Journal of Food and Nutrition Research, 2014, Vol. 2, No. 1, 1-8
Available online at http://pubs.sciepub.com/jfnr/2/1/1

DOI:10.12691/jfnr-2-1-1

The Study of Total Lipid Rate and Fatty Acids of Pearl Mullet *(Chalcalburnus Tarichii* P.1811) and Nutritional Importancein Van, Turkey

Salih Çibuk[1], Nurhayat Atasoy[2,*], Sema Kaptanoğlu[1]

[1]Yuzuncu Yıl University, Van Health Services Vocational School, Van, Turkey
[2]Yuzuncu Yıl University, Sciences Faculty, Department of Chemistry, Van, Turkey
*Corresponding author: nurhayatatasoy@ymail.com

Received November 05, 2013; Revised December 25, 2013; Accepted December 26, 2013

Abstract In this study, total lipid rate, saturated fatty acid rate, unsaturated fatty acid rate and multiple unsaturated fatty acid rates in the muscle tissues of Pearl Mullet (*Chalcalburnus Tarichii* P.1811), which is endemic to Van Lake, and a very important food source for the local residents and of commercial value, were investigated between September, November 2012 and January 2013. The fish caught in two months intervals were analyses. Crude fat rate was found 1.66 g r/100 gr in September, 1.55 gr/100gr in November, and 3.35 gr/100gr in January. An important difference was not observed in September and in November, but crude fat rate was found to be doubled in January. According to our findings, Pearl Mulletis among the lean fish. The average of three months in the meat of pearl mullet was identified as SFA 0.366 g/100g, MUFA 0.697 g/100g, PUFA 0.476 g/100g, DHA 0.222 g/100g, EPA 0.228 g/100g. However, in comparing PUFA rates, that of Pearl Mulletis seen to be higher, which increases nutritional value of Pearl Mullet.

Keywords: *fatty acid, seasonal changes, fish, Turkey*

Cite This Article: Salih Çibuk, Nurhayat Atasoy, and Sema Kaptanoğlu, "The Study of Total Lipid Rate and Fatty Acids of Pearl Mullet (*Chalcalburnus Tarichii* P.1811) and Nutritional Importancein Van, Turkey." *Journal of Food and Nutrition Research* 2, no. 1 (2014): 1-8. doi: 10.12691/jfnr-2-1-1.

1. Introduction

Fish is one of mankind's oldest known source of nutrients. In terms required amount of stored food items in terms of both easy to digest, fish has always been a valuable food source for people. The value of fish and aquatic plants have always increased with each passing day depending upon the increasing knowledge about nutrient content of fish and seafood. Vitamin A, D, E and especially B, micro elements such as calcium, phosphorus, iodine, selenium and fluorine and lipids that contain polyunsaturated fatty acids are found in fish meat [1].

Macro-nutrient elements contained in seafood are composed of proteins, fats and water. Other food items are accepted as micro-nutrient elements and do not have as much importance as macro-nutrient elements [2]. It is reported that nutrient composition of aquatic plants in general is 64-84% water, 15-24% is protein, 0.1-22% is fat, 8.8-2% is minerals and approximately 1% is carbohydrate (glycogen) [3,4,5]. However, rich omega-3 long-chain polyunsaturated fatty acids (ÇDYA) especially eicosapentaenoic acid (EPA-C20:5n 3) and docosahexaenoic fatty acids (DHA-C22:6n 3) of fish are the most valuable components for consumers in especially developed countries [6].

Lipids and fatty acids of lipids constitute the basic organic components of fish together with proteins. The main parts of fish where lipids are stored vary between species. However, lipids are primarily localized in the subcutaneous tissues and the other storage parts of them are belly, muscle tissues, liver and mesenteric tissues [7].

Distribution of lipids in fish decreased extends from head to tail. Lipid solution in dark muscles is several times higher than white muscles. Long-term migratory fish species (tuna, herring, mackerel etc.) have more dark muscles and thus more lipid when compared to slow floating species as a necessity of their functions [8].

Fish are classified that they contain in their bodies as lean if they contain fat less than 2% and fatty fish if contain fat more than 5% according to the amount of fat. A large number of oil in the fish meat are present triglycerides that these compounds are esters as a result of glycerol applied to 3-molecule fatty acid. Fatty acids are triglycerides as a result of carbon chains in different lengths indicating the degree of saturation of the fat [9]. Unsaturated fatty acids in nature are in the form of omega-9, omega-6 and omega- 3 and these are called as oleic, linoleic and linolenic respectively. The two important fatty acids that can be found in seafood and cannot be found in the other nutrients are eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA) and omega-3 fatty acids in the linoenic series. It is reported that these two important fatty acids cause biochemical and physiological changes in the body [10]. The differences between omega-3 fatty acids of land and marine animals are related to the chains

length and the degree of unsaturation. The basic difference of fish oils is the fact that long- chain highly unsaturated fatty acids of them increase up to 40% [11].

As a result of scientific studies in various fields, the important role of nutrients and feeding habits are emerging in some diseases of people and people feels the necessity of more conscious feeding. Everybody has learned the effect of red meat to diseases such as high cholesterol and cardiovascular diseases which have vital importance. In parallel with these developments, some studies are conducted to uncover the positive effect of fish consumption on human health and the claims regarding the therapeutic features of EPA and DHA that are two predominant omega 3 fatty acids. It is reported that these fatty acids that are indicated to be essential nutrients which protect the human body against the migraine type headaches, rheumatic fever, some types of cancer, diabetes, high cholesterol, high blood pressure, cardiovascular disease and some allergies in adults. Some of these claims are validated that several companies market and distribute fish oil pills by use of these fats [5,12,13,14]. DHA which is a structural compound of brain, retina, testicle and sperma is related with the appropriate functioning of tissue functions. The latest studies has shown that DHA level in the tissues of premature infants is lower than infants who is born at the end of normal period of pregnancy. Infants who do not have omega-3 fatty acids in their nutrition are insufficient the eyesight and development of nerve tissues. It is reported that the amount of omega-3 fatty acid in human milk is the highest for women who consume fish but the lowest for vegetarians [5].

It has been proven that there is a reduction in the mortality rates of people consuming fish emerging as a result of cardiovascular diseases in clinical studies. The mortality rate has been reduced after two year by 29% for men who have eaten fish at least two meals a week when compared to men who have not eaten fatty fish. In addition to these studies, the body development is better for people who consume fish and they have less heart disease when compared to others who do not consume fish. Omega-3 fatty acids have a direct effect on heart muscles and increase blood flow, treat arteries, reduce the possibilities of arrhythmia, infarction and chemical and cellular processes that are dangerous for the functioning of heart [5].

Rather than the direct treating effect of fish oils on cancer patients, preventing and pain-relieving effects of them are more common. In addition, ω-3 fatty acids have a great impact in fighting with cancer cells. The studies conducted show that there is relationship between the fish oil levels found in the blood such as EPA and DHA and prostate cancer and increasing level of EPA and DHA has been proven to reduce the effect of cancer cells [15].

In addition, another study in the aim of relieving pains and aches was conducted for *Channa* species in Malaysia. In this study, *Channa striatus* species which contain high rate ω-3(especially DHA) are used for treatment of wounds and in relieving people's pains and aches and it is a very interesting finding that the positive benefits may be associated with ω-3 [16]. Another study conducted in Denmark, the risk of preterm delivery or miscarriage 3.6 times were determined women who consume fish or other aquatic products at least once a week less than those who do not consume these products [17].

Although there have been a steady decrease in mortality rate related to cardiovascular diseases in Canada for 25 years, the mortality rate of Canada related to various cardiovascular diseases is reported to be higher than other countries according to the latest statistics of Genoa World Health Organization. Annual mortality rate per 100000 men aged between 45 and 54 in Canada is 65% higher than Japan. Cholesterol level in the blood of Canadians is slightly higher than Japanese. The significant differences between mortality rates of Canada and Japan related to cardiovascular diseases are affected by many factors but it is noteworthy that the factor that Japanese people consume more fish than Canadians may have a protective effect. Although the amount of fish consumption per person is approximately 14 kg in Canada, it increases up to 90 kg in Japan. The fish which is known as the sole source of Omega-3 polyunsaturated fatty acids contain both EPA and DHA. Japanese people consume about 500 mg EPA due to their high consumption of fish, but Canadian people consume only 70 mg [18].The effect of different dietary habits on atherosclerosis (vessel stiffness) was investigated in two villages of Japan. The body structure, blood pressure and blood chemistry were analyzed of 261 residents of the fishing village and 209 residents of farming village. Data of smoking habit and food consumption habits were obtained by use of questionnaires conducted frequently. All results of analysis that atherosclerosis was lower both in fishing village when compared to farming village both men and women [19].

It is reported that omega-3 fatty acids (approximately 1gr per day) taken with foods reduce the rate of sudden deaths caused by cardiovascular diseases. 20% reduction in death caused by any reason and 45% reduction in the risk of sudden death were observed for the group who takes 850 gr omega-3 fatty acid per day as a result of a test conducted on 11324 patients in Italy. These fatty acids have an anti-inflammatory effect and also can be antiatherogenic. Omega-3 fatty acids in high doses may reduce the high serum triglyceride level. 3 to 5 gr fatty acid per day with may reduce triglyceride level by 30-50% minimize both the risk of coronary heart diseases and acute pancreatitis (inflammation of the pancreas) [20].

The effects of consumption of fish and fish oil on cancer cells are also one of the most important studies. It was reported that tumor growth in mice which fed with fish and fish oil decreased significantly and has a preventive effect on tumor growth in breast, colon and prostate cancers [21].

In this study, total lipid rate and fatty acid composition of Pearl Mullet which has an important place in the nutrition of people living in Van Province of Turkey were researched. The pearl mullet is the sole endemic fish species that can survive in the salty and alkalinewaters of Lake Van. Covering an area of 3712 km2, with mean depth of 171 m, maximum depth of 451 m, and 1648 m above sea level, this is Turkey’s largest lake. Its waters are extremely alkaline and salty. Due to the nature of these waters, it is characterized as a “soda lake”. Researchers have reported a pH level of approximately 9.8, with saltiness at 0.19% [22]. There is only one type of fish lives in the lake known as Van fish or pearl mullet, (Chalcalburnus tarichi), which is a member of cyprinidae family, its mean fork length 19.5 cm and mean weight 80

g approximately. Pearl mullet is an immigrant type fish that normally lives in lake water, but at the reproduction period (April-June) immigrates to the surrounding freshwater rivers. After the reproduction period they return to the lake [23].

2. Materials and Methods

2.1. Material

In this study, Pearl Mullet which has an important place in the nutrition of people living in the basin of Lake Van of Turkey and commercial value for these people was used. Samples were taken in three different times with intervals of about two months. The average length of fish was determined as 20 cm and average weight of them as 71.5 kg. Then, fish bones, fins, skulls, internal organs and skins of these fish were separated by scalpel. Cleaned fish were carried to Trabzon Fishery Research Institute after being quick-frozen in styrofoam boxes by ice batteries for analysis. Their analysis was conducted by total lipid analysis method [24] and fatty acid methyl esters of them were determined by gas chromatography.

Figure 1. *Chalcalburnus Tarichii* P.1811

2.2. Metod

2.2.1. Lipid Analysis

Quick-frozen fish were thaw at 4ºC. Fishs were broken down by blender and homogenized. The balloon of extraction device was dried at 103ºC-105ºC in the drying oven. The balloon was cooled to room temperature in the desiccator and its tare was recorded when it was empty. Up to 8-15 gr of the prepared analysis sample was placed into the cartridge. The cartridge was placed in beaker at right angles and kept in the drying oven which was at 103ºC-105ºC for 3 hours. The cartridge was removed from the drying oven after three hours and cooled down to room temperature. Cooled cartridge was placed in tube of extraction device. Oils which had been leaked to the cartridge were completely cleaned by a hexane-impregnated cotton and the cotton was covered the mouth of the cartridge as a cap. Diethyl ether was added to the balloon of the device. The amount of solvent was adjusted to be at least twice of the volume of extraction tube. The glass balloon fitted to device and extraction process was continued for 4.5 hours.

Extraction is completed by making the balloon reaches the siphon, sonar, solvent extraction of the tube being removed from the solvent.Bubble extraction at 103°C-105°C was maintained for one hour in a drying cabinet and after cooling to room temperature in the desccator was recorded weighing the sonar.

The amount of fat was calculated by the following formula.

$$\text{CRUDE FAT} = \frac{(c-b)\,x100}{a}$$

a: Weighed sample

b: Tare of balloon

c: Tare of balloon + Crude fat

This study was performed on the same sample in three separate parallels and the difference between parallels was realized less than 0.3% respectively.

2.2.4. Gas Chromatography (GC) Analysis

0.1 gr of fat sample was taken up a screw-cap tube with the capacity of 5 ml the fat was resolved by adding 2ml of heptane on it and onto 0.2 ml of 2 N with methanol KOH solution was added on it. The solution was shaken vigorously for thirty seconds. The supernatant was left to stand until the upper phase clarifies. Clarified heptane solution was given for analysis by GC.

Type and amount analysis of fatty acid methyl esters was made by Shimadzu GC 2010 model gas chromatography (GC) device existing in the laboratory of Trabzon Fishery Research Institute. FID (flame ionization detector) was used together with the device. SP™-2380 FUSED SILICA Capillary Column (Supelco, USA), 100m x 0.25mm ID, 0.20 µm column and AOC-20i auto injector were used during separation process. Column oven temperature was set as 90°C-240°C (4°C/min.) and helium (He) 20cm/sec. was used as the carrier gas. Detector temperature was set 260°C and injection column temperature to 250°C. Gas flows: He: 40 ml/min, dry air: 400 ml/min, hydrogen: 40 ml/min. Carrier gas settings: pressure: 250.0 kPa, total flow: 22.8 ml/min., girth flow: 0.94 ml/min., linear velocity: 18.1 ml/sec., purge flow: 3.0 ml/min, split ratio: 20.0 Heptane was used as solvent and was set to inject 1µl sample at each time. Supelco™ 37 Component FAME Mix (Cat. No. 47885-U) fatty acid methyl standards were used for the study. The content of fatty acid methyl esters (FAME) by % and retention times are indicated in Table 1.

Table 1. Fatty acid standards used for the study and retention times

	Formula of Molecule	Retention Time (min)	Name of Fatty Acid Methyl Ester	Weight (ca)(%)
1	C4:0	11.784	Butyric Acid Methyl Ester	4
2	C6:0	12.498	Caproic Acid Methyl Ester	4
3	C8:0	13.769	Caprylic Acid Methyl Ester	4
4	C10:0	15.898	Capric Acid Methyl Ester	4
5	C11:0	17.331	Undecanoic Acid Methyl Ester	2
6	C12:0	18.983	Lauric Acid Methyl Ester	4
7	C13:0	20.804	Tridecanoic Acid Methyl Ester	2
8	C14:0	22.732	Myristic Acid Methyl Ester	4
9	C14:1	24.4	Myristoleic Acid Methyl Ester	2
10	C14:0	24.698	Pentadecanoic Acid Methyl Ester	2
11	C15:1	26.382	Cis-10-Pentadecanoic Acid Methyl Ester	2
12	C16:0	26.668	Palmitic Acid Methyl Ester	6
13	C16:1	28.074	Palmitoleic Acid Methyl Ester	2
14	C17:0	28.585	Heptadecanoic Acid Methyl Ester	2
15	C17:1	29.977	Cis-10-Heptadecanoic Acid Methyl Ester	2
16	C18:0	30.468	Stearic Acid Methyl Ester	4
17	C18:1n9	31.321	Trans-Elaidic Acid Methyl Ester	2
18	C18:1n9	31.71	Cis-Oleic Acid Methyl Ester	4
19	C18:2n6	32.667	Trans-Linolelaidic Acid Methyl Ester	2
20	C18:2n6	33.528	Cis-LinoleicAcid Methyl Ester	2
21	C20:0	34.155	Arachidic Acid Methyl Ester	4
22	C18:3n6	34.873	Gama-Linolenic Acid Methyl Ester	2
23	C20:1	35.346	Cis-11-Eicosenoic Acid Methyl Ester	2
24	C18:3n3	35.598	Linolenic Acid Methyl Ester	2
25	C21:0	35.912	Heneicosanoic Acid Methyl Ester	2
26	C20:2	37.136	Cis-11,14-Eicosadienoic Acid Methyl Ester	2
27	C22:0	37.688	Behenic Acid Methyl Ester	4
28	C20:3n6	38.51	Cis-11,14-Eicosatrienoic Acid Methyl Ester	2
29	C22:1n9	38.933	Erusic Acid Methyl Ester	2
30	C20:3n3	39.251	Cis-11,14,17-Eicosatrienoic Acid Methyl Ester	2
31	C20:4n6	39.494	Arachidonic Acid Methyl Ester	2
32	C23:0	39.613	Tricosanoic Acid Methyl Ester	2
33	C22:2	40.869	Cis-13,16-Docosadienoic Acid Methyl Ester	2
34	C24:0	41.431	Lignoseric Acid Methyl Ester	4
35	C20:5n3	42.042	Cis-5,8,11,14,17-Eicosapentaenoic Acid Methyl Ester	2
36	C24:1	42.876	Nervonic Acid Methyl Ester	2
37	C22:6n3	48.41	Cis-4,7,10,13,16,19-Docosahexaenoic Acid Methyl Ester	2

3. Results and Conclusion

In this study, an important food source in the basin of Lake Van to be the Pearl Mullet ratio or total limit and fatty acid composition were analyzed. According to the months of striped mullet lipid ratio are given in Table 2.

Table 2. The crude fat rate of Pearl Mullet for each month

	September	November	January	Average
Pearl Mullet	1.66 gr/100gr	1.55 gr/100gr	3.35 gr/100g	2.28 gr/100g

As can be seen from the table, the total lipid ratio Pearl Mullet in September and November did not show a signifant difference.A difference of 0.11 gr/100gr % was observed in November when compared with September. In January increased about twice total amounts of lipits.In the study, the total lipid ratio of pearl mullet September, November and January was founded to be2.28 gr/100gr. The lipid content for fish spread over a wide range between 0.3 - 45% w/w. Lambertsen [25] where they keep the fish were divided into 4 groups according to the amount of fat in them;

1. Lean fish (<2% fat) such as cod, haddock, crustaceans and whiting
2. Low-fat fish (2-4% fat) such as solea, scaldfish
3. Mid-fat fish (4-8%) salmon from natural environment
4. Super fatted fish (>8%) such as herring, mackerel and salmon from fish farms.

Pearl Mullet is included in low-fat fish group according to these results.

PUFA, MUFA and LCPUFA rates of Pearl Mullet

Pearl Mullet fatty acid composition as shown in the Table 3 is detected synthesis.

Table 3. Saturated MUFA and LCPUFA rates of Pearl Mullet for September and November

	September	November	January	Average
Saturated fatty acid	22.9%	21.28%	19.43%	21.2%
Monounsaturated fatty acid	42.6%	44.4%	41.82%	42.94%
Polyunsaturated fatty acid	30.31%	28.97%	26.82%	28.7%

Table 4. g/100g amount of some fatty acids of Pearl Mullet

Crude Fat g/100g	PUFA g/100g	MUFA g/100g	LCPUFA g/100g	DHA g/100g	EPA g/100g

Belonging to the months of September and November compared to fat ratio in January, although not seen a significant difference in fat increased approximately two-fold. The unsaturated fatty acids of pearl mullet were founded to be more than saturated fatty acids in this study. The MUFAs of them is seen to have the highest rate with the average rate of 42.94%. LCPUFAs have an average of 28.7%, too. These rates demonstrate the importance of pearl mullet as human food.

The analysis to fatty acid was applied as two parallels and the difference between these parallels was smaller than 0.3.The results are offered as means ± standard deviation (SD). P values < 0.05 were accepted as statistically significant [26]. The maximum value for fatty acids was measured in oleic acid and measured as (18:1, n-9) 19.21% in the month of November. The crude fat rate of Pearl Mullet is shown as g/100g in Table 4.

Table 5. Descriptive statistics and comparative results for fatty acids according to month

	SEPTEMBER					NOVEMBER					JANUARY				
	Median	Average	Sd.	Min.	Max.	Median	Average	Sd.	Min.	Max.	Median	Average	Sd.	Min.	Max.
Miristic	3.27	3.27 a	.03	3.25	3.29	3.16	3.16 ab	.01	3.15	3.17	2.93	2.93 b	.13	2.84	3.02
Palmitic	13.74	13.74 a	.02	13.72	13.75	12.53	12.53 b	.00	12.53	12.53	11.86	11.86 b	.50	11.50	12.21
Heptadecanoic	.97	.97 a	.01	.96	.98	.88	.88 b	.01	.87	.88	.85	.85 b	.03	.83	.87
Stearic	4.18	4.18 a	.05	4.14	4.21	3.66	3.66 b	.01	3.65	3.66	3.37	3.37 b	.16	3.26	3.48
Araþidic	.66	.66 a	.01	.65	.67	.60	.60 b	.01	.59	.60	.55	.55 c	.02	.53	.56
Behenic	.	.	.	.	.	.45	.45	.00	.45	.45	.49	.49	.03	.47	.51
Palmitoleic	13.33	13.33	.28	13.13	13,53	13.36	13.36	.01	13.35	13.36	13.18	13.18	.34	12.94	13.42
Oleic	18.18	18.18	.06	18.14	18.22	19.21	19.21	.01	19.20	19.21	17.53	17.53	.70	17.03	18.02
Elaidic	8.16	8.16	.06	8.11	8.20	8.42	8.42	.02	8.40	8.43	8.96	8.96	.40	8.67	9.24
Gadoleic	.83	.83	.00	.83	.83	.92	.92	.00	.92	.92	.71	.71	.11	.63	.79
Erusic	1.74	1.74 b	.00	1.74	1.74	1.98	1.98 ab	.00	1.98	1.98	2.16	2.16 a	.16	2.04	2.27
Nervonic	.58	.58	.01	.57	.58	.51	.51	.00	.51	.51	.57	.57	.08	.51	.62
Linoleic	3.47	3.47 a	.01	3.46	3.47	3.14	3.14 b	.01	3.13	3.14	2.67	2.67 c	.06	2.62	2.71
Alpha Linolenic	.61	.61 b	.01	.60	.62	.86	.86 a	.00	.86	.86	.83	.83 a	.04	.80	.85
Gamma Linolenic	1.41	1.41 b	.01	1.40	1.41	1.67	1.67 a	.01	1.66	1.67	1.51	1.51 b	.08	1.45	1.56
Arachidonic	1.60	1.60	00	1.60	1.60	1.69	1.69	.01	1.68	1.69	1.74	1.74	.11	1.66	1.82
EPA	9.11	9.11	.01	9.10	9.11	8.81	8.81	.03	8.79	8.83	8.49	8.49	.52	8.12	8.85
DPA	5.27	5.27	.02	5.25	5.28	5.13	5.13	.06	5.08	5.17	5.35	5.35	.42	5.05	5.65
DHA	8.89	8.89	.04	8.86	8.92	7.81	7.81	.08	7.75	7.86	7.57	7. 7	.64	7.12	8.02

[A]Average of three lots analyses. [B]Values reported are means ± SD. Cabc values for each sample with different letters in the same fraction are significantly different at P < 0.05. D SFA: Saturated fatty acid, MUFA: Monounsaturated fatty acid, PUFA: Polyunsaturated fatty acid. #: The differences which have the small letter on the same row are significant.

4. Conclusion

Fatty acid concentrations in the flesh of Pearl Mullet which live in soda-rich Lake Van were determined. The total lipid analysis was performed by Bligh and Dyer [24] method and the composition of fatty acid methyl esters was determined by gas chromatography. Seasonal variations of total fatty acid composition of Pearl Mulletare presented in Table 5.

Two-month intervals obtained from Lake Van was made the examination of fish. The crude oil ratio was found 1.66 gr/100gr in September, 1.55 gr/100gr in November and 3.35 gr/100gr in January respectively as a result of the study. No significant differences were not observed in the months of September and November but in January the rate of crude oil has been shown nearly doubling fatty acid analysis made three parallels and the difference between these parallels were less than 0.3. According to descriptive statistics of fatty acids are given in Chart 5. The maximum value for fatty acids was measured in oleic acid and measured as (18:1, n-9) 19.21% in the month of November. A significant difference was not observed when fat rates of September and November were compared although the fat rate in the January was almost doubled. The unsaturated fatty acids of pearl mullet were founded to be more than saturated fatty acids in this study. The MUFAs of them is seen to have the highest rate with the average rate of 42.94%. LCPUFAs have an average of 28.7%, too. These rates demonstrate the importance of pearl mullet as human food. Despite the low amount of total lipids, LCPUFA, DHA and EPA rates were viewed to be high.

These results agree with Ergun et al., 1992, the high levels these fish are a rich source of eicosapentaenoic acid (EPA) and docasahexaenoic acid (DHA) had been reported as a characteristic property of Chalcalburnus tarichi [27].

Duyar [28] conducted a study on chemical composition of muscles and eggs of Pearl Mullet and preparation of croquette as his doctoral thesis. He followed the change in chemical composition of fish by months for one-year period. He determined the crude fat rate of pearl mullet as 2.07% in the month of January as the lowest rate and 5.42% in the month of January as the highest rate. As the

result of fatty acid analysis, he determined the saturated fatty acid rate as 38.38%, monounsaturated fatty acid rate as 51.46% and polyunsaturated fatty acid rate as 7.18%.Pearl Mulletthe saturated fatty acids in muscle, while the maximum in the spring, winter, fall and summer season have followed it respectively. The highest values in terms of saturated fatty acids in the summer, while the lowest values observed in spring, autumn and winter values were close to each other.

Similarly, Bayir et al.[29], the highest values for Tls, NLs and PLs were found in winter. The highest 3/6 ratios and EPA+DHA amounts were found in the winter and this coincided with the lowest gonado-somatic index. In this study, data show that the 3/6 ratio was1.24 in spring, 1.68 in summer, 0.61 in autumn and 0.98 in winter. In our study, in comparing PUFA rates, that of Pearl Mulletis seen to be higher, which increases nutritional value of Pearl Mullet and other research according to Aziz et. al. [30] was conducted to quantitatively determine the fatty acid contents of 20 species of marine fish and four species of shellfish from Straits of Malacca. Most samples contained fairly high amounts of polyunsaturated fatty acids (PUFAs), especially alpha-linolenic acid (ALA, C18:3 n3), eicosapentaenoic acid (EPA, C20:5 n3), and docosahexaenoic acid (DHA, C22:6 n3).

Refering the literature world, fish meat yield, food composition and fatty acid composition of total lipids is observed on many studies made. Studies including muscle widely liver gonad and in portions such as the fertilized egg lipid content and fatty acid composition were analyzed. Fatty acids of freshwater fish and marine fish were compared in some studies. In addition, issues such as seasonal variation of contents of fatty acids and lipids, effects of spawning period on nutrient composition, differences in nutrient composition between female and male fish, differences in terms of effect of nutrient composition on total lipids and fatty acids and fatty acid composition and amount of fatty acids for migrating fish were scrutinized. It was founded that the fat and fatty acid rates of fish meat that are one of the basic elements of fish meat changes according to seasons (depending on genetic and environmental factors), geographic regions (variables such as water temperature, depth and salinity), age, gender, typical maturity and nutrition as well as species and also being culture or natural [29,31-39].

In fish, the most characteristic compotent of the fatty phospholipits is the LCPUFA. This is usually in long chain (n-3) configuration for aquatic animals. 18:3n-3, 20:5n-3 and 22:6n-3 fatty acids are usually dominant for aquatic plants and animals. The most common of them are EPA and DHA.

Alike resultsfor other fish species have also been reported in literature high levels of EPA and DHA were reported by otherstudies in trout species including *S. trutta macrostigma* [40,41]. Deng [42] conducted a study on pearl mullets and reported that pearl mullets which are caught in the months of September and November have the highest lipid content in their bodies. The amount of unsaturated fatty acids between the months of August and October varied from season to season. The period of time when pearl mullets have the highest amount of fat is the month of October which is the pre-spawning time of these fish. It was reported that pearl mullets spawn in the month of December and their amount of fat increases simultaneously with the growth of fish and the unsaturated fatty acids have the highest value usually between the months of August and October.

Huss indicated that lipid concentration changes in fish in the maximum rate and in addition, chemical parameters change according to age, gender, environment and season among the individuals of the same species or from species to species in 1988 [33]. Kalokwska indicated that fatty acid concentration is affected by many internal and external factors and factors such as age, gender, spawning period and nutrition are highly effective among the individuals of the similar species in 2003 [43].

Current evidence strongly supports the roles of fatty acids, particularly EPA, DHA, and a-linolenic, inreducing the risk of cardiovascular disease [44,45,46]. systematic review of the evidence supporting a causal link between dietary factors and coronary heart disease. There is noteworth evidence supporting their roles in Mental Health [47], Depression [48,49,50]. Dementia [51,52,53], Diabetes [54,55,56,57], as well. This resarch has revealed that Pearl Mulletin the Van Lake of Turkey is a desirable item in the human diet when the levels of EPA, DHA are considered. The fish identified in this study was found to be good source of n-3 fatty acid. We reported that the high rate of polyunsaturated fatty acids may have a reducing effect on the risk of coronary health diseases and arteriosclerosis for people who consume Pearl Mullet.

Pearl Mullet has an important position in nutrition of the people living in the region and especially in meeting EPA and DHA needs of people. Especially the accessibility and the amount of consumption of Pearl Mullet are taken into consideration; how the important of it for the people in the region can be better understood. While the average fish consumption of Turkey for 2010 was 7.5 kg per person, the consumption of Pearl Mullet was 9 kg per person during the same period.

The value as human food Pearl Mullet has increased cheap at the same time easily accessible. When EPA and DHA rates of Pearl Mullet is taken into consideration, this fish have to be produce more and offered to consumption of people in order to increase the consumption of fish and new products must be produced from Pearl Mullet. Establishment of new facilities which will process Pearl Mullet will be beneficial in contribution to consumption and produce additional economic value. Thus, Pearl Mullet will be conveyed to the other parts of the country.

References

[1] Baysal, A. Nutrition. Hatiboğlu Journals. 2009.93, ISBN 975-7527-73-4,12. Press.

[2] Hui, Y.H. Food Biochemistry and Food Processing, Blackwell Publishin. 2006. 351-363,

[3] Gülyavuz, H. Altınkurt K. 1991. Food Processing Tecnology (in Turkish). M.E.B. Press, Istanbul, 1991, 320 p,

[4] Tülsner, M. 1994. Fischverarbeitung band 1, rohstoffergenshaften von fische und grundlagen der verarbeitungs Prozesse. Behr's Verlag-Hamburg, 19-23, 55-66.

[5] Nettleton, J.A.2000. Seafood Nutrition in The 1990's İssues for The Consumer. Seafood Science, and Technology, Chepter 4, Ed. By Graham Bligh Can. Inst. Of Fish Tech., 32-39,

[6] Tocher, D.R.2003. Metabolism and functions of lipids and fatty acids in teleost fish . Rev. Fish Sci. 11, 107-184.

[7] Ackman, R.G.1989. Fatty Acids in Marine Biogenic Lipids, Fats and Oils, CRC PressInc. Boca Raton, 175-178.

[8] Kolakowska, A., Szczygielski, M., Bienkiewicz, G., Zienkowicz, L., 2000. Some of FishSpecies as a Source of n-3 Polyunsaturated Fatty Acids, Acta Ichthyol. Piscat. 30, 2,59-70.

[9] Pigott, G.M, Tucker, B.W. 1990. Seafood effects of technology on nutrition. Marcel Dekker, Inc. New York.

[10] Gordon, D.T. Ratliff, V.1992. TheImplications of Omega 3 Fatty Acids in Human Health, in R.E. Martin, G.J. Flick eds, Advances in Seafood Biochemistry Composition and Quality. 69-98. Technomic Publishing Co. Inc.

[11] Huss, H.H. 1988. Fresh fish Quality and Quality chances, FAO17-19, Rome.

[12] Gorga, C. 1998. Quality assurance of seafood. An avi Book Published by Van Nostrand Reinhold New York.

[13] Mozaffarian, D, Bryson, C.L. Lemaitre, R.N. Burke, G.L. Siscovick, D.S.2005.Fish intake and risk of incident heart failure. J. Am. Coll. Cardiol. 45(12), 2015-2021.

[14] Mnari, A. Boulel, I. Chraief, I. Hammami, M. Romdhane, M.S. Cafsi, M. El. 2007.Chaouch, A. Fatty acids in muscles and liver of Tunisian wild and farmed gilthead sea bream, Sparus aurata. Food Chem., 100, 1393-1.397.

[15] Terry, P. Lichtenstein, P. Feychting, M.2001. Fatty fish consumption and risk of prostate cancer. Lancet, 357, 1764-6.

[16] Zuraini, A. Somchit, M.N. Solihah, M.H. Goh, Y.M. Arifah, A.K. Zakaria, M.S. Somchit, N. Rajion, M.A. Zakaria, Z.A. Mat, Jais, A.M.2006. Fatty acid and amino acid composition of three local Malaysian Channa spp. Fish,Food Chem. 92, 637-641.

[17] Olsen, S. Secher, N.J. 2002. Low consumption of seafood in early pregnancy as a risk factor for preterm delivery: prospective cohort study. British Medical Journal, 324(7335), 447.

[18] Holub, B.J. Potential health benefits of the omega-3 fatty acids in fish. 2000, p. 40-46. In E. Graham Bligh (ed.), Seafood science and technology, Chap 5 Can. Inst. of Fish. Tech., Tech. Uni. of Nova Scotia Halifax, Canada.

[19] Yamada, T. Strong, J.P. Ishii, T. Ueno, T. Koyama, M. Wagayama, H. Shimizu A. Sakai, T. Malcom, G.T. Guzman M.A.2000. Atherosclerosis and omega-3 fatty acids in the populations of a fishing village and a farming village in Japan. Dep. of Int. Medicine, Yubara Spa Hospital, Maniwa-gun, Okayama, Japan. Atherosclerosis, 153(2), 469-81.

[20] O'keefe, J.H. Haris W.S.2000. From inuit to implementation: Omega-3 fatty acids come of age. Mid America Heart Institute of Saint Luke's Hospital and Department of Medicine, University of Missouri-Kansas City, USA Affiliation. Mayo Clin Proc (Mayo Clinic proceedings) Jun; 75(6), 607-14.

[21] Karmali, R.A. 1987. Omega-3 fatty acids and cancer: a review. In: Lands WE, ed. Proceedings of the AOCS short course on polyunsaturatedfatty acids and eicosanoids, Biloxi, Mississippi, 13–16 May 1987.Champaign, IL: American Oil Chemists' Society, 222-32.

[22] Kempe, S, Khoo, F. & Gurleyik, Y. 1978. Hydrography of Lake Van and Its Drainage Area, 30-44 The Geology of Lake Van, Degens, E.T. and Kurtman, F. (Eds.), MTA Pub. No:169, Ankara, 158 pp.

[23] Sari, M. 2006. Threatened Fishes of the World: Chalcalburnus tarichi (Pallas 1811)

[24] Bligh, E.G. Dyer, W.J. A.1959. Rapid Method of Total Lipid Extraction and Purication, Can. J.Biochem. Physiol., 37, 911- 917.

[25] Lambertsen, N. Fatty acid composition of fish fats. Comparisons based on eight fatty acids. Fisk. Dir. Skr., Ser. Ernæring, l (4), 1978, 105-116.

[26] Sümbüloğlu, K., Sümbüloğlu, V. 1998. Materiality tests. Sümbüloğlu K, Sümbüloğlu V. editors. Biostatistics. 8. printing. Ankara: Hatipoğlu Publisher, 76-156.

[27] Ergun, H. Tanyar, B. Çamaş, H. 1992. Level of Fatty Acids in Fish Meats Pearl Mullet of Lake Van. Journal of the Faculty of Veterinary Medicine, YYÜ Universty, 3(1-2), 165-174.

[28] Duyar, H.A. 2000. Chemical Composition of Muscle and Eggs Making Pearl Mullet (Chalcalburnus tarichi, Pallas 1811) and A study on the construction Croquet. PhD Thesis. Department of Fisheries and Processing Technology, Institute of Natural and Applied Science, Ege University, Turkey, pp 118.

[29] Bayır, A., Sirkecioğlu, A.N., Aras, N.M., Aksakal, E., Haliloğlu H.İ., Bayır M. 2010. Fatty acids of neutral and phospholipids of three endangered trout: *Salmo trutta caspius* Kessler, *Salmo trutta labrax* Pallas and *Salmo trutta macrostigma* Dumeril. *Food Chem.*, 119, 1050-1056.

[30] Aziz, N.A. Azlan, A. Ismail, A. Alinafiah, S. M. Razman, M. R. 2013. Quantitative Determination of Fatty Acids in Marine Fish and Shellfish from farm water of Straits of Malacca for Nutraceutical Purposes. Hindawi Publishing Corporation BioMed Research International, Article ID 284329, 12 pages.

[31] Bayır, A. Sirkecioğlu, A.N. Bayır, M. Arslan, M. Güneş, M. Haliloğlu, H. Aras, N.M. Arslan, H. 2011. Effects of dietary lipid source on growth, survival, and fatty acid composition of brown trout juveniles, Salmo trutta. Isr. J. Aquacult. Bamidgeh., IIC: 622-630.

[32] Dönmez, M. Tatar, O. 2001. Investigation of the Changes in Fatty Acids Composition of Whole Frozen Rainbow Trout (Oncorhynchus mykiss W.) and Its Fillet During Storage E.U. Journal of Fisheries & Aquatic Sciences, 18, 1-2, 125-134.

[33] Huss, H.H.1995. Quality and quality changes in fresh fish. FAO Fisheries Technical Paper, No: 348. Rome.

[34] Iverson, S.J. Frost, K.J. Lang, S.L.C.2002. Fat content and fatty acid composition of forage fish and invertebrates in Prince William Sound, Alaska: factors contributing to among and within species variability. Mar Ecol Prog Ser, 241, 161–181

[35] Dutta-Roy, A.K.1994.Insulin mediated processes in platelets, erythrocytes and monocytes/macrophages: Effects of essential fatty acid metabolism. Prostaglandins Leukotrienes and Essential Fatty Acids. 51, 385-399.

[36] Tanakol, R. Yazıc, Z. Şener, E. Sencer, E.1999. Fatty acid composition of 19 species of fish from the Black sea and Marmara sea Lipids, 34, 3,291-297.

[37] Ackman, R.G. 2002. Freshwater fish lipids- an overlooked source of beneficial long-chain n-3 fatty acids. Eur. J. Lipid Sci. Technol. 104,253-254.

[38] Inhamuns, A.J. Franco, M.R.B. 2008. EPA and DHA quantification in two species of freshwater fish from Central Amazonia. Food Chem. 107: 587-591.33.

[39] Zlatanos S, Laskaridis K. 2007. Seasonal variation in the fatty acid composition of three Mediterranean fish-sardine (Sardina pilchardus) anchovy (Engraulis encrasicholus) and picarel (Spicara smaris). Food Chem. 103, 725-728.

[40] Aras N.M., Haliloğlu H.I., Ayık Ö., Yetim H. 2003. Comparison of fatty acidprofiles of different tissues of mature trout (*Salmo trutta labrax*, Pallas, 1811) caught from Kazandere creek in the Çoruh region, Erzurum, Turkey. Turk. J. Vet. Anim. Sci. 27: 311-316.

[41] Akpinar M.A., Görgün S., Akpinar A.E. 2009. A comparative analysis ofthe fatty acid profiles in the liver and muscles of male and female*Salmo trutta macrostigma*. Food Chem. 112: 6-8.

[42] Deng, J.C. Orthoefer, F.T. Dennison, R.T. Watson, N.1976. Lipid and Fatty Acids in Mullet (Mugil Cephalus); sesonal and Locational Variations Journal of Food Secience. Volume 41.P. 1479-1483.

[43] Kolakowska, A. Olley, J. Dunstan, G.A. 2003. Fish Lipids, In Chemical and Functional Properties of Food Lipids, Sikorski, ZE and K, A. Eds.,CRC Press, Florida, 228-230.

[44] Mozaffarian D., Wu J.H.2011. Omega-3 fatty acids and cardiovascular disease: effects on risk factors, molecular pathways, and clinical events. J Am Coll Cardiol. 58, 2047-2067.

[45] De Caterina, R.2011. n-3 fatty acids in cardiovascular disease. N Engl J Med., 364:2439-2450.

[46] Mente, A., de Koning L., Shannon H.S., Anand S.S. A systematic review of the evidence supporting a causal link between dietary factors and coronary heart disease. Arch Intern Med. 2009; 169: 659-669.

[47] Ross, B.M., Seguin J., Sieswerda L.E. 2007. Omega-3 fatty acids as treatments for mental illness: which disorder and which fatty acid? Lipids Health Dis., 6:21.

[48] Lin, P.Y., Huang S.Y., Su K.P. 2010. A meta-analytic review of polyunsaturated fatty acid compositions in patients with depression. Biol Psychiatry. 68,140-147.

[49] Appleton, KM, Hayward RC, Gunnell D.2006. Effects of n-3 long-chain polyunsaturated fatty acids on depressed mood: systematic review of published trials. Am J Clin Nutr. 84,1308-1316.

[50] Lin, P.Y., Huang S.Y., Su K.P., 2010. A meta-analytic review of polyunsaturated fatty acid compositions in patients with depression. Biol Psychiatry. 68, 140-147.,

[51] Milte, C.M., Sinn N., Street S.J., Buckley J.D., Coates A.M., Howe P.R. 2011.Erythrocyte polyunsaturated fatty acid status, memory, cognition and mood in older adults with mild cognitive impairment and healthy controls. Prostaglandins Leukot Essent Fatty Acids. 84, 153-161.

[52] Cunnane, S.C., Schneider J.A., Tangney C. 2012. Plasma and brain fatty acid profiles in mild cognitive impairment and Alzheimer's disease. J Alzheimers Dis. 29, 691-697.

[53] El-Ansary, A.K., Bacha A.G., Al-Ayahdi L.Y., 2011. Plasma fatty acids as diagnostic markers in autistic patients from Saudi Arabia. Lipids Health Dis., 10, 62.

[54] Djousse´, L., Biggs, M.L., Lemaitre,R.N. 2011. Plasma omega-3 fatty acids and incident diabetes in older adults. Am J Clin Nutr. 94, 527-533.

[55] Brostow, D.P., Odegaard A.O., Koh W.P. 2011. Omega-3 fatty acids and incident type 2 diabetes: the Singapore Chinese Health Study. Am J Clin Nutr. 94, 520-526.

[56] Akinkuolie, A.O., Ngwa, J.S., Meigs J.B., Djousse´ L.2011. Omega-3 polyunsaturated fatty acid and insulin sensitivity: a meta-analysis of randomized controlled trials. Clin Nutr. 30:702-707.

[57] Wu, J.H., Micha, R., Imamura, F. 2012. Omega-3 fatty acids and incident type 2 diabetes: a systematic review and meta-analysis. Br J Nutr. 107(suppl 2):S214-S227.