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FATTY ACID COMPOSITION IN SIX FRESHWATER FISHES COLLECTED FROM RIVERS, BEELS AND PONDS OF MORIGAON DISTRICT, ASSAM, INDIA

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***Abstract*: The present study evaluated fatty acid profile of six fish muscles collected from different freshwater sources like rivers, beels and ponds to determine the composition of lauric acid (C12:0), palmitic acid (C16:0), stearic acid (C18:0), oleic acid (C18:1n-9), linoleic acid (C18:2n-9), arachidonic acid (C20:4n-6), eicosapentaenoic acid (C20:5n-3, EPA) and docosahexaenoic acid (C22:6n-3, DHA). Sampled freshwater fishes include *Eutropiichthys vacha, Aorichthys seenghala, Wallagu attu, Anabas testudineus, Clarias batrachus* and *Heteropneustes fossilis* were collected from different habitats but all were carnivorous. The results showed that the fatty acid contents in *E.vacha* (12.477%) and *A.seenghala* (12.183%) collected from the rivers were higher, followed by *W.attu* (11.997%) and *A.testudineus* (11.722%) collected from beels and *H.fossilis* (11.291%) and *C.batrachus* (11.186%) collected from ponds. The most abundant fatty acids were oleic acid (28.15±7.91 to 32.10±4.13%) followed by palmitic acid (27.40±4.55 to 29.22±5.02%), docosahexaenoic acid (9.23±2.70 to 11.30±0.47%), eicosapentaenoic acid (7.90±0.94 to 9.70±0.76%), linoleic acid (7.68±2.87 to 9.00±0.96%), stearic acid (5.60±2.27 to 8.70±3.31%), arachidonic acid (0.90±0.38 to 2.00±1.18%) and lauric acid (0.03±0.02 to 0.30±0.11%) in all the studied riverine, beel and pond fishes. The predominant fatty acids in the evaluated fishes were oleic acid (unsaturated fatty acid), palmitic acid (saturated fatty acid), stearic acid (saturated fatty acid) and lauric acid (saturated fatty acid). The major omega-3 fatty acids (EPA and DHA) were higher than omega-6 fatty acids (linoleic acid and arachidonic acid) in the studied fish muscles. These data revealed that fishes were good source of fatty acids whether fishes are collected from rivers or beels or ponds. It may also be said that fatty acid compositions significantly varied from fish to fish, collected from different habitats. So, the goal of these studies was to find out the differences among fatty acid compositions of fishes collected from different aquatic environments (rivers, beels and ponds).**

***Keywords*: Fatty acid compositions, Six freshwater fishes, Variations, Collected from Rivers, Beels, Ponds.**

1. INTRODUCTION

Fatty acids mainly occur in esterifies form as major constituents of various lipids. Fatty acids of animal origin are much simpler in structure in contrast to those of plant origin. Monounsaturated fats are considered as healthy fats especially when substituted for saturated fats and polyunsaturated fats are usually liquid at room temperature and are referred to as oils, generally used by humans. Fatty acids are required for the membrane structure and function, transport of cholesterol, formation of lipoprotein, prevention of fatty liver as well as being important energy sources. Fats are ingested into the body and stored in the liver, hypodermic connective tissues, mesentery and muscles and used when necessary for the body. Fish lipids are rich source of omega-3 and omega-6 fatty acids besides other fatty acids. According to Ozogul *et al.* (2007), Luczynska *et al.* (2008), Diraman and Dibeklioglu (2009) and Ridzwan Hashim *et al.* (2015) fishes are good source of polyunsaturated fatty acids. These fish species contain different fatty acids for promoting good health, prevention and healing of diseases in humans. There are a few reports (Punstinen *et al.*, 1985; Abd Rahman *et al.*, 1995;

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Okkes *et al.*, 1996) on the variations of fatty acid composition in fishes of different freshwaters. No attention had been given to evaluate the variation of fatty acids among freshwater fishes living in different habitats. Therefore, six commercially important species (normally consumed by the people of North-Eastern-Region of India) of freshwater fishes, two species from two different rivers, two species from two different beels and another two fishes from two different ponds were chosen and collected as samples for the study.

2. MATERIALS AND METHODS

Samples collection: Eighteen healthy and fresh fish species belonging to different freshwater families with similar feeding habits (carnivorous) were collected. Matured *E.vacha* (collected from Brahmaputra River), *A.seenghala* (collected from Sonai River), *W.attu* (collected from Charon beel), *A.testudineus* (collected from Dandua beel), *C.batrachus* (collected from Natural pond) and *H.fossilis* (collected from Manmade pond) were then washed with 1.5% $KMnO_4$ solution, acclimated to laboratory conditions for 24 hours. Muscles (without skin and alimentary canal) were excised from the six acclimated fishes and then transported to the laboratory on ice (0^0C) for fatty acids analysis. Six samples represented from six locations were randomly collected (each sample in triplicate) during the period of November and December/2018.

Lipid extraction: Muscle samples of fresh fishes from *E.vacha, A.seenghala, W.attu, A.testudineus, C. batrachus and H.fossilis* were analyzed. Lipids were extracted from fish flesh following the methodology of Berg and Nilsson (1997). The fats necessary for fatty acids analysis were prepared by using cold extraction method of Folch *et al.* (1959) as described by Christie (1973) using Chloroform: Methanol (2:1) mixture. The fatty acid methyl esters were prepared by a mixture of Chloroform: Methanol: Sulphuric acid (100:100:1, v/v) following the methods of Zegarska *et al*. (1991). The identification and quantification of fatty acids were done using Gas Chromatography (AOAC).

Statistical analysis: The data on fatty acids collected from six freshwater fishes were subjected to one-way analysis of variance (ANOVA). Takey's test was followed to determine the differences among the means of fatty acids (between riverine fish and beel fish, beel fish and pond fish) at 0.05% level of significance.

3. RESULTS

In all the fish examined, the most abundant fatty acids were lauric, palmitic, stearic, oleic, linoleic, arachidonic, eicosapentaenoic and docosahexaenoic. These data revealed that freshwater fishes were good source of fatty acids. The human body cannot synthesize certain fatty acids which are consumed from fishes along with diet. The nutrients in fish are very important for human health but are easily obtained from fishes. Fatty acids particularly polyunsaturated fatty acids play an important role in human health to prevent some disorders like hypertension, diabetes, etc. So, many investigations have been carried out to investigate the nutritional values of fishes. Most of the studies showed that there were no significant differences among fishes in terms of different freshwater medium and nutritional composition.

Fatty acids	**Brahmaputra River**	**Charon Beel**	**Natural Pond**
	Eutropichthys Vacha	***Wallagu attu***	***Heteropneustes fossilis***
(C12:0) Lauric acid (%)	**0.30±0.11**	**0.11±0.05**	**0.08±0.03**
(C16:0) Palmitic acid (%)	**29.22±5.02****	**28.50±7.47****	**27.40±4.55****
(C18:0) Stearic acid (%)	**6.90±4.35****	**6.85±3.84***	**6.74±3.57***
(C18:1n-9) Oleic acid (%)	**32.10±4.13****	**31.10±5.62****	**28.15±7.91****
(C18:2n-6) Linoleic acid (%)	**8.20±0.62**	**8.01±1.14**	**7.90±0.76**
(C20:4n-6) Arachidonic acid (%)	**2.0±1.18**	**1.30±0.91**	**0.90±0.38**
(C20:5n-3) Eicosapentaenoic acid (%) or EPA	**9.70±0.76**	**9.38±2.12**	**8.82±1.45**
(C22:6n-3) Docosahexaenoic acid (%)or DHA	**11.30±0.47**	**10.73±1.87**	**10.34±2.56**

Table-1: Fatty acid (%) composition in the three freshwater fishes collected from Brahmaputra river, Charon beel and Natural pond; values are Mean±SD of five replicates; * indicates significant; indicates highly significant (at 0.05% level).**

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The evaluation of fatty acid composition in six freshwater fishes had indicated variations among species and locations. Generally, oleic acid and palmitic acid recorded highest followed by docosahexaenoic acid (DHA), eicosapentaenoic acid (EPA), linoleic acid, stearic acid, arachidonic acid and lauric acid (Table-1 and 2). The content of **oleic acid** in *E.vacha* (32.10±4.13%) and *A.seenghala* (31.12±6.87%) was significantly higher than the other fish examined whereas the lowest value of this acid was recorded in *H.fossilis* (28.15±7.91%) and in *C.batrachus* (29.80±4.33%). **Palmitic acid** revealed highest in *E.vacha* (29.22±5.02%), *A.seenghala* (28.30±4.78%) while lowest in *C.batrachus* (27.82±4.35%) and in *H.fossilis* (27.40±4.55%).

Fatty acids	**Sonai River**	**Dandua Beel**	**Man made Pond**
	Aorichthys seenghala	***Anabas testudineus***	***Clarias batrachus***
(C12:0) Lauric acid (%)	**0.23±0.12**	**0.17±0.08**	**0.03±0.02**
(C16:0) Palmitic acid (%)	**28.30±4.78****	**28.20±5.01****	**27.82±4.35****
(C18:0) Stearic acid (%)	**8.70±3.31***	**7.17±3.94***	**5.60±2.27**
(C18:1n-9) Oleic acid (%)	**31.12±6.87****	**30.00±5.71****	**29.80±4.33****
(C18:2n-6) Linoleic acid (%)	**9.00±0.96**	**8.90±1.66**	**7.68±2.87**
(C20:4n-6) Arachidonic acid (%)	**1.90±0.45**	**1.72±0.35**	**1.55±0.71**
(C20:5n-3) Eicosapentaenoic acid (%) or EPA	**8.50±2.23**	**8.14±2.66**	**7.90±0.94**
(C22:6n-3) Docosahexaenoic acid (%) or DHA	**9.71±0.84**	**9.47±1.79**	**9.23±2.70**

Table-2: Fatty acid (%) composition in the three freshwater fishes collected from Sonai river, Dandua beel and Manmade pond; values are Mean±SD of five replicates;* indicates significant;indicates highly significant (at 0.05% level).**

In the present study, lowest values of **lauric acid** (ranged from 0.03±0.02 to 0.30±0.11%) were recorded in all the six fishes. But the content of **stearic acid** (ranged from 5.60±2.27 to 8.70±3.31%) was recorded higher in all the six studied fishes. All fishes demonstrated with higher **DHA** (ranged from 9.23±2.70 to 11.30±0.47%) and **EPA** (ranged from 7.90±0.94 to 9.70±0.76%) and are good suppliers of omega-3 fatty acids. It is also seen that the percentage of omega-3 and omega-6 fatty acids were recorded highest in riverine fishes than beel or pond fishes (Table-1 and 2). The content of **linoleic acid** in *E.vacha* (8.20±0.62%) and *A.seenghala* (9.00±0.96%) and the lowest content were noted in *C.batrachus* (7.68±2.87%) and *H.fossilis* (7.90±0.76%). In this study, lowest values of **arachidonic acid** (0.90±0.38% in *H.fossilis*, 1.30±0.91% in *W.attu*, 1.55±0.71% in *C.batrachus*, 1.72±0.35% in *A.testudineus*, 1.90±0.45% in *A.seenghala* and 2.0±1.18% in *E.vacha*) was recorded. The differences in the percentage of oleic acid and palmitic acid were statistically highly significant to each other but omega-3 or omega-6 fatty acids in beel and pond fishes were not statistically significant (at 5% level).

4. DISCUSSIONS

Oleic acid and palmitic acid presented as major fatty acids, higher in both riverine fishes. Oleic acid and Palmitic acid found highest in *E.vacha* and *A.seenghala* which is in agreement with the work of Ho and Paul (2009) in Tra catfish. Suloma *et al.* (2008) and Osibona (2011) both studied on fatty acids in Tilapia and Catfish also found that oleic acid and palmitic acid were dominant among different fatty acids. The results of oleic acid and palmitic acid in Flounder recorded by Kolakowska *et al.* (2000) were close to those measured in the present study. The present study on six carnivorous freshwater fishes suggested that fatty acids vary between species to species and location to location or based on their diets. Drobna *et al.* (2006) found that polyunsaturated fatty acids in Rainbow Trout depended on diet but the content of fatty acids differ from species to species (Bienkiewicz *et al.* (2008). It is also supported by Hossain (2011) who worked on different farmed fishes. The highest amount of Omega-3 fatty acids in particularly EPA was found to range between 7.90±0.94% and 9.70±0.76%, while DHA ranged between 9.23±2.70% and 11.30±0.47%, which were higher than omega-6 fatty acids. Fishes collected from rivers showed high amount of EPA and DHA than beel and pond fishes, which is in agreement with the works of Ozogul *et al.* (2007). Hossain (2011) in his study on wild fishes also reported higher omega-3 fatty acids than the farmed fishes. DHA and EPA fatty acids in freshwater fishes were dominant among omega-3 fatty acids studied by Pirestani *et al.* (2010) are also similar with the present work.

5. CONCLUSION

Oleic acid and palmitic acid were the dominant fatty acids followed by docosahexaenoic acid, eicosapentaenoic acid, linoleic acid, stearic acid, arachidonic acid and lauric acid. The results obtained in the study on the fatty acid compositions of six different freshwater fish species that were collected from rivers, beels and ponds or caught from their natural habitats offer intense observations of the study. All riverine fishes displayed higher fatty acids than beel fishes and pond fishes (Table-1 and 2). It may be concluded that fatty acid compositions substantially vary due to the differences in their freshwater habitats and diets. The most important causes of variations in the fatty acid compositions of fishes are the differences among species living in different ecological conditions like physico-chemical characteristics of water or soil and feeding behavior are the important sources of variation.

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