Analysis of fatty acid profile on Rono Lindu (*Oryzias sarasinorum*) and Rono Poso (*Adrianichthys oophorus*) fishes endemic of Central Sulawesi

A Widodo¹, R Ummiah¹, S Anam¹, Pitriani² and Jamaluddin*²

¹Department of Pharmacy, Mathematics and Natural Science of Faculty, Tadulako University, Palu, Central Sulawesi, Indonesia
²Department of Environmental Health, Public Health Faculty, Tadulako University, Palu, Central Sulawesi, Indonesia

*Email: jamal_farmasi02@yahoo.co.id

Abstract. Rono Lindu fish (*Oryzias sarasinorum*), and Rono Poso fish lake (*Adrianichthys oophorus*) are endemic fish of Central Sulawesi were consumed by the society, but it is have not known nutritional content. This research aims to determine the amount and the differences compositions of fatty acids in rono fish from Lindu and Poso lake. The research of fatty acid composition by using the Gas Chromatography method by changing the extraction of fats/oils into a form of FAME (*Fatty Acid Methyl Ester*). The results of the research showed that the number of fatty acid levels is different between the two samples. The composition of fatty acids found in Rono fish from Lindu lake is included saturated fatty acids (50.91665%), monounsaturated fatty acids (13.66273%), and polyunsaturated fatty acids (35.42044%). While the composition of fatty acids found in Rono fish from Poso lake is included saturated fatty acids (45.85161%), monounsaturated fatty acids (31.67566%), and polyunsaturated fatty acids (22.50430%).

1. Introduction

Fish is one of the main food sources for humans. Budi and Ardi (2009) are states recorded 406 genus and 3324 species of fish exist in Indonesia, 31 % of them in freshwater [1]. Freshwater fish in Sulawesi recorded as many as 62 species and 52 of them are species of endemic fish [2]. The endemic fish is a kind of fish found in a particular area (river, lake, sites, island, country, continent). Central Sulawesi province has several endemic fish species in Lindu and Poso lake.

There are 10 species of fish in Lindu lake, including eel fish, betok mas, muaera, tawes, sepata, gabu, lele, gabus, and *Oryzias sarasinorum*. *Oryzias sarasinorum* is endemic fish of Lake Lindu [3]. Poso lake has some species of endemic fish, they are Anasa, bungu, eel fish. Soeroto and Tungka (1996) are said that Rono Poso (*Adrianichthys oophorus*) is endemic fish of Lake Poso [4]. In general, endemic fishes in Lindu and Poso lake are unknown nutritional content. *Oryzias sarasinorum* and Adrianichthys oophorus are endemic fish which used for consumption by the local society around the Lake. People familiar with the fish *Oryzias sarasinorum* as Rono Lindu and *Adrianichthys oophorus* as Rono Poso.

The nutrient content of freshwater fish is high enough so that recommended for consumption in sufficient quantities. In [5], it can be seen that the fish from freshwater has high fat and protein.
The high-level fat of fish is also a plus value for the oil produced by that fish. The oil of fish is one of the nutrients that contain fatty acids which rich benefits because it contains approximately 25% saturated fatty acids and 75% unsaturated fatty acids [6].

Saturated fat intake in large quantities will increase total blood cholesterol, which also means increase atherosclerosis and increases the risk of coronary artery disease [7]. Unsaturated fatty acid length chain is a component of fatty acids omega-3 and omega-6, which is beneficial for health [8]. Natural fatty acids that include omega-3 fatty acids are linolenic acid (C18 : 3/ω3), Eicosapentaenoic Acid or EPA (C20 : 5/ω3), Dokosahexaeanoic Acid or DHA (C22 : 6/ω3), while omega – 6 is linoleic acid (C18 : 2/ω6) and arachidonic acid ARA (C20 : 4/ω6). The more dominant in fish oil is DHA, ARA, and EPA [9].

Two types of unsaturated fatty acids that thought most potentially that can be used as the base ingredient of medicines are omega-6 and omega-3. Omega-6 fatty acids can prevent the constriction of the blood vessel caused by the attachment of cholesterol in the blood vessel wall. While the benefits of omega-3 fatty acid for the body are to improve the durability of cardiac muscle cells from damage, thins the blood viscosity, lowers LDL (Low-Density Lipoprotein) and increase HDL (High-Density Lipoprotein), slow aging, prevent arthritis as well as for health bone [10]. Based on the above, it is necessary to test the analysis of fatty acid profiles in Rono Lindu (Oryzias sarasinorum) and Rono Poso (Adrianichthys oophorus) to complete the data regarding the fatty acid content of fish which exist in Indonesia and for the next research.

2. Materials and methods

2.1. Materials
The tools used are Gas Chromatography (GC HITACHI® 263-50) equipped with a detector FID (Flame Ionization Detector), oven, A set of tools Soxhletation, excicator, Balance analytical (Citizen®), Beaker glass (IWAKI PYREX®), Glass measuring (IWAKI PYREX®), blender, oven, Pipette drops, flask (IWAKI PYREX®), a water bath, Vortex, Column Chromatography. Materials used in this study include hexane, sodium hydroxide (NaOH), methanol, boron trifluoride (BF₃), saturated sodium chloride (NaCl), n-hexane (C₆ H₁₄), and a standard solution of fatty acids.

2.2. Preparation sample
The samples used in this study are new Rono fish taken from Lindu Lake and Poso Lake. The fish put into the container styrofoam, which already contains ice cubes before processing for extraction. Next, the sample is washed and gutted and then drained. Samples that have been drained and then dried using an oven at a temperature of 60°C. Rono Lindu dried for about 24 hours, and Rono Poso dried for about 36 hours [11].

2.3. Oil extraction
Weighed 1.3613 grams of powder of dried fish Rono Lindu and 2.1529 grams of powdered fish Rono Poso each entered into a paper sleeve (Hulls) and dried in an oven for about 1 hour at a temperature of 70°C. The samples are in a paper sleeve in extracted with a soxhletation method using hexane solvent for about 6 hours. Solvent hexane is distilled, and then the fat extract has been dried at a temperature of 105°C. Subsequently, the oil extract is cooled in an excicator then weighed until oil extract has a weight fixed [11].

2.4. Testing sample
Samples obtained from the previous stage derivatized into fatty acid methyl esters. The results of extract oil were weighed 0.0375 grams and add 2 ml NaOH of 0.5 (approximately 0.5 grams of NaOH dissolved in 25 ml of methanol), and then heated in a water bath at a temperature of 100°C for 20 minutes. Subsequently, cooled and then added BF₃ 14% in methanol (14 grams BF₃ added methanol to 100 ml) and heated again at a temperature of 100°C for 20 minutes. Cool and shakes it until the temperature 30°C and then add 2.0 ml of saturated NaCl. After that, di vortex for ± 2 minutes and added n-hexane,
then vortex again for ± 2 minutes. Furthermore, allowed to stand at a temperature room. Take layer hexane - methyl ester, transfer to a 10 mL volumetric flask and diluted and squeezed with n-hexane.

Before injecting the layer of n – hexane-methyl ester into a gas chromatography to analyze the fatty acid composition of the sample, the first standard solution of FAME Mix is diluted with n-hexane in a 10 ml flask containing 500 mL standard solution. Subsequently, inject 1 mL of a standard solution to gas chromatography and then injecting 1 mL of the sample solution.

The conditions of gas chromatography in this study are as follows; column temperature of 120°C at the beginning of the analysis is 4°C / min then rises to 240°C. FID detector temperature of 260°C, injector temperature 260°C, polyethylene glycol capillary column (30m x 0.25mm x 0.25µm), the carrier gas nitrogen, 1 mL/min [12].

3. Results and discussion

3.1. The profile of fatty acid in fish Rono Lindu

Analysis of fatty acid profile in fish Rono Lindu and Rono Poso is showed that the fatty acids in fish are classified as saturated fatty acids (saturated fatty acid/SAFA), acids monounsaturated fat (monounsaturated fatty acid/MUFA), and polyunsaturated fatty acids compound (polyunsaturated fatty acids/PUFA). The content of the fatty acid profile in both fish Rono Lindu is can be seen in Table 1, Table 2 and Table 3 below.

### Table 1. Profile saturated fatty acids that contained in fish of Rono Lindu

| No. | Types of Fatty Acids | Area | Percentage levels (%) | On the Average (%) | Conversion (g/100g) |
|-----|----------------------|------|------------------------|-------------------|-------------------|
|     |                      | I    | II                     | I     | II    |               |                  |
| 1.  | Caprylic acid        | 139.36 | 139.38          | 0.19256 | 0.19258 | 0.19257 | 0.01993        |
| 2.  | Lauric acid          | 220.39 | 220.41           | 0.30452 | 0.30454 | 0.30453 | 0.03152        |
| 3.  | Myristic acid        | 2332.60 | 2332.62         | 3.22302 | 3.22303 | 3.22302 | 0.33358        |
| 4.  | Pentadecanoic acid   | 866.55  | 866.57           | 1.19734 | 1.19736 | 1.19735 | 0.12393        |
| 5.  | Palmitic acid        | 21725.81 | 21725.83       | 30.01918 | 30.01901 | 30.01910 | 3.10698        |
| 6.  | Heptadecanoic acid   | 1649.26 | 1649.28         | 2.27883 | 2.27884 | 2.27884 | 0.23586        |
| 7.  | Stearic acid         | 8821.13 | 8821.15         | 12.18841 | 12.18836 | 12.18838 | 1.26150        |
| 8.  | Arachidonic acid     | 207.96  | 207.98           | 0.28734 | 0.28737 | 0.28736 | 0.02974        |
| 9.  | Behenic acid         | 249.57  | 249.59           | 0.34484 | 0.34486 | 0.34485 | 0.03569        |
| 10. | Lignoseric acid      | 637.30  | 637.32           | 0.88058 | 0.88060 | 0.88059 | 0.09114        |
| Total|                      | 36849.93 | 36850.13       | 50.91662 | 50.91655 | 50.91659 | 5.26987        |

### Table 2. Profile monounsaturated fatty acids that contained in fish of Rono Lindu

| No. | Types of Fatty Acids | Area | Percentage levels (%) | On the Average (%) | Conversion (g/100g) |
|-----|----------------------|------|------------------------|-------------------|-------------------|
|     |                      | I    | II                     | I     | II    |               |                  |
| 1.  | Palmitoleic acid     | 2696.39 | 2696.41       | 3.72568 | 3.72568 | 3.72568 | 0.38561        |
| 2.  | Oleic acid /ω9c      | 6167.14 | 6167.16        | 8.52132 | 8.52129 | 8.52130 | 0.88195        |
| 3.  | Eikosenoic acid      | 246.88  | 246.90            | 0.34112 | 0.34115 | 0.34113 | 0.03531        |
| 4.  | Nervonat acid        | 777.71  | 777.73            | 1.07458 | 1.07460 | 1.07459 | 0.11122        |
| Total|                      | 9888.12 | 9888.20         | 13.66270 | 13.66272 | 13.66270 | 1.41409        |
### Table 3. Profile polyunsaturated fatty acids that contained in fish of Rono Lindu

| No. | Types of Fatty Acids                  | Area I | Area II | Percentage Levels (%) | On the Average (%) | Conversion (g/100g) |
|-----|--------------------------------------|--------|---------|------------------------|--------------------|--------------------|
| 1.  | Linoleic acid /ω6c                    | 2479.45| 2479.47 | 3.42593                | 3.42593            | 3.42593            |
| 2.  | Linoleic acid /ω6                     | 268.91 | 268.93  | 0.37156                | 0.37159            | 0.37157            |
| 3.  | Linoleic acid /ω3                     | 2773.43| 2773.45 | 3.83213                | 3.83213            | 3.83213            |
| 4.  | Eikosanoot acid                       | 1016.89| 1016.91 | 1.40507                | 1.40508            | 1.40508            |
| 5.  | Eikosatrienool acid /ω6               | 388.35 | 388.37  | 0.53687                | 0.53689            | 0.53688            |
| 6.  | Eikosatrienool acid /ω3               | 254.01 | 254.03  | 0.35097                | 0.35100            | 0.35096            |
| 7.  | Arachidonic acid /ω6                  | 3991.80| 3991.82 | 5.51559                | 5.51558            | 5.51558            |
| 8.  | Doksadenooat acid                     | 621.37 | 621.39  | 0.85856                | 0.85859            | 0.85859            |
| 9.  | Eicosapentaenoic acid /ω3             | 1982.53| 1982.55 | 2.73932                | 2.73933            | 2.73932            |
| 10. | Docosahexaenoic acid /ω3              | 11858.10| 11858.12| 16.38468               | 16.38460           | 16.38464           |

**Total** 25634.84 25635.04 35.42068 35.42072 35.42070 3.66605

### 3.2. The profile of fatty acid in fish of Rono Poso

Analysis of fatty acid profile in fish RonoLindu and Rono Poso is showed that the fatty acids in fish are classified in saturated fatty acids (saturated fatty acids/SUFA), acids monounsaturated fat (Monounsaturated fatty acid/MUFA), and polyunsaturated fatty acids compound (Polyunsaturated fatty acids/PUFA). The content of the fatty acid profile in both fish Rono Poso is can be seen in Table 4, Table 5 and Table 6 below.

### Table 4. Profile saturated fatty acids that contained in fish of Rono Poso

| No. | Types of Fatty Acids | Area | Percentage levels (%) | On the Average (%) | Conversion (g/100g) |
|-----|----------------------|------|------------------------|--------------------|--------------------|
| 1.  | Lauric acid          | 273.04| 273.06                  | 0.07009            | 0.07010            | 0.01590            |
| 2.  | Tridecanoato acid    | 170.10| 170.12                  | 0.04367            | 0.04367            | 0.00990            |
| 3.  | Myristic acid        | 15289.41| 15289.43               | 3.92504            | 3.92503            | 3.92503            |
| 4.  | Pentadecanoate acid  | 3690.87| 3690.89                | 0.94751            | 0.94751            | 0.21489            |
| 5.  | Palmitic acid        | 113530.39| 113530.41             | 29.14506           | 29.14501           | 29.14504           |
| 6.  | Heptadecanoate acid  | 8591.76| 8591.78                 | 2.20564            | 2.20564            | 2.20564            |
| 7.  | Stearic acid         | 34630.69| 34630.71              | 8.89025            | 8.89024            | 8.89024            |
| 8.  | Arachidic acid       | 757.47 | 757.49                  | 0.19445            | 0.19446            | 0.19446            |
| 9.  | Heneicosanoic acid   | 108.24 | 108.26                  | 0.02779            | 0.02779            | 0.02779            |
| 10. | Behenic acid         | 785.19 | 785.21                  | 0.20157            | 0.20157            | 0.20157            |
| 11. | Lignoserat acid      | 664.35 | 664.37                  | 0.17055            | 0.17055            | 0.17055            |
|     | **Total**            | 178491.51| 178491.73         | 45.82163           | 45.82158           | 45.82161           | 10.39233           |

### Table 5. Profile monounsaturated fatty acids that contained in fish of Rono Poso

| No. | Types of Fatty Acids | Area | Percentage levels (%) | On the Average (%) | Conversion (g/100g) |
|-----|----------------------|------|------------------------|--------------------|--------------------|
| 1.  | Myristic acid        | 173.39| 173.41                  | 0.04451            | 0.04452            | 0.04451            |
| 2.  | Palmitoleic acid     | 18008.92| 18008.94           | 4.62318            | 4.62317            | 4.62318            |
| 3.  | Heptadecanoate acid  | 116.13| 116.15                  | 0.02981            | 0.02982            | 0.02981            |
| 4.  | Oleic acid /ω9t      | 815.23 | 815.25                  | 0.20928            | 0.20929            | 0.20928            |
| 5.  | Oleic acid /ω9c      | 99125.07| 99125.09           | 25.44699            | 25.44694           | 25.44696           | 5.77137            |
| 6.  | Eikosenoic acid      | 3832.07| 3832.09                 | 0.98375            | 0.98376            | 0.98376            | 0.22312            |
| 7.  | Nervonat acid        | 1317.35| 1317.37                 | 0.33818            | 0.33819            | 0.34819            | 0.07670            |
|     | **Total**            | 123388.16| 123388.30        | 31.67570           | 31.67569           | 31.67569           | 7.13659            |
The 2-nd International Seminar on Science and Technology 2020 (ISST-2) 2020
Journal of Physics: Conference Series 1763 (2021) 012081 doi:10.1088/1742-6596/1763/1/012081

Table 6. Profile polyunsaturated fatty acids contained in fish of Rono Poso.

| No. | Types of Fatty Acids               | Area (%)       | Percentage levels (%) | On the Average (%) | Conversion (g/100g) |
|-----|-----------------------------------|----------------|-----------------------|--------------------|--------------------|
| 1   | Linoleic acid /ω6t                | 205.92         | 0.05286               | 0.05287            | 0.05287           |
| 2   | Linoleic acid /ω6c                | 15594.21       | 4.00328               | 4.00328            | 4.00328           |
| 3   | Linoleic acid /ω6                 | 2001.40        | 0.51379               | 0.51382            | 0.51382           |
| 4   | Linoleic acid /ω3                 | 24735.48       | 6.34999               | 6.34999            | 6.35999           |
| 5   | Eikosanoic acid                   | 3756.53        | 0.96436               | 0.96436            | 0.96436           |
| 6   | Eikosatrienoic acid/ω6            | 1529.85        | 0.39274               | 0.39274            | 0.39274           |
| 7   | Eikosatrienoic acid/ω3            | 875.96         | 0.22487               | 0.22488            | 0.22488           |
| 8   | Arachidonic acid /ω6              | 11439.35       | 2.93666               | 2.93666            | 2.93666           |
| 9   | Dokosa dienoic acid               | 992.52         | 0.25480               | 0.25480            | 0.25480           |
| 10  | Eicosapentaenoic acid/ω3          | 5941.47        | 1.52527               | 1.52527            | 1.52527           |
| 11  | Docosahexaenoic acid/ω3           | 20583.23       | 5.28404               | 5.28404            | 5.28404           |
|     | Total                             | 87655.94       | 22.50443              | 22.50450           | 22.50448          |

In this research, the fatty acid profile analysis using gas chromatography because the tool has highly compatible with the chemical separation of fat, where the fat has a vapor drying based on the fatty acid profile contained. The previously extracted fish fatty/oily using methods soxhletation. Soxhletation method selection is based on the advantages of this method when seen from the time and the type of solvent used. The time used is relatively short and the solvents used are also less when compared with the percolation maceration method and the process is a continuous process [13]. Then for the rendering method is used to fish has high in fat and large quantities, and an appropriate pressing method is used to extract oil from grains with high oil content [8].

This is according to the working principle of gas chromatography that separates compounds based on differences in the vapor [14]. Extraction with soxhletation method is an extraction method that can attract the compound lipid/fat perfectly. Based on the solubility of fat-soluble in organic solvents (non-polar) and insoluble in water, so the process of extraction of the fat with soxhletation method used hexane organic solvents are non-polar.

Oil is known to have high enough vapor because of the constituent substances in the form of triacylglycerols. Therefore, before analyzing by gas chromatography, first of each sample of fish oil is transesterified to form a unit of fatty acid methyl ester known as FAME (Fatty Acid Methyl Ester) that has properties quite stable and volatile. The transesterification process involves two stages, namely stages of hydrolysis of triacylglycerol in the presence of a base catalyst is NaOH in methanol to process saponification (saponification) where the hydrolysis process (the process of forming salts of carboxylic esters with a base to give the alcohol and salt) [14].

The next stages of the process of esterification of fatty acids with the methyl group of methanol - assisted acid catalyst is BF₃. These processes are aimed to lower the boiling point, making it easy to evaporate into a gas and finally be able to rearrange the components of fatty acids in fish oil in all triglycerides [24]. Also, the transesterification reaction is a reversible reaction to obtain a high yield to obtain equilibrium by using one reagent excess. Where appropriate reagent is used reagent with an acid catalyst, [25] mentions that the reagent can change fatty acids in fish oil from acyl glycerol into methyl esters.

The conditions of gas chromatography in this study are as follows; column temperature of 120°C at the beginning of the analysis with the rise 4°C / min up to 240°C. FID detector temperature of 260°C, injector temperature 260°C, polyethylene glycol capillary column (30m x 0.25mm x 0.25μm), the carrier gas nitrogen, 1 mL / min.
The detector is one of the important parts of the gas chromatography apparatus. The detector acts as a detector or a compound which has been described previously separated in the column. FID (*Flame Ionization Detector*) or flame ionization detector is selected in this research because it has a quick response and sensitive for the hydrocarbon compounds or a compound that contains the atoms C. FID detector suitable for use with a carrier gas such as helium, argon, and nitrogen. Helium and argon gas was very good and not combustible, but it is very expensive so in this study were selected nitrogen carrier gas [14].

Detector temperature which higher than the temperature of the column is intended the components analyzed can be pushed out of the column to the detector. The column temperature is also lower than the temperature of the injection for some components of the mixture that can condense at the beginning of the column. The type of column used is a capillary column with the stationary phase polyethylene glycol which is polar so by the sample in the form of methyl esters are also polar. The capillary column provides is high efficiency in the separation of the sample and the separation wants short.

The detector which is have detected compounds then delivers an electrical signal to a recorder which translates into the chromatogram form. From the chromatograms obtained can be analyzed qualitatively and quantitatively. Qualitative analysis by comparing the retention time of the sample with a standard. Quantitative analysis by calculating the area or height of the chromatogram [15].

Peak area is the area under the peaks were determined by the peak height and width of the base peak. The higher the peak, and widening the base peak, the greater the peak area. Peak area is associated with the concentration of the compound, where an increasingly broad peak, the higher the concentration [16].

Results of research on fish samples Rono Lindu (*Oryzias sarasinorum*) and fish RonoPoso (*Adrianichthys oophorus*) showed high and wide varying peak area on the chromatogram. This shows that the two samples had concentrations of the fatty acid profiles for different. Rono Lindu contains saturated fatty acids, monounsaturated fatty acids, and polyunsaturated fatty acids respectively 50.91659%, 13.66270%, 35.42070%, and Rono Poso contains saturated fatty acids, acid monounsaturated fat, and polyunsaturated fatty acids respectively 45.82161%, 31.67569%, 22.50448%. The saturated fatty acid content of the fish is relatively larger than the levels of monounsaturated fatty acids and polyunsaturated. Saturated fatty acids alone when the consumed result in the liver produces high LDL (*Low-Density Lipoprotein*) in large numbers associated with the incidence of heart disease and improve cholesterol levels in the blood can cause thrombosis [17]. However, it depends on the type of food.

The result of research his compound of long-chain saturated fatty acid or *Long Carbon Fatty Acid* (LCFA) causes an increase in blood cholesterol levels different than the medium–chain saturated fatty acids or *Medium Carbon Fatty Acids* (MCFAs). The differences include the process of digestion and metabolism in the body and produce product components of bioactive substances that also different. In other words, any kind of group of fatty acids having physiological and biological effects different from health [18].

There are 22 types of fatty acids identified in Lindu Rono and 25 types of fatty acids identified in Poso Rono with different concentration ratio although most are found with the same type of fatty acid. Of the 22 types of fatty acids found in Rono Lindu, only one type of fish that is not found on Rono Poso namely caprylic acid (C8: 0) is 0.19257%. Then the fatty acids that are found in Rono Poso but not found on Rono Lindu, as follows; tridekanoic acid (C13: 0) of 0.04367%, myristoleic acid (C14: 1) of 0.04451%, heptadecanoic acid (C17: 1) of 0.02981% and hecikosanoic acid (C21: 0) was 0.02779 %. Although almost all types of fatty acids found in Rono Lindu are also found in Rono Poso the levels of fatty acids greater than the levels of fatty acids in Rono Lindu as shown [14] Figures 1-2.

In both samples of fish, which is the predominant saturated fatty acid is palmitic acid (C16: 0), stearic acid (C18 : 0), myristic acid (C14 : 0), and heptadecanoic acid (Tables 1 and 4). Palmitic acid is a long-chain fatty acid that does not raise cholesterol levels in the blood [18]. Palmitic acid is used for materials shampoo, soap, and cream soft. Stearic acid is will not raise LDL cholesterol levels because these fatty acids are quickly converted into fatty acids monounsaturated oleic acid. Myristic fatty acid is can increase LDL cholesterol levels, but this fatty acid is a minor component of the diet.
Monoglycerides of lauric acid as commonly is used in the pharmaceutical industry as an antibacterial, antiviral and anti-protozoan and also used in soaps and cosmetics industries. Lauric acid is responsible for the increase in blood LDL and is associated with heart attacks [19].

Tables 2 and 5 show that monounsaturated fatty acids / MUFA (Mono Unsaturated Fatty Acid) in Rono Lindu and Rono Poso are found in many concentrations and also varied. Rono Lindu found four types of fatty acids, they are monounsaturated palmitoleic acid (C16:1), oleic acid (C18:1/ω9), eikosenoat acid (C20:1), and nervonic acid (C24:1). Of the four types of monounsaturated fatty acids found in RonoLindu is also found in Rono Poso with different concentrations. However, Rono Poso found myristoleic acid (C14:1) and heptadekenoat acid (C17:1) are not found in Rono Lindu.

In general, monounsaturated fatty acids beneficial effect on blood cholesterol levels, especially when used as a substitute for saturated fatty acids. Monounsaturated fatty acids (MUFA) are more effective in lowering blood cholesterol levels, of the plural unsaturated fatty acids (PUFA) [10]. Monounsaturated fatty acids are found in the fish samples of RonoLindu and Poso dominated by oleic acid each - each amounting to 8.52130% and 25.65624%. Oleic acid is also known as omega-9 fatty acids. These fatty acids have protective power of the body that can lower LDL cholesterol (Low-Density Lipoprotein) cholesterol and increase levels of HDL (High-Density Lipoprotein) [20]. HDL cholesterol is often referred to as good cholesterol because they contain large amounts of protein and cholesterol in small amounts, to pick up the remnants of cholesterol in the blood vessels and bring it back to the liver to be removed from the body [21].

Figure □ Comparison of saturated fatty acid value (g / 100g ) in fish of rono from Lindu and Poso

Figure □ Comparison monounsaturated fatty acids value (g/100g) In Fish of Rono from Lindu and Poso
Also, saturated fatty acids and monounsaturated are found polyunsaturated fatty acids in both of fish samples of Rono from Lindu and Poso amounted to 35.42070% and 22.50448% of the total fat content obtained two samples. Both of fish samples of Rono from Lindu and Poso are found some type of unsaturated fatty acid compound, they are linoleic acid / ω6, linoleic acid / ω6t, linolenic acid / ω6, linolenic acid / ω3, acid eikosadienoat, acid eikosatrienoat / ω6 acids eikosatrienoat / ω3, arachidonic acid / ω6, dokosadienoat acid, eicosapentaenoic acid / ω3, and acid dokosahexaenoat / ω3.

Unsaturated fatty acid compound or Poly Unsaturated Fatty Acid is abbreviated PUFA, including omega-3 and omega-6 are essential fatty acids that can not be synthesized by the body and have great benefits for health. PUFA (linoleic and linolenic fatty acids) plays an important role in transport and fat metabolism, immune function, maintain the function and integrity of cell membranes. Derivatives of fatty acids derived from essential fatty acids are arachidonic acid from linoleic acid (omega-6), EPA (eicosapentaenoic), and DHA (docosahexaenoic) of linolenic acid (omega-3). Omega-6 fatty acids are can prevent the constriction of blood vessels caused by the attachment of cholesterol in the blood vessel wall. While the benefits of omega-3 fatty acid are for the body among other things to improve the durability of cardiac muscle cells from damage, thins the blood viscosity, lowers LDL (Low-Density Lipoprotein) and increase HDL (High-Density Lipoprotein), slow ageing, prevent arthritis as well as for health bone [10].

Both samples found omega-3 and Omega-6 PUFA with derivatives, they are fatty acid arachidonic, EPA, and DHA. Levels percent of total omega-3 and omega-6 are respectively 23.30708% and 9.84996% of samples fish of Rono from Lindu and, omega-3 and omega-6 respectively 13.38418% and 7.89 937% of samples fish of Rono from Poso. PUFA types that dominate in fish samples of RonoLindu, a fatty acid docosahexaenoic (DHA) is 16.38464% and RonoPoso namely linolenic / ω3 amounted 5.28404%. Fatty acids eicosapentaenoic (EPA) is also derived from omega-3 had levels less than the fatty acid arachidonic (ARA) which derived from omega-6 that are shown in Figure 5 for both of fish samples of Rono from Lindu and Poso.

Fatty acids, such as stearic acid (C18: 0) and oleic acid (C18: 1) is a carboxylic acid formed by biochatalyst (enzyme). Special formation of unsaturated fatty acids such as oleic fatty acid is can occur via two pathways, namely aerobic and/or anaerobic, both involving desaturation over saturated fatty acids [22]. Further, acid-unsaturated fatty acids such as oleic acid (C18: 1 / ω9), linoleic acid (C18: 2 / ω6), and linolenic acid (C18: 3 / ω3), are can be a process of desaturation followed by elongation or
addition C in sequence, so it is possible for the formation of acid-unsaturated fatty acids such as C18: 2, C18: 3, C18: 4, C20: 2, C20: 3, C20: 4, C20: 5, C22: 3, C22: 4, C22: 5 and C22: 6 [23].

Lipid and fatty acid composition in both samples of fish Rono from Lindu and Poso were found different, and quite diverse. It depends on the species, sex, age, season, food availability, salinity, and water temperature [24]. Therefore, the results obtained in this study are different in terms of composition and content of fatty acids in fish of Rono from Lindu (Oryzias sarasinorum) and Rono from Poso (Adrianichthys oophorus) of the same Family.

The fish that contains protein, vitamins, minerals, carbohydrates, and fats, are can be used as a source of nutrients in the body. Fat consumption total maximum per day is recommended that 30 % of the total energy, which includes 10 % saturated fatty acids (SAFA), 10 % fatty acids monounsaturated (MUFA), and 10 % unsaturated fatty acids plural (PUFA) [27]. The need for fatty acid per day is can be obtained by consuming Ronofish from Lindu and Poso Lake, which has a variety of types of fatty acids.

4. Conclusion

Results of analysis of fatty acid composition using gas chromatography instrument in Rono fish from Lindu (Oryzias sarasinorum) is a saturated fatty acid (50,91665%), monounsaturated fatty acids (13,66273%), polyunsaturated fatty acids (35,42044%) and in Rono fish from Poso (Adrianichthys oophorus) is saturated fatty acids (45,85161%), monounsaturated fatty acids (31,67566%), and polyunsaturated fatty acids (22,50430%). The composition of fatty acids contained in Ronofish from Lindu (Oryzias sarasinorum) and Rono fish from Poso (Adrianichthys oophorus) is different. The levels of saturated fatty acids and unsaturated acids are found in Rono fish from Poso, it is greater than the levels of saturated fatty acids and unsaturated fatty acids in Rono fish from Lindu, although most of them are have the same type of fatty acid. Caprylic acid found in Rono fish from Lindu but not found in Rono fish from Poso. Instead, tridecanoic acid, as.myristoleic, as. heptadecanoic acid, and alices.

5. Acknowledgement

The author would like to thank the Laboratory of PT. Saraswanti Indo Genetec, Bogor. West Java who has helped in amino acid analysis, as well as all parties who have helped provide support.

References

[1] Budi K E and Ardi F E 2009 Ensiklopedia Populer Ikan Air Laut (Yogyakarta:Andi Offset)
[2] Mamangkey, JJ 2010 Endemic Fish Biopopulasi Butini (Glossogobius matanensis) On the lake towuti, South Celebes (Bogor: IPB)
[3] Lukman 2007 Lake Lindushade that Merindu LIPI Press Jakarta.
[4] Soeroto B F and Tungka 1996 Proceedings of the First International Conference on Eastern Indonesia-Australian Vertebrate Fauna BHP Petroleum Pty Ltd Melbourne, Australia 5 pp
[5] Marpaung R and Asmaidah 2011 Jambi Batang Hari University Scientific Journal 11 (3)
[6] Ackman R G 1982 Fatty Acid Composition in Fish Oil (London: Academic Press)
[7] Tuminah S 2009 articles Health Research and Development 19 (2)
[8] Ketaren S 1986 Introduction of Food Technology Oils and Fats (Jakarta: UI-Press)
[9] Panagan AT, Yohandini H, Wulandari M, 2012 Science Research Journal 15 (3).
[10] De Roos N M, Bots M L, Katan M B 2001 Arterioscler ThrombVasc Biol 21(7) 7-1233
[11] Jamaluddin, Mappiratu, Septiawan and Yuyun Y 2016 RASAYAN Journal of Chemistry (9) 4 673-679
[12] Jamaluddin, Muhsinah N A, and Widodo A 2019 Research Journal of Pharmacy and Technology (12) 12
[13] Sarker H, Latif Z, Gray 2005 Natural Products Isolasi Second Edition Human Press
[14] Gandjar I G and Rohman A 2007 Pharmaceutical Chemistry Analysis (Yogyakarta: Pustaka)
Pelajar)

[15] Hendayana S 2006 Kimia Pemisahan Metode Kromatografi dan Elektroforesis Modern (Bandung: PT Remaja Rosdakarya)
[16] Pontoh J and Buyung NTN 2011 Scientific journal Science 11 (2)
[17] Marcel Dekker Inc 1996 OR Fennema, Food chemistry, 3rd ed USA p.9-22.
[18] Ayu D S R Jurnal Kesehatan Masyarakat Nasional 2 (4)
[19] Silalahi J 2006 Makanan Fungsional (Yogyakarta: Kanisius)
[20] Khomsan A 2004 Role of Food and Nutrition for the Quality of Life (Jakarta: PT. Scholastic Widiasarana Indonesia)
[21] Legowo AM 1996 The issue Fat And Cholesterol In Animal Food Ingredients Media Edition II Year XXI 8-15
[22] Herbert R B 1988 Biosynthesis of Secondary Metabolites (London: Chapman & Hall)
[23] Gurr M I 1992 Role of Fats in Food and Nutrition Elsevier Appl Sci, London.
[24] Stansby M E 1967 Fish Oils Their Chemistry Technology Stability Nutritional Properties and Uses (Wesport: The AVI Publishing Company Inc)
[25] Bucklet K A, R A Edwards, G H Fleet, M Wooton 1987 Food Science (Jakarta: UI Press)
[26] Shanta 1992 Esterification of Fatty Acids (North Sumatra: Digital Library University of Northern Sumatra)
[27] Lichtenstein A H, Appel L J, Brands M, Carnethon M, Daniels S, Franch HA, Franklin B, Kris-Etherton P, Harris W S, Howard B, Karanja N, Lefevre M, Rudel L, Sacks F, Van Horn L, Winston M, Wylie-Rosett J 2006 Diet and Lifestyle Recommendations Revision