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Fatty Acid Composition and Chemical Parameters of *Liza parsia*

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ABSTRACT

The main purpose of this study was to quantify fatty acids & chemical parameters of *Liza parsia* fish oil. Ethyl acetate was used to extract lipid from *Liza parsia* fish fillet. The extracted lipid was saponified by using alcoholic potassium hydroxide and it was converted into volatile methyl ester by esterification process. Lipid of *Liza parsia* was composed of Oleic acid (1.17 ± 0.09%), Palmitic acid (55.56 ± 0.15%), Stearic acid (5.24 ± 0.10%), Palmotelic acid (18.45 ± 0.02%), Arachidic acid (5.64 ± 0.15%), Linoleic acid (10.43 ± 0.02%) and Lauric acid (4.40 ± 0.18%). The chemical parameters revealed that saponification value, iodine value, ester value, acid value, percentage of fatty acid and Reichert-Meissl value was 178.5± 0.22 mg KOH/g, 113.67 ± 0.24 mg I_2/g oil, 165.75 ± 0.19 mg KOH/g, 12.75 ± 0.15 mg KOH/g, 6.41 ± 0.20 and 0 respectively. The quality of fish lipid depends on these above chemical parameters.

KEYWORDS: Fatty acid; Chemical parameters; *Liza parsia*; Esterification; Acid value, Iodine value.

INTRODUCTION

Fish is a vital source of food and nutrition through all over the world. Millions of people in Bangladesh satisfy their demand of nutrition, animal protein by taking fish [1]. Marine fishes (442 species) as well as local fishes (266 species) are playing this role [2]. Both marine and local fish contains different fatty acids. These fatty acids perform different biological functions in body. PUFAs are very essential for some human diseases like heart disease, mental growth, hypertension, cancer, lung disease etc. [3]. In this purpose, *Liza parsia* (Local name "Parsie") can contribute to fulfill these demands. It is brackish water fish. Besides this, it is also found in fresh and marine water of tropical and subtropical regions. This species is very popular in these regions due to tasty, good source of protein, lipid, and high quality of fish fillet as well as commercially important [4]. So, it can contribute nutrition and animal protein sources to the people in our country [5]. It contains higher amount of protein (21.52 mg/g) and lipid (1.91 mg/g) [6]. Moreover, *Liza parsia* contains different minerals and trace elements like Zn (18.2 mg/kg), Fe (30.3 mg/kg), Ca (45.1 mg/kg), Mg (26.7 mg/kg), K (40.0 mg/kg), Na (37.4 mg/kg), Si (0.02 mg/kg), Mn (6.0 mg/kg) and Cu (2.9 mg/kg). This fish species can satisfy the mineral level of human [7]. As *Liza parsia* is known as fatty fish, the energy content of *Liza parsia* is comparatively higher than other fishes (813 kJ/ 100 g) [8]. The quality of this fish lipid depends on some chemical parameters like saponification value, iodine value, acid value, ester value, Reichert-Meissl value etc. Length and size of the fatty acid chain can be predicted from saponification value. Besides, unsaturation of the fatty acid depends on iodine value. For example, fat or oil can be oxidized due to its high iodine value. Furthermore, edibility of the lipid is related to acid value. Offensive taste and aromas of lipid causes with the increase of acid value [9, 10]. Reichert-Meissl value is the direct measure of lower fatty acids present in oil or fat [11].

SAMPLE PREPARATION

The fresh samples were collected from gher. Collected fish samples were washed by using distilled water and scales were removes with sharp knife. Then the samples were dismembered and fillet was collected. Any Bone, scale was removed from fish fillet. The collected fillet was preserved for the extraction of lipid.

METHODOLOGY

Ethyl acetate was used to extract lipid from fish fillet. A "PYE UNICAM" 4500 U model GC was used for the detection and quantification of fatty acid. For the analysis of fatty acids, this model was furnished with a FID [3].

IODINE VALUE

The experimental samples were subjected to iodine value analysis in accordance with standard methods described by the literature [12].

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SAPONIFICATION VALUE

The experimental samples were subjected to saponification value analysis in accordance with standard methods described by the method [12].

ACID VALUE

The experimental samples were subjected to acid value analysis in accordance with standard methods described by the procedure [13].

PERCENTAGE OF FREE FATTY ACID

The experimental samples were subjected to percentage of free fatty acid analysis in accordance with standard methods described by the method [13]**.**

REICHERT-MEISSL VALUE

The experimental samples were subjected to Reichert-Meissl value analysis in accordance with standard methods described by the literature [14]**.**

STATISTICAL ANALYSIS

Data were analyzed using Microsoft Excel 2013. All the data were presented as average ± standard deviation (SD). Dixon's Q test was run for the marking off and refusal of outliers. With three (n=3) observations and at 95 % confidence level, it was observed that all the data were statistically appropriate with no meaningful distinction within the values.

RESULTS AND DISCUSSION

Fatty acids of *Liza parsia* were known from obtained chromatogram by comparing the retention time with standard fatty acids. The retention time of fatty acid in sample was varied from standard value due to the difference of analysis time between sample and standard fatty acids. This analysis revealed that fatty acid profile of *Liza parsia* was consisted of Lauric acid ($C_{12:0}$), Palmitic acid ($C_{16:0}$), Palmotelic acid ($C_{16:1}$), Stearic acid ($C_{18:0}$), Oleic acid ($C_{18:1}$), Linoleic acid ($C_{18:2}$) and Arachidic acid ($C_{20:0}$). The obtained results can be compared with the results of other fish species.

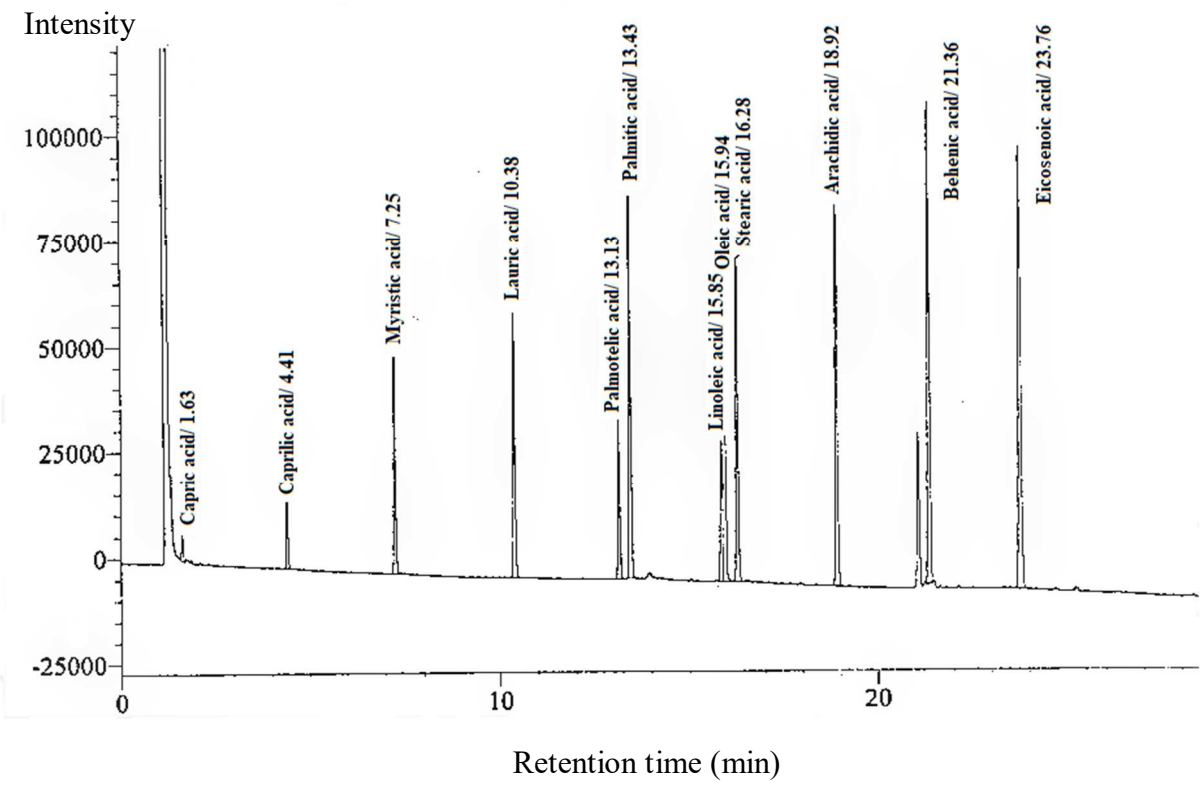

Fig 1. GC spectrum of standard fatty acid mixture

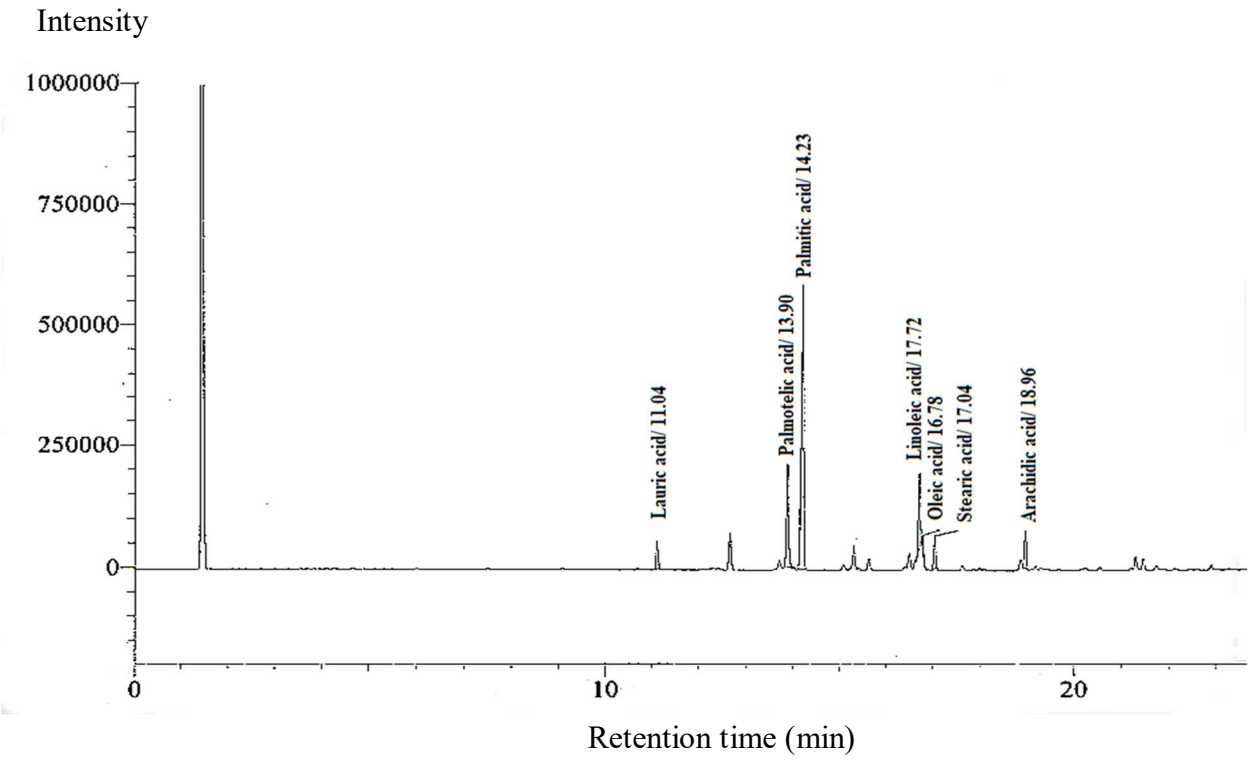

Fig 2. GC spectrum of fatty acid found in *Liza parsia*

Lates calcarifer is a brackish water fish commonly known as Bhetki [15]. The percentage of Palmitic acid, Lauric acid, Oleic acid and Stearic acid in *Lates calcarifer* fish lipid was 52.86, 4.49, 36.88 and 5.75 respectively [16]. The percentage of Palmitic acid, Lauric acid, Oleic acid and Stearic acid in *Liza parsia* fish lipid was 55.56 ± 0.15, 4.40 ± 0.18 , 1.17 ± 0.09 and 5.24 ± 0.10 respectively. The percentage of Palmitic acid, Lauric acid, Stearic acid in *Liza parsia* is not much differ from *Lates calcarifer* fish lipid. But the percentage of Oleic acid in *Lates calcarifer* fish lipid is higher than *Liza parsia* fish lipid. This low level of Oleic acid may be originated due to the nature of food chain and sometimes, the percentage of Oleic acid in fish species is found below 10 % [17].

An investigation on *Mystus gulio* (brackish water fish) showed that fish lipid was consisted of Palmitic acid (24.23%), Stearic acid (8.42%), Oleic acid (30.29%), Linoleic acid (7.35%) and Arachidic acid (2.47%) whereas lipid of *Liza parsia* was consisted of Palmitic acid (55.56 ± 0.15%), Stearic acid (5.24 ± 0.10%), Oleic acid (1.17 ± 0.09%), Linoleic acid (10.43 ± 0.02%) and Arachidic acid (5.64 ± 0.15%) [3]. In *Liza parsia*, the percentage of Palmitic acid is high whereas the percentage of Oleic acid is high in *Mystus gulio* fish lipid from each other [18]. A study on *Mugil cephalus* (brackish water fish) was showed that *Mugil cephalus* fish lipid contained different fatty acid like Palmitic acid (27.45%), Stearic acid (3.68%) and Oleic acid (10.77%). Significant amount of Palmitic acid was present in fish lipid compared with other SFAs like Lauric acid, Myristic acid, Stearic acid and Arachidonic acid [19]. This variation may be arisen due to size, maturity, reproductive status, temperature of water etc. [18].

The obtained fatty acids from this lipid can be fallen into two classes: saturated and unsaturated fatty acids. The percentage of SFAs (Saturated Fatty Acids), MUFAs (Mono Unsaturated Fatty Acids) and PUFAs (Poly Unsaturated Fatty Acids) in *Liza parsia* fish oil was 69.85 ±0.05, 19.66 ±0.10 and 10.43 ±0.02 respectively. An investigation on *Saurida undosquamis* showed that the range of saturated fatty acid was 58% to 72.14% [20]. This statement supports the percentage of saturated fatty acid in *Liza parsia*. The lower percentage of unsaturated fatty acid in *Liza parsia* can be explained due to higher temperature in sample area [21]. Another researchers have shown that the percentage of saturated fatty acid may vary from 9% to 76% [22]. The composition of *Mugil cephalus* fish lipid was 40.24% SFAs, 33.48% MUFAs and 26.28% PUFAs that was different from *Liza parsia* [19]. Difference of fatty acid composition from other species and presence of linear chain and even-number fatty acids in *Liza parsia* are due to some factors like sub-species, food habit, season, environmental conditions [22].

Table 1. Fatty acid profile of *Liza parsia*

Sample	Name of fatty acid	Retention time (in min)	Individual fatty acid (%)	Range of fatty acid
	Lauric acid	11.10	4.40 ± 0.18	4.58~4.22
	Palmotelic acid	13.90	18.45 ± 0.02	18.47~18.43
	Palmitic acid	14.22	55.56 ± 0.15	55.71~55.41
Sample	Linoleic acid	16.71	10.43 ± 0.02	10.45~10.41
	Oleic acid	16.78	1.17 ± 0.09	1.26~1.08
	Stearic acid	17.04	5.24 ± 0.10	5.34~5.14
	Arachidic acid	18.96	5.64 ± 0.15	5.79~5.49
	Capric acid	1.63	-	-
	Caprilic acid	4.41	-	-
	Myristic acid	7.25	-	-
	Lauric acid	10.38	-	-
	Palmotelic acid	13.13	-	-
Standard	Palmitic acid	13.43	-	-
	Linoleic acid	15.85	-	-
	Oleic acid	15.94	-	-
	Stearic acid	16.28	-	-
	Arachidic acid	18.92	-	-
	Behenic acid	21.36	-	-
	Eicosenoic acid	23.76	-	-

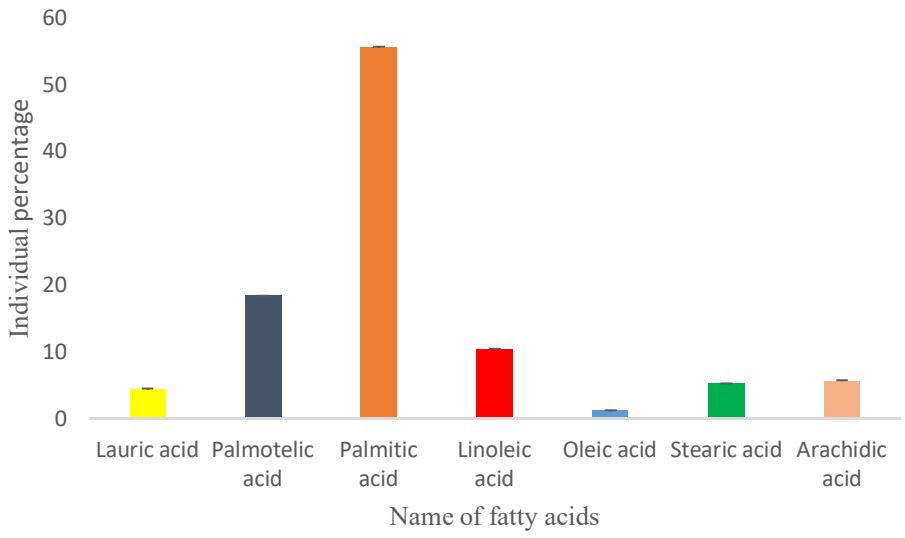

Fig 3. Bar chart of individual fatty acids in fish lipid with standard deviation

Table 2. Percentage and ratio of different classes of fatty acid in *Liza parsia*

Types of fatty acid	Percentage of fatty acid	Range
MUFAs	19.66 ±0.10	19.76~19.56
PUFAs	10.43 ±0.02	10.45~10.41
TUFAs	30.08 ±0.11	30.19~29.97
SFAs	69.85 ±0.05	69.90~69.80
MUFAs/SFAs	0.2814 ±0.0015	0.2829~0.2799
PUFAs/MUFAs	0.5304 ±0.0024	0.5328~0.5280
(PUFAs + MUFAs)/SFAs	0.4307 ±0.0016	0.4323~0.4291

MUFAs = Mono Unsaturated Fatty Acids, PUFAs = Poly Unsaturated Fatty Acids
TUFAs = Total Unsaturated Fatty Acids, SFAs = Saturated Fatty Acids

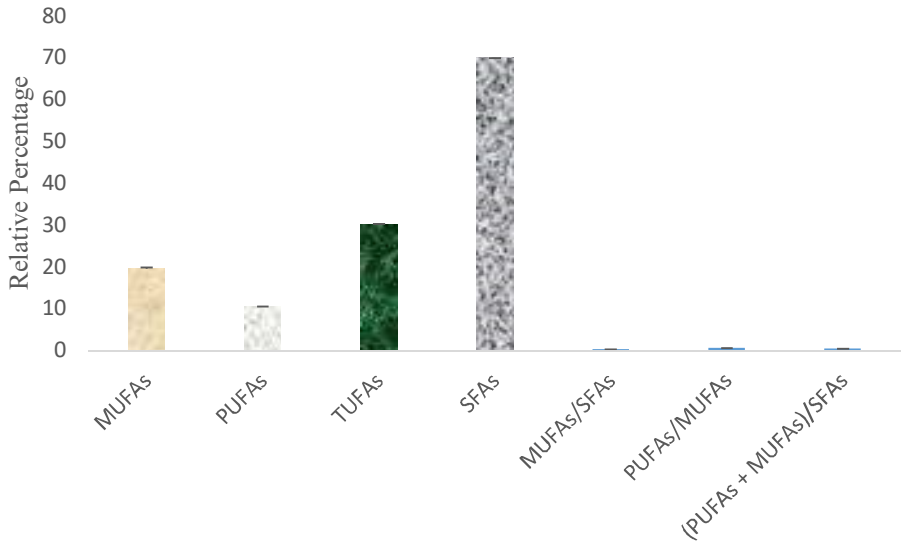

Fig 4. Relative percentage of different classes of fatty acids in *Liza parsia* with standard deviation

It has been shown that the lipid of fresh water fish has lower level of PUFAs. Data mentioned in the above **(Table 2)** showed that the percentage of SFAs in *Liza parsia* was higher than MUFAs and PUFAs. The differences were arisen from other fishes due to food habit. Generally, freshwater and brackish water fishes take up vegetables and fractions of plant. On the other hand, marine fish lives on zooplanktons that are enriched in PUFAs. Moreover, omega-6 fatty acids are available in fresh water fish than marine fish [23]. Our research supports the above statement due to finding a ω-6. This fatty acid lowers the level of low-density lipoprotein and triglyceride but it helps to increases high-density lipoprotein [3]. Degree of saturation of fatty acids and dietary cholesterol are main factors that govern plasma cholesterol. It has been known that PUFAs reduce plasma cholesterol and LDL whereas and SFAs raise plasma cholesterol and LDL levels in human and animal body. On the other hand, MUFAs like Oleic acid have no impact on plasma cholesterol. So, the ratio of PUFA/SFA is used to know the cholesterol emic effect about the dietary fat. When the ratio of PUFA/SFA is high severe hypo cholesterol emic effect is found. The most important criteria to control low plasma and liver Cholesterol are (1) lower ratio of MUFAs and SFAs (2) high ratio of PUFAs and MUFAs and (3) the ratio of PUFAs + MUFAs and SFA has to be 2 [24].

Table 3. Different chemical parameters of *Liza parsia* fish lipid

Name of Parameters	Value of parameters	Range
S.V. (mg KOH/g)	178.5± 0.22	178.72~178.28
A.V. (mg KOH/g)	12.75 ± 0.15	12.90~12.60
F.F.A. (%)	6.41 ± 0.20	6.61~6.21
I.V. (mg I_2/g)	113.67 ± 0.24	113.91~113.43
E.V. (mg KOH/g)	165.75 ± 0.19	165.94~165.56
R.M.V.	0	0
Percentage of glycerin	9.06 ± 0.08	9.14~8.98

S.V. = Saponification value, A.V. = Acid value, F.F.A. % = Percentage of free fatty acid, I.V. = Iodine value, E.V. = Ester value, R.M.V. = Reichert-Meissl value.

Iodine value, Saponification value, Percentage of FFA content, Acid value, Reichert-Meissl value have been shown **(Table 3)** above.

High iodine value is the indication of the presence of unsaturated fatty acid present in the fish lipid. Oxidation i.e. stability of oil depends on iodine value [25]**.** Iodine value of *Liza parsia* fish oil was found 113.67 ± 0.24 mg I_2/g. Iodine value of Ajiaji fish oil was found 110 mg I_2/g. This value supports the iodine value of *Liza parsia*. Moderate level of iodine value is due to moderate level of unsaturated fatty acids (PUFAs 10.43 ±0.02% and MUFAs 19.66 ±0.10 %) in *Liza parsia* fish oil [26]. Another study on shoul fish showed that iodine value of fish lipid was 110.85 mg I_2/g. For fresh water fishes, this value is high but comparatively lower for marine fishes. Iodine value is the measure of unsaturation of fatty acids in triglyceride molecule. Besides, rancidity of fish oil by oxidation depends on iodine value. Higher iodine value indicates the fish oil is very sensitive to oxidation and can be easily oxidized [9]. Iodine value for *Mugil cephalus* was determined as 125.92 mg I_2/g whereas the iodine value of *Liza parsia* was found 113.67 ± 0.24 mg I_2/g. These two values support the presence of moderate percentage of unsaturated fatty acids in these two species [11]. An investigation on Cuttle showed that iodine value of fish lipid was found 106.82 mg I_2/g. From this value, it can be predicted that fish lipid contains moderate level of unsaturated fatty acids [10].

Chain length of fatty acid can be known from saponification value. Saponification value of *Liza parsia* was found 178.5± 0.22mg KOH/g. From this data, it can be concluded that this fish contains high molecular weight fatty acids [11]. A research on Shoul fish showed that the saponification value of the fish oil was 146.94 mg KOH/g whereas 178.5± 0.22 mg KOH/g was for *Liza parsia* fish oil. The saponification value of Menhaden fish oil was 180.9 mg KOH/g. From this value, it can be predicted that both the species contain high molecular fatty acids [9]. Another research showed that the saponification value of *Mugil cephalus* fish lipid was 182.5 mg KOH/g. This value supports the found results in *Liza parsia* and indicates that the fish lipid abundant in higher molecular weight fatty acids [11]. Saponification value determines the average molecular weight of fatty acid in fish lipid. Low saponification value indicates the presence of long chain fatty acids in fish lipid due to lower number of carboxylic groups present per unit mass of fish lipid. Saponification value is inversely related to the average molecular weight of the fatty acid [10]. The found result points out that *Liza parsia* fish lipid has high molecular weight fatty acids. As the saponification value of *Liza parsia* has been compared with the saponification value of Aji-aji fish. This fish oil has showed higher saponification value (259.5 mg KOH/g) whereas saponification value of Menhaden fish oil is 180.9 mg KOH/g. The authors pointed out that Ajiaji fish lipid contained shorter chain fatty acid due to high saponification value. On the other hand, Manhaden oil contained longer chain fatty acid due to low saponification value compare to Ajiaji fish lipid. As the saponification value of *Liza parsia* and Manhaden was about same, *Liza parsia* contained higher chain fatty acids [26].

Acid value determines the presence of free fatty acids in fish lipid. Acid value of *Liza parsia* was found 12.75 ± 0.15 mg KOH/g. From this value, it can be predicted that percentage of FFA will be high [9]. Acid value of Aji-aji fish oil was 6.0 mg KOH/g whereas in Menhaden fish oil, it was found as 1.0 mg KOH/g. Acid value of *Mugil cephalus* fish lipid was found 2.83 mg KOH/g [11]. Lipid of shoul fish showed that acid value of the lipid was equal to 13.95 mg KOH/g. Acid value of Tilapia was found 6.72 mg KOH/g [9]. From the above observation, it can be said that acid value of *Liza parsia* is higher than others. Only shoul fish has similar acid value to *Liza parsia*. Higher value may be explained due to presence of impurities in fish lipid [26]. Besides, higher acid value may be arisen due to hydrolytic decomposition of the oil or fat. This fish oil is not suitable for edible purpose due to high acid value [10].

The percentage of free fatty acid was found to be equal 6.41 ± 0.20% that is very high than other fishes. The main sources of these fatty acids are the hydrolytic decomposition of fish lipid. Besides, the higher value of acid value shows that this lipid will not be used as edible purpose [10]. The percentage of free fatty acid of Aji-aji fish lipid was 3.0%. On the other hand, Menhaden fish lipid showed 0.5% [26]. Shoul fish lipid showed higher percentage of free fatty acid (7.01%) like *Liza parsia*. But the percentage of free fatty acid for Tilapia fish lipid was 3.38 % [9]. But *Mugil cephalus* showed lower level of percentage of free fatty acid and was found 1.26% [11]. Percentage of free fatty acid above 1.5% is not suitable for edible purpose [9]. From the above statement, it can be predicted that *Liza parsia* fish lipid is not suitable for edible purposes.

Reichert-Meissl value indicates the presence of volatile, water soluble and lower fatty acids in fish oil. R. M. value of the lipid of *Liza parsia* was equal to zero. This value revealed that volatile water soluble lower fatty acids were absent in this fish lipid. R. M. value for *Mugil cephalus* was found to be 0.92 that was higher than *Liza parsia* fish oil [11]. In Cuttle fish, Richert-Meissl value was equal to 0.91 [10]. From the saponification value, it has been showed that *Liza parsia* fish lipid contains higher molecular weight fatty acids. So, lower water soluble fatty acids are absent in this fish lipid.

Ester value is the measure of the amount of ester in fish lipid [10]. The ester value of *Liza parsia* was observed equal to 165.75 ± 0.19 mg KOH/g. Ester value of *Mugil cephalus* was found to be 179.67 mg KOH/g [11]. Ester value of *Liza parsia* fish lipid was not much differ from ester value of *Mugil cephalus*. If the ester

value of *Liza parsia* is compared with other fishes like ester value of *Metapenaeus brevicornis* (271.2 mg KOH/g). It can be said that this lipid contains moderate level of ester [10, 27].

CONCLUSION

The main purpose of this investigation was to analyze fatty acid composition of *Liza parsia*. Above study showed that this fish species contained different fatty acids. These fatty acids are very conducive to human health in various ways. Besides, estimation of chemical parameters characterized the quality of fish lipid.

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