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Extraction and Characterization of Fish oil from various parts of Snakehead fish (*Chana striata*)

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Abstract : Snake head fish (*gabs* fish; (*Chana striata*) is rich in omega three fatty acids, therefore it is interested to study the potential for the production of omega three supplement. This study is focused on the extraction of oil in various parts of the snakehead fish body. Snakehead fish was purchased from the local fishermen in Lake Tornado, North Sulawesi. The fish was cut into three main parts including head, body and viscera. The fish parts were boiled with water to extract the oil and the fatty acid composition were determined by gas chromatographic method. The total oil content for whole fresh fish was 0,41 percent. The highest oil content was in the mussels of the head (63.8 %) followed by viscera (19.9 %) and abdomen (16.3 %). Palmitic and docosahexanoic acids are the main fatty acids in the fish oil. DHA and EPA as omega-three fatty acids were significantly present in this fish oil (14.99 and 8.65 %, respectively).
Keywords : Snakehead, body parts, oil content, fatty acid composition.

Introduction

Indonesia is very rich in natural resources including fish. Other than marine fishes, Indonesia is rich in fresh water fishes. This is due to, Indonesia geographically situated in the equator with rain forest climate and mountainousterrains creating so many fresh water bodies such as lakes, rivers and ponds. Those natural settings such as river, lakes and abdomen ponds are ideal for the supporting of snakehead fish growth.

Snakehead fish belongs to the predator fish, therefore their present in the cultured waters with other fish are not expected. Nevertheless, this fish is present in many water bodies in Indonesia. In North Sulawesi this fish is hardly cultured by the people, but many people like this fish so they are taking it mostly from natural water bodies such as abandoned ponds, rivers and lakes.

Snakehead fish has so many functional properties as food. The protein, especially albumin extracted from the meat is used for albumin supplement for various purposes such as for patient with low blood albumin,

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postpartum women (especially with Caesarean delivery and wounded people[1, 2, 3]. The treatment could be oral (food) or topical treatments. For the albumin production, the oil part of the snakehead is not utilized quite well yet.

Our previous research shows that snakehead fish contain significant omega three fatty acids[4]. Omega three fatty acid especially eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA) have a prevalent impact to prevent atherosclerosis diseases and can improve the human brain activity and eye visuality[5]. Recent studies showed that EPA alone can reduce triacylglycerol and low-density lipoprotein cholesterol as well as prevent the artery inflammation[6].

This study will be focused on the content of oil and fatty acid composition in the head, abdomen and viscera. The head and viscera are used to be by products during production of extract albumin.

Experiments

Materials

Fish samples were collected from the fishermen in the North Part of Lake Tondano, North Sulawesi. Coconut oil and FAME mix C8-C24 (Supelco) was used as standard. Methanol, sodium hydroxide, sodium chloride and hexane were purchased from Sigma as analytical grades.

Oil extraction

The fish is transported lively into processing place then cut to separate the head, viscera and abdomen. The abdomen is sliced into small pieces around 1cm thickness. The cut samples were transferred into stainless-steel pan and added water 2 times of sample volume. Samples were boiled for about 1 hour and continually added water to keep the water volume constant. After that samples were leaved to cool. The warm broth then transferred into 600 mL transparent bottle with long narrow neck. After the broth leaved in the bottle, the oily fraction accumulated at the top of the broth, on the narrow part of the bottle was syphoned to the centrifuge tubes then centrifuged for 15 minutes in a table top centrifuge. The oil was separated and collected for further analysis. The oil content was calculated as the weight of oil divided by the weight of fresh samples time 100 percent.

Fatty acid derivatization.

Sample preparation for analysis using gas chromatography was performed according to the following method. Typically, a 50 mg of extracted oils was measured in a 5 mL of sample bottle and added to 1.5 mL of 0.5 M sodium hydroxide (NaOH) in methanol. The mixture was heated to 100 ºC for 5 minutes. After cooling, 1 mL of hexane was added, mixed and settled. A 5 mL saturated sodium chloride (NaCl) solution was also poured into the mixture for the separation purpose. The top layer consisting of fatty acid methyl ester (FAME) was collected for GC sample analysis.

Gas chromatography analysis.

The fatty acid methyl ester was analyzed using Shimadzu GC- 2014 with a flame ionization detector. This GC was equipped using RTX wax column with 30 m in length, 0.25 mm in diameter and a 0.25 □m film. The injection was performed in a split mode 1:10 and the injection port temperature was set at 240 ºC. The oven temperature was programmed at 120 ºC for 7 minutes and then increased up to 240 ºC with 10 ºC/minute increment. The temperature was kept at 240 ºC for 15 minutes. The detector was used at a temperature of 300 ºC. The Helium gas was set at a flow of 3 mL/minute with a pressure of 100 kPa. A 1 □L of the sample was injected into gas chromatography injection port for every sample.

Fatty acid determination

In order to determine the retention times of each fatty acid in the sample, a FAME analytical reference material as a mixture of C8-C24 (Supelco) was measured along with a coconut oil sample derivatized following the above method. Coconut fatty acid was used to verify the retention time of main fatty acids[7]in the fish sample. The reason for using two standards of fatty acids was due to the FAME mix C8-C24 (Supelco) has been

generated previously[8] and the present study of the fatty acid retention time had changed quite significantly. The individual fatty acid concentration was determined based on the peak area of correspondent fatty acid and divided by the total peak area of fatty acids times 100 percent. The fatty acid concentration is expressed in average of percentage of the content from two replicates.

Results and Discussion

Snakehead fish organs

The fish collected from the fishermen was about 628 grams each. The portion of abdomen was 87.7 percent, while the head was 8.4 percent and the viscera was only 3.8 percent (Table 1). The head contained more bone compared to the abdomen. Therefore, the tissue in the head was only 59 percent compared in the abdomen which was 95 percent.

Table 1. Proportion of bodies' organs of fish samples

	Total Fresh Weight (g)	Percent Weight	Tissue Weight (g)	Bone Weight (g)	Percent Tissue Weight (%)
Total Weight (g)	11300				
Number of Fish	18				
Average Weight (g)	628				
Head (g)	1700	17.5	700	1000	8.4
Abdomen (g)	7700	79.2	7300	400	87.7
Viscera (g)	320	3.3	320		3.8
Total (g)	9720	100	8320		100

Oil Content

The oil content in the various fish body can be seen at Table 2. Head contained the highest oil followed by the viscera. The tissuefrom abdomen contain only 0.09 percent of oil. The oil content in tissueis slightly different with that previously reported[4] showed 0.12 percent, and much lower than reported by Ngui, et al.[9], 5.50 percent. The reason for this low oil content found in this experiment was due to the fish was caught from a wild environment (lake) while the fish from the previous experiment was from a cultured pond.Chasanah[10] reported that snakehead oil content depended on the growing environment of the fish.At wild environment, the oil content was 0.4% and in the cultured environment was 2.7%. Low oil concentration from fish tissue in this experiment could be due to also the extraction method using was boiling water compared to the previous experiment using methanol and chloroform.

Table 2. Oil content in head, abdomen and viscera of fish samples

	Total Oil Weight(g)	Percent Oil from Total Weight	Percent Oil in Tissue	Percent Oil fromTotal Fish Oil
Head (g)	24.4	1.44	3.49	63.81
Abdomen (g)	6.3	0.08	0.09	16.34
Viscera (g)	7.6	2.38	2.38	19.85
Total (g)	38.3	0.39	0.46	

The highest oil content in the fresh fish was in the viscera (2.38 %) followed in the head (1.44 %) and then in the abdomen (0.08 %).But because the portion of meat in the head was higher than in the viscera then the head contained more oil in total. About 63.81 percent of oil found in the head, followed by in the viscera was 19.85percent, and in the abdomen was 16.34 percent.

Fatty acid composition

The chromatogram of fatty acids in the head, abdomen and viscera can be seen in figure 1, 2 and 3. The results showed that the fatty acid patterns were similar one to another. The fatty acid composition can be seen in Table 3.

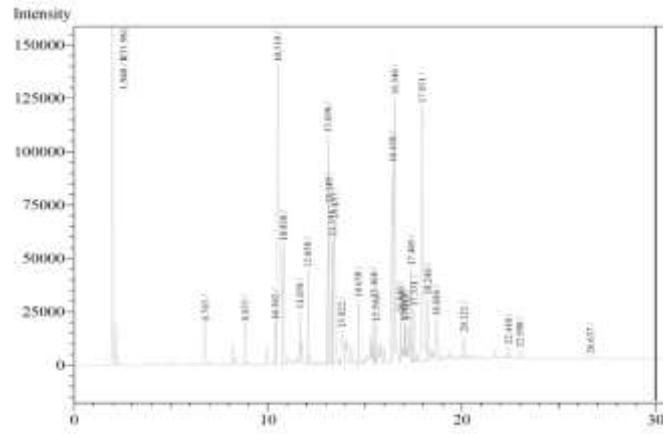

Figure 1.Chromatogram of fatty acid from the head of snakehead fish.

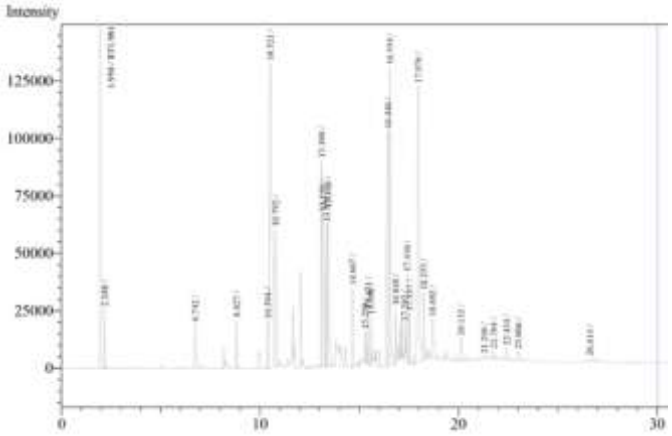

Figure 2.Chromatogram of fatty acid from the abdomen of snakehead fish.

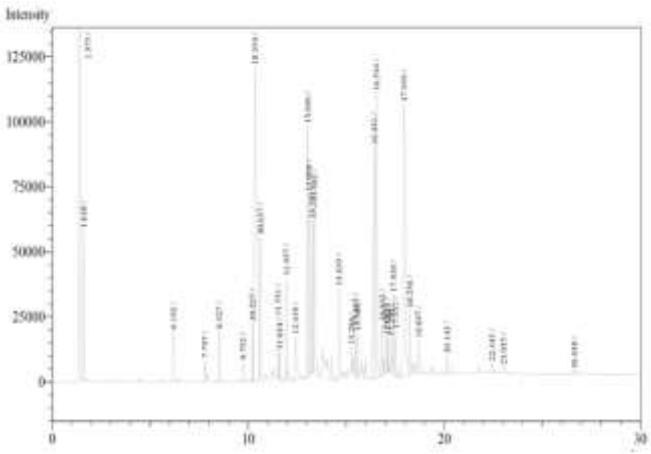

Figure 3.Chromatogram of fatty acid from the viscera of snakehead fish.

The fatty acid composition in the three parts of the snakehead body can be seen in Table 3. The composition of fatty acids in the head, abdomen and viscera of snakehead fish oil was similar to each other.

Table 3. Fatty acid composition of oil from head, abdomen and viscera of snakehead fish

Fatty Acids	Head	Abdomen	Viscera
Lauric Acid	0.11±0.16		
Myristic Acid	3.69±1.18	2.83±0.13	1.99±1.53
Palmitic Acid	31.20±2.84	29.75±4.61	29.98±1.71
Palmitoleic Acid	8.83±0.90	8.91±0.35	10.29±3.53
Stearic Acid	3.71±1.16	2.70±0.71	4.22±2.24
Oleic Acid	9.41±4.71	8.07±2.26	7.96±2.32
Linoleic Acid	9.77±0.81	8.76±0.22	6.72±2.76
Linolenic Acid	1.20±0.73	1.51±0.33	4.54±3.02
Eicosatetraenoic Acid	8.80±4.84	11.38±3.18	9.54±3.93
Eicosapentaenoic Acid (EPA)	5.98±3.20	8.32±2.87	8.65±1.55
Docosapentaenoic Acid	1.61±1.46	1.85±1.74	1.12±0.64
Docosahexaenoic Acid (DHA)	15.69±3.81	15.91±3.37	14.99±3.69

The major fatty acids in the snakehead fish were palmitic and docosahexaenoic acid (DHA). The palmitoleic, oleic, linoleic and eicosatetraenoic acids (EPA) were present at medium level, whilemyristic, stearic and docosapentaenoic acid. These results were slightly different from the previous finding[4]where the EPA content was slightly lower than these findings, but the ratio of these two fatty acids which has significant impact to human health[5, 6]was the same higher for DHA and lower for EPA. The significant content of omega-three in the head and viscera of this fish can be used as a byproduct of albumin production from snakehead fish.

Conclusion

Most of the oil in the snakehead is in the head of the fish (63.8 %). The fatty acid composition in the main organs (head, abdomen and viscera) was similar one to another. Palmitic and docosahexanoic acids are the main fatty acids in the fish oil. DHA and EPA as omega-three fatty acids were significantly present in this fish oil. Therefore, this fish oil from the head is potential to developfor producing of omega-three fatty acids as by product for albumin production.

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