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PROXIMATE, FATTY ACID AND HEAVY METAL COMPOSITION OF SWAMP WATER FISH IN TANAH LAUT, SOUTH KALIMANTAN

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ABSTRACT

In present study, chemical, fatty acid, and heavy metal compositions were determined for five species of swamp water fish from Tanah Laut, South Kalimantan, Indonesia. Chemical composition was found to be 15.85-21.74% protein, 0.45-3.24% fat, 0.99- 4.13% ash, and 74.23-78.84% water, whereas the fatty acid compositions consisted of 0.04-19.99% saturated fatty acids (SFA), 0.79-19.66% monounsaturated fatty acid (MUFA) and 0.05-4.7% polyunsaturated fatty acids (PUFAs). Among them, those occurring in the highest proportions were lauric acid (C12:0, 0.04-0.1%), myristic acid (C14:0, 0.51-1.03%), palmitoleic acid (C16:1, 0.79-2.67%), linolenic acid (C18:3, 0.18-3.09%), arachidonic acid (C20:4, 1.18-3.19%), linoleic acid (C18:2, 1.31-4.7%), stearic acid (C18:0, 5.86-10.62%), oleic acid (C18:1, 5.19-19.66%), palmitic acid (C16:0, 8.86-19.99 %), eicosapentaenoic acid (EPA, C20:5,n-3 0.05-1.53%), docosahexaenoic (DHA, C22:6,n-3 0.41-1.97%). The rest of heavy metals contents including lead (Pb) and cadmium (Cd) were not detected.

Keywords— swamp water fish, proximate, fatty acid, and heavy metal

INTRODUCTION

There was an increase in Indonesia's fisheries production by an average of 225.24% in 2009 and is expected to reach 5.37 million tons for capture fisheries and 3.25 million tons for aquaculture (Salim, 2010). This indicates the potential use of fisheries opportunities are indeed very large.

According to Chairuddin (1977), the province of South Kalimantan is dominated by swamp water and rivers. Information on the proximate content and fatty acid distribution is important when utilization of new species of swamp water fish is considered. This is because swamp water fishes are considered to be not only food with good source of high quality protein but also food with healthy components. Polyunsaturated fatty acids (PUFAs) such as eicosapentaenoic acid (EPA, 20:5 (n-3)) and docosahexaenoic (DHA, 22:6 (n-3)) have been recommended for human health and fish fecundity; particularly in DHA, has a therapeutic effect on human physiology (Ackman, 1988). The studies about food consumption and metabolism of swamp fish were rarely studied.

The information of of fatty acid contents in some fish in the swamp water of South Kalimantan have never been found before, so it is important to conduct research about swamp water fish. Therefore this study was conducted to investigate the proximate composition of heavy metal and fatty acid of swamp water fishes caught in the Tanah Laut, South Kalimantan.

MATERIALS AND METHODS

Materials: Samples used in this work consisted of 5 species of swamp water fishes (*M. erythrotaenia/*Sili fish; *H. fortis/* Baung fish; *C. micropeltes/* Toman fish; *C. striatus/* Haruan fish; and *C. Lucius/* Kehung fish) from South Kalimantan. Results of Physical measurement can be seen in Table 1. The fish samples were kept frozen at -20 ^{o}C until analyzed.

Chemical analysis: Moisture content was determined by drying samples in an air circulation oven for 8 h at 100 ^{o}C. Samples for ash determination were heated in a furnace at 550 ^{o}C for 6 h to constant weight as described in the AOAC manual (AOAC, 1975). Crude protein was determined on the edible portions of fish by Kjeldahl nitrogen using a 6.25 conversion factor (AOAC, 1975). Lipids were extracted by using hexane/methanol and were gravimetrically determined as described previously (Bligh & Dyer, 1959).

Fatty acid analysis: Preparation of fatty acids methyl ester was carried out according to the method of AOAC (1984). Crude oil extract (20 µL) from swamp water fish samples were trans-esterified in a pyrex tube by using 200 µL of borontrifluoride-methanol (20 % BF3) reagent and heated at 100 ^{o}C for 30 min. After cooling, 200 µL of n-hexane and 800 µL of distilled water were added to the mixture, which was then agitated manually for 1 min and centrifuged for 2 min. Approximately 100 µL of the upper n-hexane layer was transferred to a 150 µL glass insert for 2 ml vials after diluting the extracted hexane to obtain a suitable chromatographic response. Fatty acids were identified by comparing the retention times of FAME mixture with the standard myristic acid palmitic acid, stearic acid, oleic acid, linoleic acid, eicosapentaenoic acid (EPA), docosahexaenoic acid (DHA). Two replicate GC analyses were performed and the results were expressed in GC area % as mean values ± standard deviation. The fatty acid composition of swamp water fish oil triacyglyserol was directly analyzed using Gas Chromatography (GC) after methyl esterification. One µL of each fatty acid methyl ester (FAME) sample was injected (split ratio 15:1) into a Gas Chromatography Instrument Shimadzu GC 2010(Shimadzu Scientific Inc., USA) with flame ionization detector (GC-FID). Chromatographic peaks were identified by comparing retention times with the PUFA standard.

Heavy metal analysis (lead and cadmium): Lead and cadmium analysis was carried out according to SNI 01-2891-1992 (The National Standardization Agency of Indonesia 1992). The principle of the determination of heavy metals (Pb and Cd) is dissolving the residue of dry or wet ashing in dilute acid. The solution was deployed in a flame that is in the Atomic Absorption Spectrophotometer (AAS) instrument, so the absorption or emission of metals can be analyzed and measured at specific wavelengths. Wavelengths used in the analysis of lead and cadmium was 283.3 nm and 228.8nm, respectively.

RESULT AND DISCUSSION

Characteristics and yield fillet of some fish of the swamp waters: Physical measurement of five kinds of swamp water fish is shown in Table 1. The length of the fish which examined ranged from 25.50-42.00 cm. The calculated fillet yield showed in Table 2. For comparison between the weights of meat fillet with whole fish weight obtained yield percentage of fillet production 27.63- 43.73%. This can be influenced by the existence of a difference species, age, habitat, gonad maturity level, and feed intake (Asty 2007).

Table 1: Physical measurements and weight of some swamp water fish from Tanah Laut, South Kalimantan

Fish Species	Length (cm)	Weight (g)
M. erythrotaenia	42.00	152.00
H. fortis	35.50	342.50
C. micropeltes	31.00	343.00
C. striatus	25.50	157.00
C. Lucius	28.50	205.00

Table 2: Percentage yield fillet production of some swamp water fish from Tanah Laut, South Kalimantan

Species	Weight (g)	Fillet weight (g)	Yield (%)
M. erythrotaenia	152.00	42.00	27.63
H. fortis	342.50	146.00	42.62
C. micropeltes	343.00	150.00	43.73
C. striatus	157.00	51.00	32.48
C. lucius	205.00	80.00	39.02

Proximate analysis results: The moisture, protein, fat and ash contents in the muscles of the swamp water fishes (*M. erythrotaenia/*Sili fish;, *H. fortis/* Baung fish; *C. micropeltes/* Toman fish; *C. striatus/* Haruan fish and *C. Lucius/* Kehung fish) are shown in Table 3.

Table 3: Proximate composition and energy values of edible portion of the swamp water fish species (per 100 g)

Species	Water content (%)	Ash content (%)	Fat content (%)	Protein content (%)
M. erythrotaenia	78.84	0.99	3.02	15.85
H. fortis	74.23	1.28	2.31	21.74
C. micropeltes	75.90	4.13	0.47	17.84
C. striatus	77.14	2.10	0.45	19.59
C. lucius	74.60	3.42	3.24	18.13

The moisture content was between 74.23 and 78.84%, protein contents was between 15.85 and 21.74%, fat content ranged from 0.45 to 3.24%, and ash content was from 0.99 to 3.42%. The diversity of chemical composition can be caused by foods, species, sex, and age of the fish (Kusumo 1997).

The protein content of *H. fortis* was the highest of swamp water fishes examined. The high levels of the protein are influenced by the type of species, environment and food. Based on protein content and fat, fish can be classified into 5 types (Stansby and Olcott, 1963), as listed in Table 4. The fifth type of fish, A, B, C, D and E are based on protein and fat content.

Table 4: Types of fish based on protein and fat contents

Category	Content	Protein (%)	Fat (%)
A	High Protein, Low Fat	15-20	<5
B	High Protein, Medium Fat	15-20	5-15
C	Low Protein, High Fat	<15	>15
D	Very High Protein, Low Fat	>20	<5
E	Low Protein, Low Fat	<15	<5

Note: *Source : Stansby dan Olcott (1963)

Based on Table 4, some fish on the swamp waters of the South Kalimantan that are researched, can be grouped into two types. Grouping several of these fish are listed in Table-5.

Table 5: Types of some fish in the swamp water of the Tanah Laut, South Kalimantan based on protein and fat contents

Species	Types	Category
M. erythrotaenia	A	High Protein, Low fat
H. fortis	D	Very High Protein, Low Fat
C. micropeltes	A	High Protein, Low Fat
C. striatus	A	High Protein, Low Fat
C. lucius	A	High Protein, Low Fat

In Table 5 it looks that the fish examined consisted of 2 types: type A and type D. Type fish belonging to A is *M. erythrotaenia*, *C. micropeltes*, *C. stratus* and *C. lucius*, namely fish with high protein levels (15-20%) and low fat solution (5%). Fish that belong to the type D was *H. fortis* that fish with a very high protein level (20%) and low fat solution (5%).

Fatty acid profile of swamp water fish muscles: The fatty acid composition of the species investigated is summarized in the Table 6.

Table 6: Fatty acid composition of some swamp water fish from Tanah Laut, South Kalimantan (% w/w)

Fatti acids types	Fatty acids	*M. erythrotaenia*	*H. fortis*	*C. Micropeltes*	*C. striatu*	*C. lucius*
Saturated fatty acid	Lauric	0.05	0.1	0.07	0.04	0.05
	Myristic	0.94	1.03	0.7	0.51	0.92
	Palmitic	16.97	17.05	16.47	8.86	19.99
	Stearic	6.81	10.26	10.62	5.86	7.78
Total SAFA		24,.77	28.44	27.86	15.27	28.74
Mono un-saturated fatty acids	Palmitoleic	2.6	2.67	2.32	0.79	2.35
	Oleic	14.18	19.66	10.33	5.19	13.99
Total MUFA		16.78	22.33	12.65	5.98	16.34
Poly unsaturated fatty acids	Linoleic	4.7	4.57	1.96	1.31	4.15
	EPA	1.88	3.09	0,8	0.18	1.97
	DHA	1,18	2.59	1.73	3.19	2.27
	Linolenic	0.05	0.37	0,32	1.53	0.45
	Arachidonic	0.41	0.96	1.43	1.62	1.97
Total PUFA		8.22	11.58	6.24	7.83	10.81
Total Fatty Acid		42.74	61.74	36.92	45.63	61.93

The results demonstrated that a significant part of the fatty acid in the muscles was saturated fatty acid (SFA), monounsaturated fatty acid (MUFA) and polyunsaturated fatty acids (PUFA). The content of SFA varied from 0.04-19.99% of the total fat content among the different species examined, the range of MUFA content was between 0.79-19.66% and PUFA varied from 0.05 to 4.7%. Among the fatty acids, palmitic acid (16:0) was dominant, especially in *C. lucius* and *H. fortis*.

Fish fatty acid composition of *H. fortis* was dominated by monounsaturated fatty acids, there were oleic acid (C18: 1, n-9, 19.66%) and saturated fatty acids such as palmitic acid (C16:0, 17.05%) and stearic acid (C18:0, 10.26%). Fish fatty acid composition of *C. micropeltes* was dominated by monounsaturated fatty acids, there were oleic acid (C18:1, n-9, 10.33%) and saturated fatty acid such as palmitic acid (C16: 0) of 16.47%) and stearic acid (C18:0, 10.62%). The content of monounsaturated fatty acids that highly suitable habitat can be influenced his life contained little phytoplankton in the water of swamps and marshes which is the tendency of fish predators of small fishes.

Fish fatty acid composition of *S. Stratus* was dominated by the monounsaturated fatty acids, there were oleic acid (C18:1, n-9, 5.19%) and saturated fatty acids such as palmitic acid (C16:0, 8.86%) and stearic acid (C18:0, 5.86%). Fatty acid composition of fish *C. luscious* was dominated by monounsaturated fatty acids, there were oleic acid (C18:1, n-9, 13.99%) and saturated fatty acids such as palmitic acid (C16:0, 19.99%) and stearic acid (C18:0, 7.78%).

Overall, several species of freshwater fish had been studied. The composition of the fatty acids are almost the same, but with variations in fatty acid values that are quite diverse. Basically, the fatty acid composition of fish on average is dominated by the monounsaturated fatty acids (MUFA), saturated fatty acids (SAFA) and unsaturated fatty acids (PUFA). Differences in the levels of these fatty acid composition and occurs because the composition of fats and fatty acids in fish depending on the type of species, habitats and types of food consumed such fish (Ackman 1982). Some fatty acids that dominated in swamp water fish and had an important role in health is oleic acid (MUFA), EPA, and DHA. Comparison of oleic acid, EPA and DHA several species of the swamp water fishes rawa showed on Table 7.

Table 7: Comparison composition of oleic, EPA and DHA on some swamp water fish from Tanah Laut, South Kalimantan

Species	Oleic	EPA	DHA
M. erythrotaenia	14.18	0.05	0.41
H. fortis	19.66	0.37	0.96
C. micropeltes	10.33	0.32	1.43
C. striatus	5.19	1.53	1.62
C. lucius	13.99	0.45	1.97

Heavy metal composition (Pb and Cd): The heavy metal contents of the edible portion of the swamp water fish species were listed in Table 8.

Table 8: Heavy metal contents of edible portion of swamp water fish species from Tanah Laut, South Kalimantan

Species	Heavy metals (Tocsic) (ppm)	
	Pb	Cd
M. erythrotaenia	Not detected	Not detected
H. fortis	Not detected	Not detected
C. micropeltes	Not detected	Not detected
C. striatus	Not detected	Not detected
C. lucius	Not detected	Not detected
Standard*	0,05-1,0	0,005-0,2

Note: *Source: Nauen (1983)

Pb and Cd were determined by atomic absorption spectrophotometer in the raw tissues. The results of the analysis showed that Pb and Cd were not detected by the tool being used.

Based on the FAO and of health, the maximum content of cadmium is still allowed in the body of the commodity chain of fresh seafood is about 0.2 ppm of materials, and the maximum concentration for lead are still allowed in the fisheries and other fisheries which results of 0.2-0.4 ppm (Sunaryo 2002). Then it can be known that some of the fish that examined were safe for the consumption, because of the content of heavy metals cadmium (Cd) and lead (Pb) were on the threshold of safe consumption.

CONCLUSION

The five species swamp waters from South Kalimantan studied has a potential source of fatty acid. The fatty acid analysis showed that several species contain 11 types of fatty acids. The fatty acids that dominated in these fish are palmitic acid with 8.86-19.99% (b/b) and oleic acid included into the omega-9 with 5.19-19.66% (b/b). Heavy metal such as (Pb) and cadmium (Cds) is not detected in samples analyzed.

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