of life for residents in Central Sulawesi.

**Keywords:** *Awaous sp*, Small Indigenous Fish, Fish Protein Powder, Bio-Mineral

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## INTRODUCTION

Improving nutritional status is focused on the first 1000 days of life as an effort to accelerate the reduction of stunting and address malnutrition during this period. Stunting remains a significant challenge in Central Sulawesi Province. Therefore, local resources with high nutritional potential, both from terrestrial and aquatic sources, need further exploration of their nutritional content through research. According to Gowele et al., 2021, micro-nutrient deficiencies such as calcium, iron, zinc, phosphorus, and vitamin A are of concern because some studies have shown their close association with stunting<sup>1</sup>. Protein-rich aquatic sources, especially small-sized fish, are known to be rich in mineral content. Byrd et al.,

2021 therefore, state that small-sized fish are essential nutrition during the first 1000 days of life<sup>2</sup>.

Several studies indicate that whole consumption of small fish species significantly contains higher micro-nutrient nutrition such as calcium, iron, zinc, manganese, vitamin A, vitamin D, E, K, EPA, and DHA compared to fish consumed as meat only<sup>3,4</sup>. Additionally, as noted by Abbey et al., 2017, small-sized fish have the potential to meet the nutritional needs of communities, especially those with limited economic resources<sup>5</sup>. Similar phenomena are also demonstrated by small-sized endemic fish species with high iron and vitamin A content<sup>6,7</sup>. Central Sulawesi Province has an endemic small-sized fish known as *Awaous sp*, which requires further study of its bio-mineral content

in the form of fish protein powder. Based on Shaviklo's review in 2015, fish flour is a stable fish product with higher protein content than the original fish meat.

*Awaous sp* fish can serve as raw material for fish flour production, which can be used as a fortifying ingredient in the food sector due to its presumed high bio-mineral content. However, research related to the mineral content of *Awaous sp* fish has never been conducted. Meanwhile, studies on the nutritional content of small-sized endemic fish flour have been widely conducted, including research conducted by Kasozi et al. in 2018 using small fish (*Brycinus nurse*) from Lake Albert, Uganda<sup>6</sup>. Nevertheless, minerals from supplements are difficult to be directly absorbed by the body because they form insoluble mineral salt deposits in the intestine<sup>8</sup>. Therefore, some research focuses on discovering bio-mineral supplements that can be effectively absorbed, by utilizing food protein to solubilize minerals for subsequent mineral absorption<sup>9</sup>. Recent research shows that mineral complexation with amino acids as chelators can improve mineral absorption and bioavailability<sup>10,11,12</sup>. Peptides can be derived from whey protein<sup>13</sup>, soy protein<sup>14</sup>, clam meat<sup>15</sup>, tilapia protein<sup>16</sup>, fish bones and fish meat<sup>9</sup> as calcium-binding peptides. Research utilizing small fish as iron-binding peptides was conducted by Wu et al., 2012<sup>17</sup>, Miao et al., 2020<sup>18</sup>, and Lin et al., 2021<sup>19</sup>. Fish proteins as zinc-binding peptides have also been successfully employed in the study by Chen et al., 2020<sup>20</sup>.

The fish flour production process, involving high heat and exposure to ultraviolet light, can damage peptide or protein content, resulting in poor solubility of mineral-amino acid complexes in the digestive tract and lower bioavailability<sup>21</sup>. Therefore, this study aims to develop method for *Awaous sp* fish flour production that preserves its peptide content. The objective of this research is to analyze the protein, calcium (Ca), iron (Fe), and zinc (Zn) content of *Awaous sp* fish protein flour.

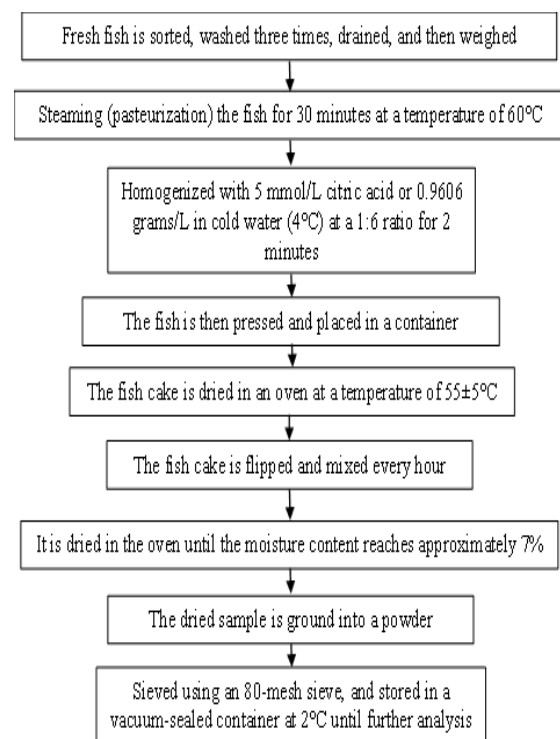
## METHOD

The research design is an experimental laboratory study, and the sampling technique used purposive sampling, which involved purchasing *Awaous sp* fish from the local market in Palu city. The research was conducted

from January to September 2023.

The production process of fish protein flour was carried out at the Ilmu Bahan Makanan Laboratory Department of Nutrition Poltekkes Kemenkes Palu. The analysis of moisture, ash, protein, as well as the analysis of calcium, iron, and zinc content of fish protein flour was conducted at the PT. Saraswanti Indo Genetech Laboratory in Bogor, West Java.

The production process of fish protein flour is carried out by applying a heating process using an oven method with slight modifications<sup>22</sup>. To reduce the fat content, the fish is homogenized with citric acid<sup>23</sup>. The flowchart of fish protein flour production is presented as Figure 1.



**Figure 1. Flow chart for fish protein flour production**

The analysis methods employed for testing moisture and ash content are gravimetric, following the SNI 01-2891-1992 standard. Protein content analysis is conducted using titrimetry, while the analysis of Ca, Fe, and Zn content is performed using ICP-OES (Inductively Coupled Plasma Optical Emission Spectrometry). The analysis procedures are carried out in triplicate (three repetitions).

## RESULTS

The results of anthropometric

measurements of fresh *Awaous sp* fish can be seen in Table 1.

**Table 1. Anthropometric of fresh *Awaous sp* fish**

	Length (cm)	Width (cm)	Weight (g)
Replicate 1	2,3	0,1	0,1186
Replicate 2	2,4	0,1	0,1347
Replicate 3	2,1	0,1	0,1038
Average	2,26	0,1	0,1190

The results of testing the quality of *Awaous sp* fish flour can be seen in Table 2.

**Table 2. Quality of *Awaous sp* fish flour**

	Moisture (%)	Ash (%)	Protein (%)
Replicate 1	3,91	9,73	73,17
Replicate 2	3,87	9,68	73,88
Replicate 3	3,89	9,72	73,54
Average	3,89	9,71	73,53

The results of testing mineral content of *Awaous sp* fish flour can be seen in Table 3.

**Table 3. Mineral content of *Awaous sp* fish flour**

	Ca (mg/100g)	Fe (mg/100g)	Zn (mg/100g)
Replicate 1	2318,82	24,73	8,97
Replicate 2	2319,14	24,38	8,96
Replicate 3	2312,68	24,52	8,98
Average	2316,88	24,54	8,97

## DISCUSSION

Anthropometric measurements and taxonomic of fresh *Awaous sp* fish, including length, width, and weight, categorize *Awaous sp* as a small-indigenous fish species (SIS) <sup>24</sup>. The animal protein food originating from the waters of Central Sulawesi is locally known as “duo” or “penja”. In traditional markets, there are two types of penja available, namely black penja and white penja. White penja and black penja are the same species but differ in their harvest times, with black penja being more mature than white penja <sup>25</sup>.

The amount of moisture (3,89%), ash (9,71%), and protein (73,53%) content in the *Awaous sp* fish flour are similar to Mahmud, et al., 2019 (1), who reported the moisture, ash, and protein contents of scribbled goby (*Awaous grammepomus*), puntio barb (*Puntius puntio*), and spotted snakehead (*Channa punctata*) as 6.84%, 9,19%, and 73.36%. The moisture, ash, and protein content vary depending on the species and drying method <sup>26</sup>.

Based on SNI 01-2715-1996/Rev.92

(2), the minimum protein content for fish flour falls into Quality I, II, and III categories, which are 65%, 55%, and 45%, respectively. The protein content in *Awaous sp* fish flour, at 73.53%, meets the Quality I standard.

The recommended daily protein intake for infants/children varies, with 15 grams for ages 6-11 months and 20 grams for ages 1-3 years. For pregnant women and lactating women, it is 73.7 grams and 77.5 grams, respectively <sup>27</sup>. To meet the daily protein intake, the recommended consumption of *Awaous sp* fish flour is 20.4 grams for ages 6-11 months, 27.2 grams for ages 1-3 years, 100.23 grams for pregnant women, and 105.4 grams for lactating women.

Although the calcium content in *Awaous sp* fish flour is 2316.88 mg/100g, which is lower than *Brachydeuterus auratus* fish in a study by Abbey et al., 2017 <sup>5</sup>, it is higher than *Glossogobius giuris* fish in a study by Akther et al., 2018 <sup>28</sup>, and *Labeo rohita* fish in a study by Mahmud et al., 2019 <sup>29</sup>. The recommended daily calcium intake for infants/children varies, with 270 mg for ages 6-11 months and 650 mg for ages 1-3 years. For pregnant women and lactating women, it is 1200 mg <sup>27</sup>. To meet the daily calcium intake, the recommended consumption of *Awaous sp* fish flour is 11.6 grams for ages 6-11 months, 28 grams for ages 1-3 years, 51.8 grams for pregnant women, and 51.8 grams for lactating women.

The iron content in *Awaous sp* fish flour, at 24.54 mg/100g, is higher than the iron content in *Hypophthalmichthys molitrix* fish in a study by Mahmud et al., 2019 <sup>29</sup>, and *Brachydeuterus auratus* fish in a study by Abbey et al., 2017 <sup>5</sup>. The recommended daily iron intake for infants/children varies, with 11 mg for ages 6-11 months and 7 mg for ages 1-3 years. For pregnant women and lactating women, it is 24 mg and 18 mg, respectively <sup>27</sup>. To meet the daily iron intake to prevent iron deficiency, the recommended consumption of *Awaous sp* fish flour is 44.8 grams for ages 6-11 months, 28.5 grams for ages 1-3 years, 97.8 grams for pregnant women, and 73.3 grams for lactating women.

The zinc content in *Awaous sp* fish flour, at 8.97 mg/100g, is higher than that in *Engraulis encrasicolus* fish in a study by Hasselberg et al., 2020 <sup>30</sup>. The recommended daily zinc intake for infants/children varies, with 3 mg for ages 6-11 months and 1-3 years.

For pregnant women and lactating women, it is 11,3 mg and 13 mg, respectively<sup>27</sup>. To meet the daily zinc intake to prevent zinc deficiency, the recommended consumption of *Awaous sp* fish flour is 33,4 grams for ages 6-11 months and 1-3 years, 126 grams for pregnant women, and 145 grams for lactating women.

The Recommended Dietary Allowance (RDA) for Indonesia, known as AKG, provides the average daily nutritional requirements for most individuals, based on characteristics such as age, gender, physical activity level, and physiological condition, for a healthy life<sup>27</sup>. In this study, AKG was used to determine the adequacy of protein, calcium (Ca), iron (Fe), and zinc (Zn) intake for the age groups of 6-11 months, 1-3 years, pregnant women, and lactating women, as these age groups are the focus of efforts to accelerate the reduction of stunting and combat malnutrition during the first 1000 days of life.

## CONCLUSION

Drying in an oven at a temperature of 60°C is a viable method for producing protein flour from the small-indigenous fish species *Awaous sp*. We found that the protein, calcium (Ca), iron (Fe), and zinc (Zn) content of *Awaous sp* fish protein flour is relatively high compared to other small-fish species, making it a potential candidate for the development of bio-mineral fortification ingredients in food. The results of the AKG (nutrient adequacy ratio) indicate that *Awaous sp* fish protein flour can contribute to nutrition, especially for infants aged 6-11 months, children aged 1-2 years, pregnant women, and lactating women, who are in the crucial first 1000 days of life. Therefore, consuming *Awaous sp* fish protein flour as part of the daily diet can be an appropriate strategy to address stunting in Central Sulawesi.

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## CONFLICTS OF INTEREST

The authors declare that they have no known competing financial interests or personal

relationships that could have appeared to influence the work reported in this paper.

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