

Species composition and fatty acid profile in family Leiognathidae sampled from west coast of Sri Lanka

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Introduction

Fish and sea food play a very important role in human food and nutrition. They provide high quality protein, vitamins, minerals, lipids and carbohydrates. It is also good source of readily digested high quality animal protein. It contains lysine and sulphur containing amino acids which complement cereal based diet (Edirisinghe *et.al.* 1998). Fish also rich in Sodium, Pottasium, Calcium, Zinc and Iron (Nettleton, 1985) . Generally fresh fish contain reasonable amounts of minerals but processed fish such as dried fish contain higher values. (Kinsella, 1998)

All fats can be divided into three categories such as saturated fatty acids, monounsaturated fatty acids and polyunsaturated fatty acids. The fatty acid found in fish oil is Omega 3 comes under the polyunsaturated group.

They are classed as essential fatty acids or EFA as the body cannot produce them itself, and has them from diet. The two most important types of the Omega 3 are, eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA). These essential nutrients are found in high quantities in oily fish such as Mackerel, Halibut Tuna, Herring, Trout Sardines and Salmon (Alison, J. *et.al* 2006). Omega -6 fatty acids are also considered essential fatty acids (EFA s), but cannot be made in the body. Together, Omega -3 and Omega -6 fatty acids play a crucial role in brain function as well as normal growth and development (Alison, J. 2004) .

Several studies have been conducted in the past decade concerning the possible beneficial health effects of Omega-3 fatty acids present in fish oils (Ackman, 1990; Duthie and Barlow, 1992; Vauy-Dagach and Valenzuela, 1992). This interest stemmed from the observation by Dyerberg and Bang (1982) that the incidence of cardiovascular disease is remarkably low in Eskimos compared to other people.

In recent times, information regarding fatty acid composition of fish is reported from all over the world. The fatty acid composition of sole, squid fish, herring, sable fish, cod, red fish, cappline, rockfish, cohosalmon and three species of mackerels was investigated. (Ackman, 1974). It was

investigated fatty acid composition of 12 species of fish from the Bay of Bengal (Yusuf et.al (1993), thirty- five Iceland fish (Sigurgisladottir & Palmadottir 1993) and 25 species of temperate fish and 4 species of invertebrates from Southern Australia.(Gilson 1983). In addition to these, the work of Ackman & Mcleod (1988), Kaitaranta (1980) and Low *et.al* (1994) also highlight the occurrence of Omega 3 fatty acids in fish.

More than 600 of marine species in around Sri Lanka and 80% of them are edible. The Chemical characteristics of some Sri Lankan fish species were recorded earlier. It was reported that the fatty acid composition of edible parts of ten marine fish species and three prawn species (Jayasinghe 1994) and twenty low value marine fish species (Edirisinghe *et.al* 1997). However, still there are gaps to be filled about information on the fatty acid composition of fish commonly available in Sri Lanka. It was reported that high levels of Omega -3 polyunsaturated fatty acids found in most of the small pelagics, Yellow stripe, scad, Dorab wolf herring, Spotted sardinella, Balcktip sardinella, Toothpony, White sardinella (Sudaya) (Edirisinghe *et.al.* 1998)

In Sri Lankan society, especially in the urban and rural sectors, consumption of fish is comparatively high compared to meat (Jayasinghe, J.A.G, *et.al* 1996). Although Sri Lankans consume a large quantity of fish, knowledge on health aspects of commonly eaten fish found in Sri Lankan waters is very limited. Scientific research conducted during last three decades revealed that most Sri Lankan traditional food habits are highly favorable for human health. Fish is considered as major component of traditional Sri Lankan meal.

Pony fishes belong to the family leiognathidae with three genera namely; Leiognathus, Gazza and Secutor. Pony fishes are also known as Silverbellies or Slip mouths throughout the world. The species of this family are bioluminescent fishes and inhabit the coastal waters and brackish waters around Sri Lanka, contributing a considerable amount to the fishery. The species of this family are widespread in the tropical Indo- Pacific region, ranging from South east Asia, through the Indian sub continent and to East Africa. These fishes are commonly caught with bottom trawls as well as with beach seines, gill nets and other artisanal gears. Some are found dense schools and may constitute a major component of the catch especially along the coasts of India and Sri Lanka. These fishes are most commonly marketed dried salted and large species are popular as food fish in Sri Lanka. Among the different species of fish belong to family Leiognathidae were highly recommended traditionally to be used for curing properties, therefore this study was carried out to identify different species in family Leiognathidae and investigated the fatty acid composition of these species in west coast of Sri Lanka.

Materials and methods

Fish samples were collected from selected landing sites (Beruwala, Panadura, Wadduwa) and fish marketing sites (Pettah, Kesbewa, Horana) in western province once in two weeks. These fish samples were packed in polythene and were immediately transferred to the Zoology laboratory of the Open University of Sri Lanka and the samples were kept in a freezer at -18 °C until use.

A set of three fish samples from each species was taken for the analysis. The amount of lipids present in the whole fish was extracted and determined by modified Bligh & Dyer method. The methyl esters of fatty acid were analysed by Gas chromatography on the Gas chromatograph (supelco wax 10) , the temperature of injector and detector 250⁰C the oven was first maintained at 190 ⁰C and then programmed to 220⁰C at the rate of 5⁰C / minute .

Selected most available species in this family and analysed fatty acid profiles in different age groups.

Results

1.

Thirteen species were identified in family leiognathidae in west coast of Sri Lanka. Three genera were identified; Leiognathus, Gazza and secutor



Leiognathus



Gazza



Secutor

Species composition in family Leiognathidae

1. *Gazza achlamys* (Naked tooth pony)



Body deep, compressed ventral profile equal to or slightly more convex than dorsal. Colour is bluish dorsally, brilliant silvery-white ventrally; vertical broad but irregular dark wavy bands above lateral line.

2. *Gazza minuta*



Body elongate oval to oval.

Compressed and ventral profile almost equally.

Colour ; Body bluish dorsally, brilliant silvery-white ventrally Mouth protractile with caniniform teeth.

3. *Leiognathus equulus*

(common pony fish)



Body extremely deep, compressed; dorsal profile more convex than ventral

Colour; Body blue –grayish silver dorsally, brilliant silvery-white ventrally , snout with black blotch.

Caudal fin yellowish with an indistinct broad dusky margin.

4. *Leiognathus splendens*



Body very deep ,compressed, dorsal profile more convex than ventral. Snout with black blotch. Dorsal fin membranes between second and fifth spines black.

5.*Leiognathus brevirostris*



Dorsal and ventral profile equal Brown vertical bands on back and a dark saddle on the nape.

6.*Leiognathus faciatus*



Deep bodied and vertical dark bars on upper sides . Long filament on dorsal spine. Silvery body

7.*Leiognathus leuciscus*



Body compressed and rather elongate. Second dorsal spine distinctly elongated. Second anal spine slightly elongate

8. *Leiognathus lineolatus*



Body slightly elongated and silvery colour . Dorsal side with irregular margins.

9. *Leiognathus daura* Goldstripe pony fish



Body silvery . lateral line with gold stripe . Dorsal fin end black blotch.

10. *Leiognathus dussumieri*

Body silvery colour . Dark bars on the upper side . Snout with black blotch.



11. *Secutor ruconius*



Body strongly compressed and deep. Mouth pointing upward when protracted lateral line ending about middle of soft part of dorsal fin.

12. *Secutor insidiator*



Body oval and compressed. Mouth pointing upward when protracted.

13. *Leiognathus bindus*



Silvery body . Snout with dark band. Dorsal and anal fins with orange tips.

Table 01 Ffatty acid profile different species in family Leignathidae

Fatty acids	<i>L.brevirostris</i>	<i>S.ruconius</i>	<i>L.daura</i>	<i>L.lineolatus</i>	<i>L.dussumieri</i>	<i>L.equulus</i>	<i>Gazza minuta</i>	<i>L.leuciscus</i>	<i>L.splendens</i>	<i>S. insidiator</i>	<i>G. achlamys</i>	<i>L. Faciatus</i>
C14:0	1.8	3.8	3	1.7	5.3	4.1	1	3.3	2.5	2.8	1	3.8
C15:0	0.7	0.5	0.5	0.5	1	1.2	0.2	0.8	4.3	0.3	0.1	1.1
C16:0	13.8	11.1	12.7	8.6	22.6	21.7	8.7	23.7	21	10.9	8.2	20.1
C16:1	3.1	4.2	4.7	2.5	6	4.5	1.3	4	5.9	3.2	1.2	4.3
C17:0	0.9	0.6	0.9	0.6	1.8	1.6	0.3	1	4	0.7	0.3	1.6
C18:0	5.8	4.7	6.7	4.5	12.2	8.5	3.5	10.5	11.4	3.8	4.5	6.3
C18:1	7	3.6	7.4	3.4	11.1	9.5	3.9	10.2	9.3	3.7	3.7	3.9
C18:2n-6	0.5	0.5	0.5	0.5	0.9	1.6	0.4	1.1	1.2	0.5	0.35	0.3
C18:3n-3	0.3	0.4	0.1	0.3	0.3	0.9	0.2	0.4	0.5	0.3	0.2	0.2
C18:4n-3	0.1	0.4	0.2	0.3	0.8	0.5	0	0.3	0	0.3	0	0.4
C20:1	1.3	0	0.5	0.1	1.7	0.5	0	0.4	1	0.1	0.1	0.4
C20:2n-6	0.3	0.1	0.2	0.1	0.5	0.7	5.9	0.3	0	0.2	4.8	5.3
C20:3n-6	4.6	8.6	5.1	5.6	0.4	1.8	0	0	0.8	7.5	0	0.5
C20:4n-6	1.4	1	2.2	1.5	2.6	1.6	1.3	4.2	4.4	1.2	1.3	1.5
C20:3n--3	0.4	0.2	0.3	0.2	0	0	0.2	0.1	0	0.2	0.1	0
C20:4n-3	0.1	0.2	0.2	0.1	0	0.4	0.1	0.5	0.5	0.2	0.1	0.4
C20:5n-3	1.9	5	6.3	4.4	8.2	5.3	1.5	4.8	4.3	4.8	1.4	5.1
C22:1	0.4	0	0.4	0	0.5	0	0	0	0.5	0.4	0	0
C21:5n-3	31.4	27.2	21	31.3	0.4	10.2	51.9	0.2	0.7	25.1	49.3	9.6
C22:4n-6	0.5	1	1.2	0.8	0.9	1.6	0	2.2	1.1	0.5	0	1.2
C22:5n-6	0.6	0.6	0.5	0.3	0	0	0	0	0	0.4	0	0
C22:5n-3	3	3.5	3.9	5.5	2.8	2.2	2.8	2.6	2.1	2.9	2.5	2.2
C22:6n-3	2.8	5.8	3.2	9.6	8.8	5.8	6	22.2	5.9	4.8	5.9	5.4

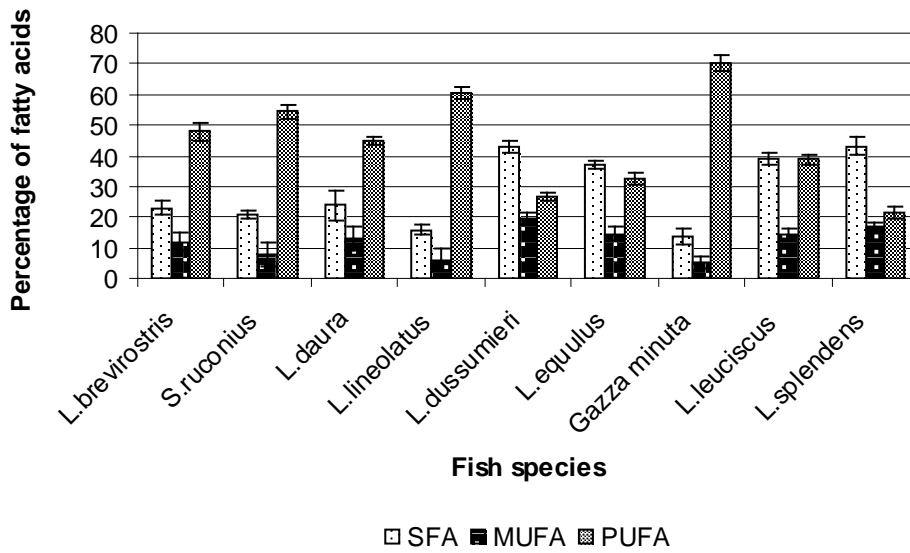


Figure 1: Fatty acid profiles in different species in family Leiognathidae

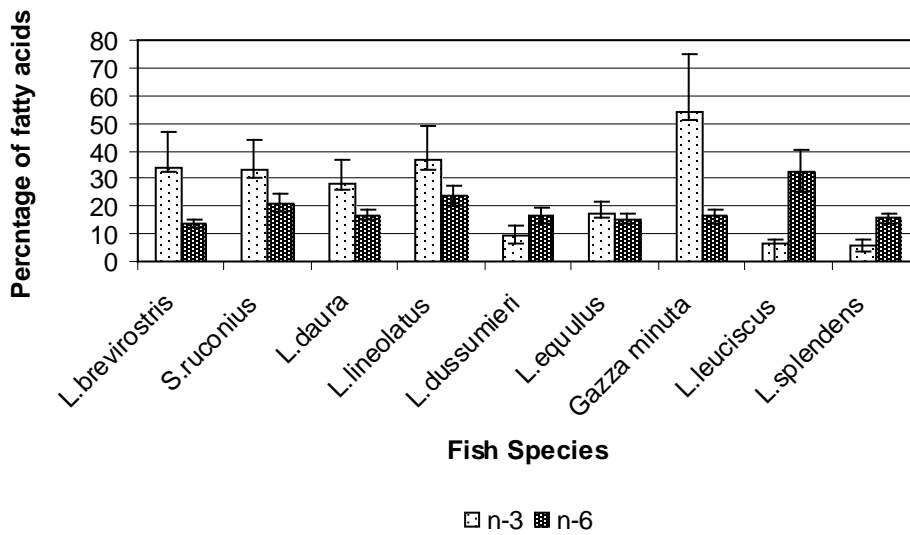


Figure 2- Omega -3 and omega-6 fatty acids found in different species family Leiognathidae.

Table 2 Fatty acid profiles in different age groups in most available species

	<i>Gazza minuta</i>			<i>L.dusumieri</i>	
	11-13cm	10-11cm	8-9 cm	11-13 cm	7-8cm
C14:0	1	3.4	1.8	5.4	5.8
C15:0	0.2	0.9	0.6	0.8	1.6
C16:0	8.7	23.6	14.3	23.8	23.8
C17:0	0.3	1.3	2.5	1.2	1.7
C18:0	3.5	11.7	11.6	12	11.5
	13.7	40.9	30.8	43.2	44.4
	3.589289623	9.661107597	6.308169307	9.597291285	9.266984407
C16:1	1.3	3.8	3.2	5.6	7.3
C18:1	3.9	9.8	9.9	13.8	10.7
C20:1	0	0.4	0.6	2.1	0.5
C22:1	0	0.1	17.3	0.6	0.3
	5.2	14.1	31	22.1	18.8
	1.838477631	4.507308879	7.47551559	5.901059227	5.15622601
C18:2n-6	0.4	1.3	1.5	0.6	1
C18:3n-3	0.2	0.5	0.3	0.2	0.5
C18:4n-3	0	0.4	0.3	0.6	0.5
C20:2n-6	5.9	0	0.8	0.4	0.4
C20:3n-6	0	4	2.7	0	0
C20:4n-6	1.3	0.1	0	4	2.8
C20:3n--3	0.2	0.5	0.2	0	0.1
C20:4n-3	0.1	5.1	2.8	0	0.5
C20:5n-3	1.5	0.3	0	6.4	6.3
C21:5n-3	51.9	2	0.6	0.4	0.6
C22:4n-6	0	0	0	0.9	1
C22:5n-6	0	2.2	2.3	0	1.2
C22:5n-3	2.8	20.5	7.3	3.3	2.4
C22:6n-3	6	6.6	16.4	5.4	8.1
	70.3	43.5	35.2	22.2	25.4
	13.65352468	5.420397982	4.451768386	2.213544718	2.442211212

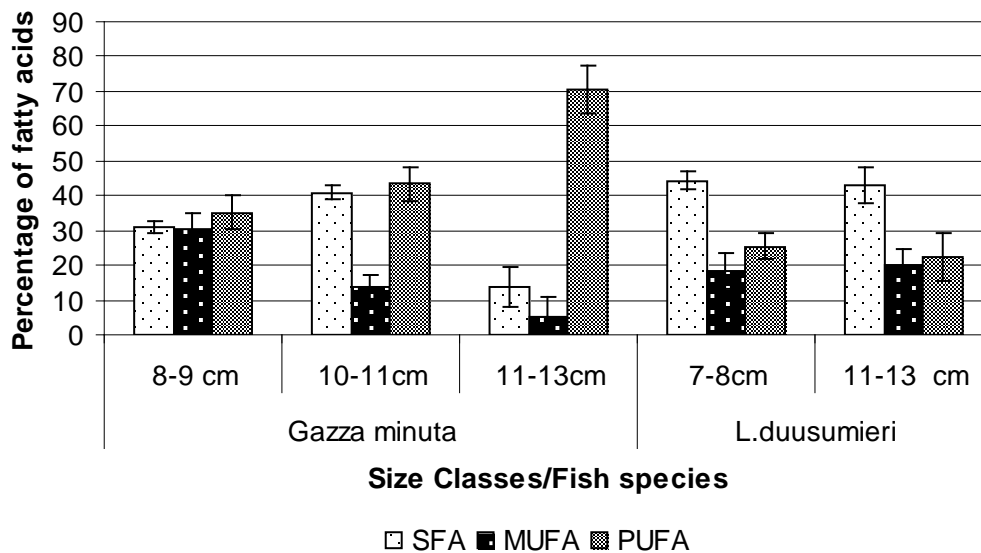


Figure3 – Fatty acid profiles in different size classes in two species in family Leignathidae

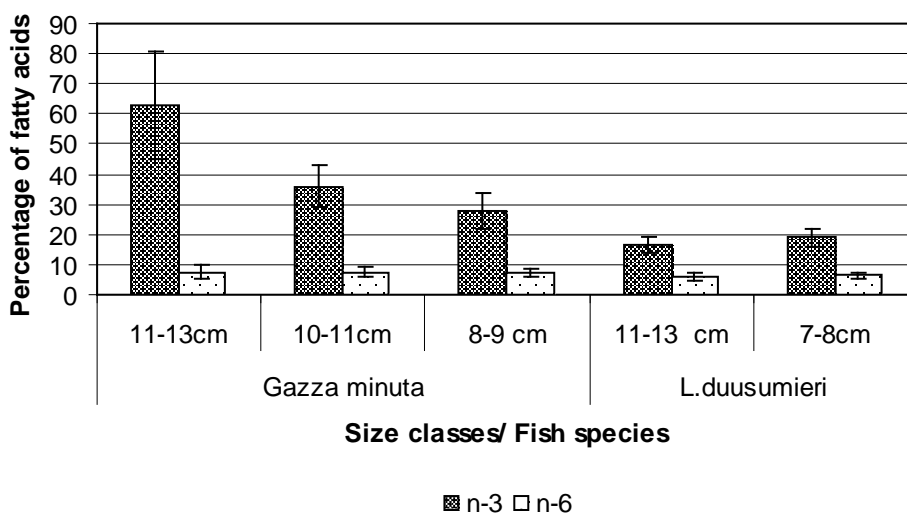


Figure 4- Omega-3 and Omega -6 fatty acids found in two species, *Gazza minuta* and *L. dussumieri*

Fatty acid composition

It was observed that the fatty acid composition in species in family Leiognathidae, the most abundant fatty acids were Myristic (C14), Palmitic acid (C16) Palmitoleic acid (C16:1), Stearic acid (C18), Oleic acid (C18:1), Linolenic acid (C20:3n-6), Arachidonic acid (C20:4n-6), eicosapentaenoic acid (C20:5n-3)(EPA), Heneicosapentaenoic acid (C21:5n-3), Docosapentaenoic acid (C22:5n-3) and Docosahexaenoic acid (DHA).(Table 1)

Saturated fatty acid

Saturated fatty acids contributed to the major part of the fatty acid profile. Saturated fatty acid group consist of myristic acid (C14:0), pentadecanoic acid (C15:0), palmitic acid (C16:0), heptadecanoic acid (C17:0), stearic acid (C18:0). Palmitic acid was predominant in all species in family leiognathidae. Myristic acid and stearic acid also contributed to a considerable proportion but the contribution from pentadecanoic acid (C15) and heptadecanoic acid (C17:0) was comparatively low. The highest saturated fatty acids were recorded in *L. dussumieri*, *L. equulus*, *L. daura*, *L. leuciscus* and *L. splendens*. *Gazza minuta* was recorded the lowest amount of saturated fatty acids. (Fig .2)

It has observed different size classes in two species, *Gazza minuta* and *L. dussumieri*, the highest saturated fatty acid content was recorded in 7-8cm size class in *L. dussumieri*. Both species in 11- 13 cm size class, they are sexually matured but saturated fatty acid content was high in *L.dussumieri*. (Fig 3)

Monounsaturated fatty acids

Mono unsaturated fatty acids consisted mainly of palmitoleic acid (C16:1) and oleic acid (C18:1) and minor quantities of myristoleic acid (C14:1), eicosenoic acid (C20:1) erucateic acid (C22:1) and nervoneic acid (C24:1). Present study, it has shown C16:1 and C18:1 monounsaturated fatty acids were recorded in all species in family leiognathidae. The highest mono unsaturated fatty acid content was recorded in *L.dussumieri* and the lowest value was recorded in *Gazza minuta* .(Fig.1)

It was observed that the highest monounsaturated fatty acids were recorded in, size classes 11-13cm and 7-8cm in *L.dussumieri*. The lowest monounsaturated fatty acids were recorded in size class 11-13 cm in *Gazza minuta*.(Fig.3)

Poly unsaturated fatty acids

Poly unsaturated fatty acids mainly consisted two types i.e omega 3 and omega 6. Among the species studied the highest poly unsaturated fatty acids content were observed in *Gazza minuta* and the lowest in *L.dussumieri*. (Fig.2) According to the size classes in two species, it has observed high poly unsaturated

fatty acid content in all different size classes in *Gazza minuta* but low values were observed in all size classes in *L. dussumieri*.

EPA and DHA content

The omega 3 poly unsaturated fatty acids mainly consist of C18:4n-3, C20:4n-3, eicosapentanoic acid (EPA) (C 20:5n-3), docosapentaenoic acid (C22:5n-3) and docohexaenoic acid (DHA) (C22:6n-3). The highest percentage of EPA (8.2%) was recorded in *L.dussumieri* and the lowest value (1.5%) was recorded in *Gazza minuta*..(Fig.2)

Docohexanoic acid content was greater than eicosapentanoic acid in all species except *L.daura*. The highest DHA value was recorded for *L. leucissus* and the lowest value was recorded for *L.brevirostris*. The highest heneicosapentaenoic acid (C21:5n-3) was recorded for *Gazza minuta* and lowest value was recorded for *L.dussumieri*). The omega 6 fatty acids consist of C18:2n-6, C20:2n-6, C20:3n-6 (linolenic acid), C20:4n-6 (arachidonic acid), C22:4n-6 and C22: 5n-6. High linolenic acid content (C20:3n-6) was observed in *L.brevirostris*, *S. ruconius*, *L.daura*, and *L.lineolatus* and trace amounts were observed for other species in family leiognathidae. Among the size classes in *Gazza minuta* and *L.dussumieri* high EPA values were recorded in all size classes in *L.dussumieri*. The highest docopentaenoic acid was recorded for size class 10-11cm in *Gazza minuta* and the lowest was recorded 7-8 cm in *L.dussumieri* High docohexaenoic acid content was recorded for size class 8-9 cm in *Gazza minuta* .

Discussion

Main saturated fatty acids in Sri Lankan fish oils, contains Palmitic, Stearic and myristic acids. It was seen that Palmitic acid was the main saturated fatty acid in family Leiognathidae followed by Stearic acid myristic acid. According to the results saturated fatty acids in family Leiognathidae contains with Palmitic acid and Stearic acid. Gopakumar *et.al* (1972) and Jayasingha *et.al* (1996) have also shown that the tropical fish oils relatively saturated and the present results agree with them. It was observed that arachidonic acid (20:4n-6) is a major component of the fish oil but present study it has been shown that the low levels, of n-6 found in the species of leiognathidae except *L.dussumieri* , *L. leuciscus* and *L.splendens*. Jayasinghe *et.al* (1996) has reported trace amounts of 22:4n-6 have been found in most commercial species of fish in the cold waters of the Northern hemisphere. They also reported shark also contained a relatively higher level of 22:5n-6. Seer had the least content of archidonic acid. The (n-3) acids (20:5n, 22:5n, 22:6n, 21:5n) were present in high concentrations in most of the fish oil samples examined. In all samples except *L. dussumieri*, *L. leuciscus* and *L splendens*, heneicosapentaenoic acid (21:5n-3) was the predominant n-3 acid followed by 20:5n-3 and 22:5n-3. Larsen *et.al* (1997) has reported that heneicosapentaenoic acid (C21:5n-3) (HPA), present in small amounts in fish oil. Other n-3 fatty acid (C18:3, C18:4, C20:3) were relatively minor. It has been shown that fatty acid profiles in different size classes in species, *Gazza minuta* and *L. dussumieri*. According to the results Palmitic acid is the main saturated fatty acid in all different size classes in these two species. Archidonic acid is low in both size classes in *L.dussumieri* but it was high in all different classes in *Gazza minuta*. Among n-3 fatty acid, C20:5n-3 is high in all size classes in *L. dussumieri* but it was a low

value in all size classes *Gazza minuta*. C21:5n-3 fatty acid is a predominant value in size class 11-13cm in *Gazza minuta*. Compared with Age classes (10-11cm) in *Gazza minuta* and *L. dussumieri*, *Gazza minuta* has shown predominant value for C22:5n-3 fatty acid. C22:6n, n-3 fatty acid in age class (8-9 cm) in these two species *Gazza minuta* is higher than *L. dussumieri*. According to the present results saturated fatty acids are slightly higher than the monounsaturated acids in these different species in family leiognathidae. And also *Gazza minuta* is very rich in n-3 fatty acids in family Leiognathidae. Finally we can assumed that fatty acid content in fish oil depend on maturity, sex, season, and varieties.

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