

Potential of Louhan fish (*Amphilophus labiatus*) as a local fishery pest in Lake Toba North Sumatra as a source omega 3 and 6 fatty acids

Maruba Pandiangan^{1,*}, Dewi Restuana Sihombing¹, Connie Daniela¹, Posman Sibuea¹, Sanggam Dera Rosa Tampubolon¹, Apul Sitohang¹, and Lasmianna Sitanggang²

¹Program Study of Agricultural Product Technology, Faculty of Agricultural, Universitas Katolik Santo Thomas, Medan 20132, Indonesia

²Graduate from Program Study of Agricultural Product Technology, Faculty of Agricultural, Universitas Katolik Santo Thomas, Medan 20132, Indonesia

Abstract. Identifying the oil of Louhan fish (*Amphilophus labiatus*), which are now considered a nuisance and a danger to the native fish of Lake Toba, as a source of omega 3 and omega 6 fatty acids is the aim of the study. From August to November 2023, the research was conducted at the Faculty of Agriculture Laboratory at Santo Thomas Catholic University. The physical and chemical properties of Louhan fish oil, as well as its fatty acid content, were examined using a gas chromatograph. The physical and chemical analysis of Louhan fish oil revealed the following results: turbidity point 36 °C, total solids 34 °Brix, free fatty acid content 3.35 mg KOH/g, peroxide number 7.3 meq/kg, iodine number 45 mg/100g, and saponification number 198 mg KOH/g. The results of the gas chromatography study showed that the levels of unsaturated fatty acids were higher than those of saturated fatty acids. Furthermore, linolenic acid, an omega 3 fatty acid, and linoleic acid, an omega 6 fatty acid, were found in the analysis's results. Louhan fish oil may include omega 3 and omega 6 fatty acids, which are beneficial to human health, based on its fatty acid composition.

1 Introduction

The existence of the Louhan fish, also known as the red devil fish in Lake Toba, has caused the population of fish endemic to Lake Toba to decline. Named the red devil fish apart from its basic red color, it is also because it is very aggressive with big and strong teeth. It is a predatory fish that preys on other fish there. Louhan fish is an introduced fresh water fish

* Corresponding author: maruba_pandi@yahoo.com

or not native to Indonesia. Even though it is an introduced fish, this fish has good adaptability, so it can reproduce quickly and rapidly [1-3].

The Louhan fish habitat is generally in fresh water, such as rivers, rice fields, lakes and swamps that do not contain mud. Initially, this fish was introduced as an ornamental fish in Indonesia. Even though it has a beautiful color and figure like a Louhan fish, devil fish is not a fish that can be kept. Louhan fish do not have the potential to be developed, because apart from being difficult to cultivate, the economic value of Louhan fish is not too high in the market. Apart from that the Louhan fish also includes predators of other fish such as pora-pora fish, tilapia fish, Nile tilapia, and goldfish [4].

Based on its type, the red devil fish is a carnivorous fish, which is a fish that eats other types of fish. Its existence is certainly dangerous for the natural ecosystems of rivers and lakes with a variety of endemic fish species, which makes it one of the most invasive fish in Indonesian fresh waters [4-6]. According to the IUCN (International Union for Conservation of Nature), invasive alien species are species capable of forming colonies in natural or semi-natural ecosystems, which damage and threaten local biodiversity [7].

The use of Louhan fish, which is currently a threat to fish endemic to Lake Toba, is an approach from the nutritional components they contain. In general, fish as a food ingredient that contains high protein and essential fatty acids needed by the body. Eating fish not only strengthens the endurance of the heart muscle, but also improves brain intelligence, lowers triglyceride levels, and prevents blood clots [8, 9].

In addition to being a decorative fish, the goal of this research is to find new uses for Louhan fish, which are seen as a nuisance and hazardous to fish that are native to Lake Toba. This work used a gas chromatography instrument to analyze the content and physical and chemical properties of omega 3 and omega 6 fatty acids in Louhan fish oil [10, 11].

2 Research methods

The Lake Toba Louhan fish, which were acquired at the Tongging market in the Brand District of the Karo Regency, served as the study material. Acetic acid-chloroform solvent, saturated KI, distilled water, 1% starch indicator, 0.01N sodium thiosulfate, 0.5 N KOH, 0.5 N HCl, pp indicator, 0.1 N KOH, 95% ethanol, chloroform, iodine-bromide reagent, 15% KI, and 0.1 N sodium thiosulfate were among the reagents used for the physico-chemical tests. 0.5 N NaOH, methanol, BF₃, saturated NaCl, n-hexane, and anhydrous Na₂SO₄ were used for the fatty acid composition test.

A Shimadzu QP 2010 ULTRA gas chromatography (GC) device with a FID detector was used. DB-23 column, 30 m length, 40⁰-250 °C column temperature, 20 °C/min temperature rise rate, 260 °C detector temperature, nitrogen carrier gas, 0.72 ml/min column rate, and 37.7 ml/min flow rate [12, 13], extraction based on SNI 01-2354.3-2006 utilizing the n-hexane soxhletation technique.

Following a thorough washing, 500 g of fish fillets were crushed and dried in a vacuum oven set at 70 °C for three hours. After that, it was extracted using n-hexane solvent for 50 minutes at a temperature of 80 degrees Celsius. The resulting extract was then distilled for 60 minutes at ± 70 °C and baked for 25 minutes at ± 50 °C [14]. The fatty acid content and physico-chemical characteristics of the produced fish oil were evaluated. Physical factors like as total solids and turbidity point are tested. Free fatty acid content, peroxide number, iodine number, and saponification number are among the chemical parameters that are

tested [15]. A gas chromatography tool was used to analyze the water-free liquid phase after 25 mg of oil had been dimethyl esterified with BF_3 to determine the fatty acid composition of Louhan fish oil [16, 17]. Fig. 1 shows the research method flowchart.

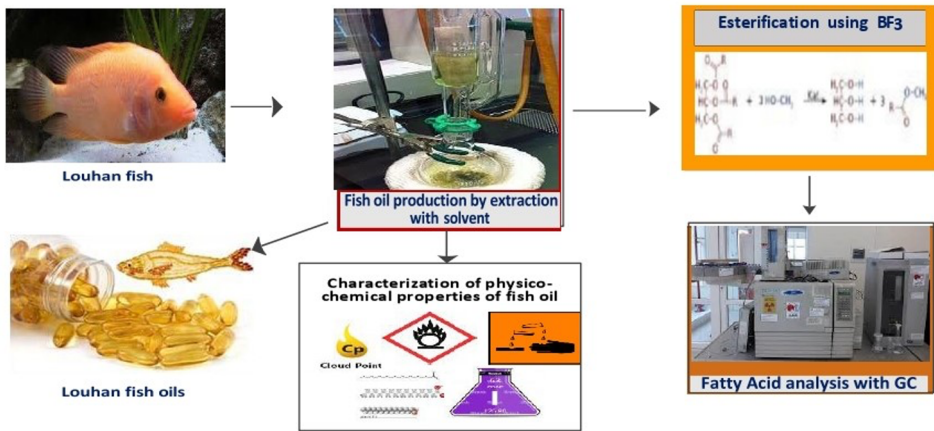


Fig. 1. Flowchart of research method.

3 Results and discussion

The physical and chemical properties of Louhan fish oil were analyzed by determining the turbidity point, total solids, free fatty acid content, peroxide number, iodine number and saponification number which are presented in Table 1.

Table 1. The physical and chemical characteristics of Louhan fish oil.

Characteristics	Unit	Amount
Physical properties		
Turbidity point	°C	36.00
Total solids	°Brix	34.00
Chemical properties		
Free fatty acid	%	3.35
Peroxide number	meq/kg	7.30
Iodine number	mg/100g	45.00
Saponification number	mg KOH/g	198.00

The existence of contamination from foreign components or oil mixing was assessed by analyzing cloud point and total solids. Louhan fish oil's cloud point and total solids are 36.00 °C and 34.00 °Brix, respectively. These values are sufficiently enough to suggest that the fish oil is not pure. According to Table 1, the free fatty acid level is 3.35 mg KOH/g,

which is more than the 0.6–1.0 mg KOH/g standard acid number recommended by BPOM. A high acid value suggests that the oil has undergone a hydrolysis process. The oil's quality decreases as the acid number rises. The oil has undergone an oxidation process, as shown by the peroxide number of 7.30 meq/kg, which satisfies the maximum 5.0 meq/kg criterion of SNI 01-3555-1998 [13, 18, 19].

Louhan fish oil's iodine content of 45.00 mg/100g satisfies the 45–46 mg/100g standard iodine level specified in SNI 01-3741-2002. Unsaturated fatty acids are present in oil when the iodine number is high [18]. Louhan fish oil satisfies the standard (196-200 mg KOH/g) with a saponification number of 198.00 mg KOH/g in Table 1. The presence of long chain fatty acids in fish oil is indicated by the saponification number [20, 21].

Table 2 displays the fatty acid content of Louhan fish oil as determined by gas chromatography.

Table 2. Fatty acid composition contained in Louhan fish oil by gas chromatography.

Name of fatty acids	Carbon	Amount (%)		
		1	2	Average
Saturated fatty acids (SFA)				
Capric acid	C:10-0	0.4024	0.4071	0.4047
Lauric acid	C:12-0	4.3566	4.3758	4.3662
Myristic acid	C:14-0	0.4534	0.4598	0.4566
Palmitic acid	C:16-0	34.4114	33.7788	34.0951
Stearic acid	C:18-0	10.1651	10.2412	10.2031
Arachidic acid	C:20-0	1.4350	1.4348	1.4349
Σ SFA		51.6257	50.6975	50.9606
Mono unsaturated fatty acids (MUFA)				
Palmitoleic Acid	C:16-1	11.0059	11.1630	11.0844
Oleic Acid ω -9	C:18-1	6.5918	6.6511	6.6214
Trans-Elaidic acid	C:18-1 ^{ts}	27.4665	27.7454	27.6059
Σ MUFA		45.0642	45.5559	45.3117
Poly unsaturated fatty acids (PUFA)				
Linoleic Acid ω -6	C:18-2	2.2596	2.2451	2.2523
Linolenic Acid ω -3	C:18-3	0.5160	0.5380	0.5270
Σ PUFA		2.7756	2.7831	2.7793

Table 2 shows that saturated fatty acids account for 50.9606%, while unsaturated fatty acids make up 48.0910%. Among the unsaturated fatty acids, 45.3117% are MUFA and 2.7793% are PUFA. The most abundant saturated fatty acid is palmitic acid (C: 16-0), with a content of 34.0951%. Regarding unsaturated fatty acids, linolenic acid (C: 18-3), an omega-3, is present at 0.5270%; linoleic acid (C: 18-2), an omega-6, at 2.2523%; and oleic acid (C: 18-1), an omega-9, at 6.6214%.

The gas chromatography analysis results reveal that the omega-9 fatty acid content in Louhan fish oil surpasses that of omega-6 and omega-3. This finding aligns with the assertion that fish oil generally contains more omega-9 compared to omega-6 and omega-3 [22, 23].

The nutritional value of fats or oils is assessed by analyzing the fatty acid composition, particularly the percentage deviation from the ideal SFA:MUFA:PUFA ratio of

33.33%:33.33%:33.33%. Table 3 illustrates the nutritional value of Louhan fish oil based on its deviation from this ideal fatty acid composition.

Table 3. Nutritional value of Louhan fish oil.

Sample	Fatty Acid Composition (Deviation)			Σ Deviation (%)
	SFA (%)	MUFA (%)	PUFA (%)	
Ideal Composition	33.33 (0.00)	33.33 (0.00)	33.33 (0.00)	0.00
Louhan fish Oil	50.9606 (17.63)	45.3117 (11.98)	2.7793 (30.55)	60.16

According to Table 3, Louhan fish oil's fatty acid composition is composed of 2.7793% polyunsaturated fatty acids (PUFA), 45.3117% monounsaturated fatty acids (MUFA), and 50.9606% saturated fatty acids (SFA). The nutritional value of Louhan fish oil does not meet the ideal norm, where the ratio of SFA, MUFA, and PUFA should be 33.33% each, as shown by the total departure of 60.16% from the ideal ratio. However, since Louhan fish oil contains unsaturated fatty acids, including MUFA and PUFA, which are recognized for their health advantages, it still offers enough nutritional value [24].

The comparison of omega-3 and omega-6 fatty acids in Louhan fish oil, as shown by gas chromatography analysis, is shown in Table 4.

Table 4. The comparison of omega 3 with omega 6.

Distribution	Omega 3 (ω -3)	Omega 6 (ω -6)	Ratio (ω -3/ ω -6)
Louhan fish oil	0.5270 %	2.2523 %	(1:4.27)

According to Table 4, Louhan fish oil has an omega-3 to omega-6 ratio of (1:4.27). The ideal ratio between omega 3 and omega 6 is 2:1, which is also the suggested ratio [25]. Overconsumption of omega 3 may have negative consequences for membrane permeability and enzymatic function. If omega 6 consumption surpasses the ratio (1:20), it may lead to the pathophysiology of inflammation, raise the risk of cancer, impair eyesight, and cause autoimmune and neurological illnesses. Louhan fish oil nevertheless satisfies the standards since its omega-3 to omega-6 ratio is within the acceptable comparison range [26].

4 Conclusion

Louhan fish oil has the following fatty acid composition: 2.7793% PUFA, 45.3117% MUFA, and 50.9606% SFA. Omega 6 fatty acids, which include 2.2523% linoleic acid, and omega 3 fatty acids, which contain 0.5270% linolenic acid. Louhan fish oil's omega-3 to omega-6 ratio has remained within the advised range. As an alternative to using Louhan fish, which is regarded as a nuisance and harmful to fish unique to Lake Toba, Louhan fish oil provides omega 3 and omega 6 fatty acids in a ratio within the advised limits.

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