Fatty Acid Profile of Fresh and Processed Shortfin Scad Fish (Decapterus macrosomma)

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Abstract. Fisheries resources in Indonesia, especially in Maluku including small pelagic fish species hold an important role in the daily consumption of the society. Small pelagic fish include fishes that are exist in the sea level such as cob fish (Auxis thazard), skipjack fish (Katsuwonus pelamis), layang fish (Decapterus macrosomma) and others. Chemically, fat is the esters of fatty acids and glycerol. Fats composed by fatty acids consisting of saturated fatty acids and unsaturated fatty acids. The body's ability to synthesize unsaturated fatty acids with two or double bond is very limited, so these fatty acids must be obtained from food. The purposes of this research are to know the type of fatty acids found in fresh and processed Shortfin scad fish; to know the content of fatty acids found in shortfin scad fish. The method used in this study includes the extraction of fat, then the process of transesterification and observation with GCMS. The results showed Fatty Acid Profiles of Fresh Shortfin scad Fish (Decapterus macrosomma) consisted of myristic acid, palmitic acid, stearic acid, nonadecanoic acid, arachidic acid, lignoceric acid, heptadecanoic acid which are classified as saturated fatty acids, whereas unsaturated fatty acids include palmitoleic acid, arachidonic acid, eicosanoic acid and oleic acid. Fatty acid profile of processed shortfin scad fish, smoked shortfin scad fish, are myristic acid, palmitic acid, stearic acid, nonadecanoic acid, arachidict acid, lignoceric acid, behenic acid, pentadecanoic acid, margaric acid, mellisic acid that are classified as saturated fatty acids, while those classified as unsaturated fatty acids are palmitoleic acid, oktadecanoicacid, arachidonic acid and eicosanoic acid.

1. Introduction

Fisheries resources in Indonesia, especially in Maluku, from small pelagic fish species play an important role in people's daily consumption. Small pelagic fish include fish that live on the surface of the sea such as tuna (Auxis thazard), Tuna fish (Katsuwonus pelamis), Layang fish (Decapterus macrosomma) and others [1]. Fish contains components such as: water, protein, fat, vitamins, and other minerals. So that fish has an important meaning in meeting the needs for animal protein, vitamins and minerals sources [2]. Besides fish lipids or fats are also known as sources of plural / polyunsaturated fatty acids Ω6 which are very useful for the body and health.

The lipid content in fish meat ranges from less than 1 to 22% of the main constituents in different species and the variation is wider than protein and water. The biggest fluctuations are due to location, season, food, spread and maturity level [3,2]. Fat is chemically an ester of fatty acids and glycerol. Fat is composed by fatty acids consisting of saturated fatty acids and unsaturated fatty acids. The body's ability to synthesize unsaturated fatty acids that have two or more double bonds is very limited, so these fatty acids must be obtained from food. [4]

Based on its fat content, fish are divided into 3 groups: fish with low fat content (less than 2%) found in pomfret and cork fish; fish with moderate fat content (2-3%) found in carp and lemuru fish; fish with high fat content (4-5%) found in herring, mackerel, salmon, tuna, sepat, Tawes and tilapia. [5,6]

Fish and other fishery products are perishable foodstuffs, so the processing carried out aims to inhibit or stop the activity of damaging microorganisms or enzymes that can cause deterioration in
quality and damage [7]. In addition to inhibiting and stopping the activity of enzymes and microorganisms, processing also aims to extend the durability and diversify processed fishery products. [8]

Basically processing and preserving fish can be done in various ways including: Smoke, drying, boiling, canning and cooling [9]. The processing technology applied in the Maluku region is generally the same as that applied in other regions in Indonesia, which is still traditional. In general, fish processing for daily consumption by people in Maluku is by smoking and boiling [10]. The types of fish processed in Maluku generally consist of economically important types of fish, one of which is the Flying fish. A correct understanding in food processing including fish, is needed so that food or fish prepared is safe for consumption and not much reduced in nutrition. This is because the processing is thought to affect the lipids or fatty fish, especially the constituent fatty acid components. The long process of processing and changes during the process, such as salting, drying and heating can be a source of causes of changes in the components of the processed food fat including fish and its processed fish [11]. This fact becomes a starting point of thought, how necessary this study was carried out to determine the profile of fatty acids contained in fresh Shortfin scad fish fish (Decapterus macrosomma) and their processed products.

The purpose of this study is to determine the types of fatty acids found in fresh and processed Shortfin scad fish (Decapterus macrosomma), and to determine the content of fatty acids found in fresh and processed Shortfin scad fish (Decapterus macrosomma) fresh and processed.

2. Experimental

2.1. Materials
The materials used in this study were the Layang fish (Decapterus macrosomma), salt, coconut shell and chemicals used for the analysis process, among others, chloroform, methanol, BF3 methanol, n-hexane, Na2SO4 and aquades.

2.2. Tools
The equipment used in this study were knives, analytical scales, stoves, cauldrons, draining containers, mechanical drying, plastic basins, blenders, filter paper, separating funnels, vacuum evaporators, Erlenmeyers, measuring cups, pipettes, test tubes and a set of GC-tools MS.

2.3. Procedure

2.3.1. Sample preparation
Fresh floating fish are weeded (discharged stomach contents and gills) then the fish are washed again, in this study two treatments were carried out namely without processing and processing. For without processing, fresh fish, while for processing, it is smoked floating fish and boiled floating fish. For smoked floating fish, the fish is cut into two parts and then the fish is washed again to remove the remaining blood and blood impurities, then continued with fumigation until cooked, and for boiled tuna, the fish is cut into sticks and then the fish is washed again to remove the remaining blood and impurities, and after that the fish is boiled with boiling water then salt and vinegar are added until cooked. After all the treatments have been completed, fresh and processed fish are chopped free of bones and then extracted.

2.3.2. Fat Extraction
The meat of fresh fish that has been chopped bone free each weighed as much as 20 grams and put into a waring blender, add 20 ml of chloroform and 40 ml of methanol (for each sample). Then homogenized by blending for 2 minutes, adding 20 ml of chloroform to homogenate and blending again for 30 seconds. The addition of distilled water is adjusted to the sample water content. If the water content is 80%, then adding enough distilled water 20 ml. But if the water content is less than
80%, then add 40 ml of distilled water. After adding distilled water again for 30 seconds. Then the homogenate is filtered with filter paper in a funnel and the filtratnya accommodated in 500 ml Erlenmeyer. Filtrat then put into a measuring cup volume of 1000 ml, allow a few moments until there is separation and clarification which will form two layers. The top layer consists of methanol-water while the bottom layer consists of oil solution in chloroform. Then the top layer is taken by means of aspiration using a pipette, until what is really left behind is the oil layer in chloroform. Chloroform is then evaporated using a vacuum evaporator.[3]

2.3.3. Transesterification
The transesterification method uses an acid catalyst, boron triflouride (BF3). As much as 0.33 grams of oil is added to a beaker containing 10 ml of BF3 methanol, then stirred and refluxed at 40 °C for 1 hour on a hot plate. The reflux product is cooled, after that it is put into a separating funnel and 25 ml of distilled water is added, then extracted with the addition of 20 ml of n-hexane. After forming 2 layers in which the lower layer containing glycerol is separated and the top layer containing methyl ester is extracted again with 10 ml of n-hexane, then adding distilled water until the pH is neutral. After that 10 grams of Na2SO4 anhydride are added to remove water that might still be left in the solution. Furthermore, the separation and filtrat obtained were evaporated with the buchi evaporator. The methyl ester mixture obtained was analyzed by means of GC-MS to determine the profile of fatty acids.[2]

2.3.4. Observation
Observations made in this study were to look at the composition of tuna fatty acids using Gas Chromatography - Mass Spectrophotometer (GC-MS). [12]

3. RESULTS AND DISCUSSION

3.1. Profile of Fatty Acid of Shortfin scad Fish and its Processes
The results of the analysis of the composition of the fatty acids of fresh and processed Shortfin scad fish by GC-MS can be seen in Fig. 1, 2 and 3.

![Figure 1. Methyl ester chromatogram of fresh shortfin scad fish fatty acid](image)
On a fresh Shortfin scad fish chromatogram (Fig. 1) 29 peaks were found. From these peaks, 11 peaks were identified through a library approach to the mass spectrum of each peak. The eleven detected peaks were methyl esters of myristic acid (C_{15}H_{30}O_2) with molecular weights of 242, methyl esters of palmitoleic acid (C_{17}H_{32}O_2) with molecular weights of 268, methyl esters of palmitic acid (C_{17}H_{34}O_2) with molecular weights of 242, methyl esters of heptadecanoic acid (C_{17}H_{32}O_2) with molecular weights of 268, methyl esters of palmitoleic acid (C_{17}H_{34}O_2) with molecular weights of 270, methyl esters of stearic acid (C_{18}H_{36}O_2) with a molecular weight of 312, methyl esters of margaric acid (C_{18}H_{36}O_2) with molecular weights of 296, methyl esters of stearic acid (C_{18}H_{36}O_2) with a molecular weight of 318, methyl esters of eicosenic acid (C_{20}H_{40}O_2) with a molecular weight of 324, methyl ester arachidic acid (C_{20}H_{40}O_2) with a molecular weight of 326, and methyl ester of lignoseric acid (C_{25}H_{50}O_2) with a molecular weight of 382.

Figure 2. Methyl ester chromatogram of smoke shortfin scad fish fatty acid

In the smoked fish chromatogram smoked (Fig. 2) found 32 peaks. From the detected peaks there were 14 peaks that were successfully identified through a library approach to mass spectrum of each peak. The fourteen peaks identified were, respectively, methyl esters of myristic acid (C_{15}H_{30}O_2) with molecular weights of 242, methyl esters of pentadecanoic acid (C_{16}H_{32}O_2) with molecular weights of 256, methyl esters of palmitoleic acid (C_{17}H_{32}O_2) with molecular weights of 242, methyl esters of pentadecanoic acid (C_{16}H_{32}O_2) with molecular weights of 256, methyl esters of palmitoleic acid (C_{17}H_{32}O_2) with molecular weights of 256, methyl esters of palmitoleic acid (C_{17}H_{32}O_2) with molecular weights of 268, methyl esters of palmitoleic acid (C_{17}H_{32}O_2) with molecular weights of 270, methyl esters of octadecenoic acid (C_{18}H_{36}O_2) with molecular weights of 296, methyl esters of margaric acid (C_{18}H_{36}O_2) with molecular weights of 284, methyl esters of melissic acid (C_{18}H_{36}O_2) with molecular weights of 296, methyl esters of margaric acid (C_{18}H_{36}O_2) with molecular weights of 296, methyl esters of margaric acid (C_{18}H_{36}O_2) with molecular weights of 296, methyl esters of stearic acid (C_{18}H_{36}O_2) with molecular weights of 296, methyl esters of margaric acid (C_{18}H_{36}O_2) with molecular weights of 296, methyl esters of stearic acid (C_{18}H_{36}O_2) with molecular weights of 296, methyl esters of eicosenic acid (C_{20}H_{40}O_2) with molecular weights of 322, methyl esters of arachidonic acid (C_{20}H_{40}O_2) with molecular weights of 326, methyl esters of eicosenic acid (C_{20}H_{40}O_2) with molecular weights of 326, methyl esters of arachidonic acid (C_{20}H_{40}O_2) with molecular weights of 326, methyl esters of eicosenic acid (C_{20}H_{40}O_2) with molecular weights of 326, methyl esters of arachidonic acid (C_{20}H_{40}O_2) with molecular weights of 326, methyl esters of arachidonic acid (C_{20}H_{40}O_2) with molecular weights of 326, methyl esters of arachidonic acid (C_{20}H_{40}O_2) with molecular weights of 326, methyl esters of arachidonic acid (C_{20}H_{40}O_2) with molecular weights of 326, methyl esters of arachidonic acid (C_{20}H_{40}O_2) with molecular weights of 326, methyl esters of arachidonic acid (C_{20}H_{40}O_2) with molecular weights of 326, methyl esters of arachidonic acid (C_{20}H_{40}O_2) with molecular weights of 326, methyl esters of arachidonic acid (C_{20}H_{40}O_2) with molecular weights of 326, methyl esters of arachidonic acid (C_{20}H_{40}O_2) with molecular weights of 326, methyl esters of arachidonic acid (C_{20}H_{40}O_2) with molecular weights of 326, methyl esters of arachidonic acid (C_{20}H_{40}O_2) with molecular weights of 326, methyl esters of arachidonic acid (C_{20}H_{40}O_2) with molecular weights of 326, methyl esters of arachidonic acid (C_{20}H_{40}O_2) with molecular weights of 326, methyl esters of arachidonic acid (C_{20}H_{40}O_2) with molecular weights of 326, methyl esters of arachidonic acid (C_{20}H_{40}O_2) with molecular weights of 326, methyl esters of arachidonic acid (C_{20}H_{40}O_2) with molecular weights of 326, methyl esters of arachidonic acid (C_{20}H_{40}O_2) with molecular weights of 326, methyl esters of arachidonic acid (C_{20}H_{40}O_2) with molecular weights of 326, methyl esters of arachidonic acid (C_{20}H_{40}O_2) with molecular weights of 326, methyl esters of arachidonic acid (C_{20}H_{40}O_2) with molecular weights of 326, methyl esters of arachidonic acid (C_{20}H_{40}O_2) with molecular weights of 326, methyl esters of arachidonic acid (C_{20}H_{40}O_2) with molecular weights of 326, methyl esters of arachidonic acid (C_{20}H_{40}O_2) with molecular weights of 326, methyl esters of arachidonic acid (C_{20}H_{40}O_2) with molecular weights of 326, methyl esters of arachidonic acid (C_{20}H_{40}O_2) with molecular weights of 326, methyl esters of arachidonic acid (C_{20}H_{40}O_2) with molecular weights of 326, methyl esters of arachidonic acid (C_{20}H_{40}O_2) with molecular weights of 326, methyl esters of arachidonic acid (C_{20}H_{40}O_2) with molecular weights of 326, methyl esters of arachidonic acid (C_{20}H_{40}O_2) with molecular weights of 326, methyl esters of arachidonic acid (C_{20}H_{40}O_2) with molecular weights of 326, methyl esters of arachidonic acid (C_{20}H_{40}O_2) with molecular weights of 326, methyl esters of arachidonic acid (C_{20}H_{40}O_2) with molecular weights of 326, methyl esters of arachidonic acid (C_{20}H_{40}O_2) with molecular weights of 326, methyl esters of arachidonic acid (C_{20}H_{40}O_2) with molecular weights of 326, methyl esters of arachidonic acid (C_{20}H_{40}O_2) with molecular weights of 326, methyl esters of arachidonic acid (C_{20}H_{40}O_2) with molecular weights of 326, methyl esters of arachidonic acid (C_{20}H_{40}O_2) with molecular weights of 326, methyl esters of arachidonic acid (C_{20}H_{40}O_2) with molecular weights of 326, methyl esters of arachidonic acid (C_{20}H_{40}O_2) with molecular weights of 326.
behenic acid \((C_{23}H_{46}O_2)\) with molecular weights of 354, and methyl esters of lignoseric acid \((C_{25}H_{50}O_2)\) with molecular weights of 382.

Figure 3. Methyl ester chromatogram of boiled shortfin scad fish fatty acid

On the boiled Shorfin scad fish chromatogram (Fig. 3) 25 peaks were found. From the detected peaks, 12 peaks were identified through a library approach to the mass spectrum of each peak. The twelve peaks identified were methyl esters of myristic acid \((C_{15}H_{30}O_2)\) with molecular weights of 242, methyl esters of arachidic acid \((C_{21}H_{42}O_2)\) with molecular weights of 326, methyl esters of palmitoleic acid \((C_{17}H_{32}O_2)\) with molecular weights of 242, methyl esters of palmitic acid \((C_{17}H_{34}O_2)\) with molecular weights of 296, methyl esters of palmitoleic \((C_{17}H_{32}O_2)\) with a molecular weight of 298, methyl esters of melissic acid \((C_{31}H_{62}O_2)\) with molecular weights of 466, methyl esters of octadecenoic acid \((C_{24}H_{42}O_2)\) with molecular weights 296, methyl esters of nonadecanoic acid \((C_{25}H_{50}O_2)\) with molecular weights of 466, methyl esters of octadecenoic acid \((C_{19}H_{38}O_2)\) with molecular weights 296, methyl esters of nonadecanoic acid \((C_{21}H_{42}O_2)\) molecular weight 312, methyl esters of arachidonic acid \((C_{21}H_{34}O_2)\) with molecular weights 318, methyl ester eicocioic acid \((C_{21}H_{40}O_2)\) with molecular weights 324, methyl esters of behenic acid \((C_{22}H_{46}O_2)\) with molecular weights of 354 and methyl esters of lignoceric acid \((C_{21}H_{40}O_2)\) with molecular weights of 382.

3.2. Composition of Fatty Acids and Processed Shortfin scad Fish

In Table 1, we can see the eleven fatty acids identified from fresh shortfin scad fish fat, each consisting of seven saturated fatty acids, 3.07% myristic acid; palmitic acid 19.28%; heptadecanoic acid 1.80%; stearic acid 12.12%; nonadecanoic acid 0.45%; arachidic acid 0.60% and lignoceric acid 0.71%. While the four unsaturated fatty acids identified were 4.29% palmitoleic acid; oleic acid 13.00%; arachidonic acid 2.39% and eikosenoic acid 1.69%.
Table 1. Composition of fresh shortfin scad fish fatty acid

| No | Fatty Acid             | Symbolic     |
|----|------------------------|--------------|
|    | **Saturated**          |              |
| 1  | Miristate              | 14 : 0       |
| 2  | Palmitate              | 16 : 0       |
| 3  | Heptadecanoate         | 17 : 0       |
| 4  | Stearic                | 18 : 0       |
| 5  | Nonadecanoate          | 19 : 0       |
| 6  | Arachidate             | 20 : 0       |
| 7  | Lignoserate            | 24 : 0       |
|    | **No Saturated**       |              |
| 8  | Palmitoleate           | 16 : 1 , n-7 |
| 9  | Oleat                  | 18 : 1 , n-9 |
| 10 | Arachidonate           | 20 : 4 , n-6 |
| 11 | Eicosenoate            | 20 : 1 , n-11|

From the composition of fresh Shortfin scad fish (*Decapterus macrosomma*) above when compared with the composition of fresh fatty cob fish (*Auxis thazard*), there are many similarities in the composition of fatty acids found between the two types of fish, but only differ in percentage of the content. That is because both types of fish are pelagic fish [13]. For example there are myristic fatty acids and palmitic fatty acids in both types of fish, but they have different contents, namely myristic fatty acids, 1.74% and palmitic fatty acids 19.69% in fresh Cob fish while in fresh shortfin scad fish have fatty acids, myristate 3.07% and palmitic fatty acid 19.28%. This difference in content is caused by the two types of fish being different species. [10]

Table 2. Composition of smoked shortfin scad fish fatty acid

| No | Fatty Acid    | Symbolic     |
|----|---------------|--------------|
|    | **Saturated:**|              |
| 1  | Miristate     | 14 : 0       |
| 2  | Pentadecanoate| 15 : 0       |
| 3  | Palmitate     | 16 : 0       |
| 4  | Margaric acid | 17 : 0       |
| 5  | Melissic acid | 30 : 0       |
| 6  | Stearic       | 18 : 0       |
| 7  | Nonadecanoate | 19 : 0       |
| 8  | Arachidid     | 20 : 0       |
| 9  | Behenic acid  | 22 : 0       |
| 10 | Lignoserate   | 24 : 0       |
|    | **No Saturated**|            |
| 11 | Palmitoleate  | 16 : 1 , n-7 |
| 12 | Octadecenoate | 18 : 1 , n-11|
| 13 | Arachidonate  | 20 : 4 , n-6 |
| 14 | Eicosenoate   | 20 : 1 , n-11|

In Table 2 you can see the fourteen fatty acids identified from smoked fatty fish each consisting of ten saturated fatty acids namely myristic acid 2.36%; pentadecanoic acid 1.24%; palmitic acid 14.99%; margaric acid 2.02%; melissic acid 0.37%; stearic acid 10.96%; nonadecanoic acid 0.71%; arachidic acid 1.02%; behenic acid 0.61% and lignoceric acid 0.89%. While the four unsaturated fatty
acids identified were 4.55% palmitoleic acid; octadecenoic acid 12.38%; arachidonic acid 2.90% and eikosenoic acid 2.45%.

From the composition of the fatty acids of smoked shortfin scad fish (*Decapterus macrosomma*) above when compared to the fatty acid composition of smoked cob fish (*Auxis thazard*), there are many similarities in the composition of fatty acids found between the two types of fish, but only differ in percentage of their contents. That is because both types of fish are pelagic fish species [13]. For example, there are myristic fatty acids and palmitic fatty acids in smoked cob fish and smoked shortfin scad fish, but they have different contents, namely myristic fatty acids, 2.47% and palmitic fatty acids 18.93% in smoked cob fish while in Smoked shortfin scad fish that contain 2.36% myristic fatty acid and 14.99% palmitic fatty acid. This difference in content is caused by the two types of fish being different species. [10]

| No | Fatty Acid       | Symbolic          |
|----|------------------|-------------------|
| 1  | Miristate        | 14:0              |
| 2  | Arachidate       | 20:0              |
| 3  | Palmitate        | 16:0              |
| 4  | Stearic          | 18:0              |
| 5  | Melissat         | 30:0              |
| 6  | Nonadecanoate    | 19:0              |
| 7  | Behenat          | 22:0              |
| 8  | Lignoseronate    | 24:0              |
| 9  | Palmitoleate     | 16:1, n-7         |
| 10 | Octadecenoate    | 18:1, n-11        |
| 11 | Arachidonate     | 20:4, n-6         |
| 12 | Eicosenoate      | 20:1, n-11        |

Table 3 shows the twelve fatty acids identified from boiled Shortfin scad fish fat, each consisting of eight saturated fatty acids, 4.22% myristic acid; arachidic acid 0.87%; palmitic acid 22.91%; stearic acid 11.64%; melissic acid 0.19%; nonadecanoic acid 0.47%; behenic acid 0.50% and lignoceric acid 0.75%. While the four unsaturated fatty acids identified were 4.81% palmitoleic acid; octadecenoic acid 13.78%; arachidonic acid 1.71% and eicosenoic acid 1.75%.

From the composition of boiled shortfin scad fish fatty acid (*Decapterus macrosomma*) above when compared with boiled cob fish composition (*Auxis thazard*), there are many similarities in fatty acid composition between the two types of fish, but only differ in percentage of the content. That is because both types of fish are pelagic fish species [13]. For example there are myristic fatty acids and palmitic fatty acids in boiled cob fish and boiled shortfin scad fish, but they have different contents, namely myristic fatty acids, 2.47% and palmitic fatty acids 18.93% in boiled cob fish while in Boiled shortfin scad fish has a myristic fatty acid content of 4.22% and palmitic fatty acid of 22.91%. This difference in content is caused by the two types of fish being different species. [10]

4. Conclusions

Based on the results of the study, it can be concluded that the fresh Shortfin scad fish (*Decapterus macrosomma*), namely myristic acid, palmitic acid, stearic acid, nonadecanoic acid, arachidic acid, lignoseric acid, heptadecanoic acid, which are classified as saturated fatty acids, while unsaturated fatty acids namely palmitoleic acid, arachidonic acid, eikosenoic acid and Oleic acid. Processed fatty acid fatty fish profile, Smoked Shortfin scad fish namely myristic acid, palmitic acid, stearic acid, nonadecanoic acid, arachidic acid, lignoceric acid, behenic acid, pentadecanoic acid, margaric acid,
Meilicic acid are classified as saturated fatty acids, while those classified as acidic, arachidic acid, lignoceric acid, behenic acid, pentadecanoic acid, margaric acid, melissic acid are classified as saturated fatty acids, whereas those classified as acidic Unsaturated fats namely palmitoleic acid, octadecanoic acid, arachidonic acid and eikosenoic acid. For boiled shortfin scad fish, namely myristic acid, palmitic acid, stearic acid, nonadecanoic acid, arachidic acid, lignoseric acid, behenic acid, melissic acid, which are classified as saturated fatty acids, while those classified as unsaturated fatty acids namely palmitoleic acid, octadecenoic acid, arachidonic acid and eikosenoic acid.

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