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Impact of Seasonal and Habitat variation on composition of Total Lipid content in Muscle and Liver of *Labeo gonius* (Ham)

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Abstract- Fish lipid is regarded as quality lipid being rich in cholesterol, triglyceride and essential fatty acids. The changes in habitat and seasonal variation have a significant impact on the quality and quantity of different components of lipid profile. The present paper reports on the seasonal differences in the quantitative compositions of total lipid of *Labeo gonius* in lotic and lentic habitats. These nutrients were determined in muscle and liver tissues in four different seasons of the year (pre-monsoon, monsoon, retreating monsoon and winter). In lotic habitat the highest amount of total lipid (301.00 ± 2.73mg/g) was observed in retreating monsoon in the muscle tissue . Similarly in liver tissue the highest amount of total lipid was observed in winter (208.50 ± 1.84mg/g). Though apparently similar trend was observed in lentic habitat, but some amount of differences with higher values were observed in muscle tissue. The present study with comparative analysis of total lipid components reveals a significant impact of habitat and seasonal variation on the nutritional quality of lipid in *Labeo gonius*.

Index Terms- *Labeo gonius*, lotic, lentic, nutrients, lipid

I. INTRODUCTION

Fish is one of the main sources of protein and fat and has become a healthier alternative to meat for the last fifty years. It stores the lipids in various organs particularly in muscle and liver. The lipids in fish muscle have received much attention as source of EPA and DHA fatty acids in human diets. Lipid and fatty acid composition of many marine fish and shell fish as well as the effect of different diets and factors on lipid compositions of various species have been investigated (Ackman and Takeuchi, 1986 ; Viswanathan and Gopakumar, 1984; Halver, 1980); Suzuki et al. (1986); Viola et al. (1988); Bieniarz et al. (2000) and observed some of the factors causing changes in the composition of fatty acids in various species.

The lipid in fish muscle can influence product quality through interaction with other components. Lipid composition of fish is of practical importance, particularly in relation to the effects of lipid components on deterioration during frozen storage and consumer acceptance. Information about lipid components and their fatty acid constituents is needed to prevent the oxidative or hydrolytic factors affecting the quality of fish. Buckley et al., (1989) also studied the lipid composition of *Heterotis niloticus*, *Brycenus nurse*, *Gnathonemus cyprinoids* and *Sarotherodon galilaeus* and reported the common neutral fats as cholesterol, free fatty acids and cholesterol esters and also diphosphatidyl glycerol, phosphatidyl glycerol and phosphatidyl ethanolamine as the most predominant phospholipids.

Takama et al. (1985) reported seasonal variation in fat deposition in Mackeral and Capelin with tissue variation. Stansby and Hall (1967) reported approximately 70% of fatty acids with four, five or six double bonds in lipids from freshwater fishes which is slightly lower than that of the marine fish (approximately 88%). Fish oils with polyunsaturated fatty acids are "essential" to prevent skin diseases and have neurological benefits in growing children. Recently Eicosapentaenoic acid has shown great importance because of its preventive role in arteriosclerosis. Simopoulos et al. (1991) reported that eicosapen-taenoic acid in the blood is an extremely potent antithrombotic factor. Some researchers reported the role of n-3 fatty acids in cancer treatment like breast tumours (El-Sayed et al., 1994). Lack of these essential fatty acids causes symptoms of slow growth, deformation of tail fin, faded and fatty liver, skin pigmentation and stress-shocked (Ackman and Eaton, 1976).

The freshwater fishes provide a great amount of nutrient food source for human. Presently, a large part of these fish species are in cultivated forms. Therefore, information about the chemical composition of various species and their nutritional properties, biochemical structure and habitat condition is greatly needed. Impact of seasonal variations on the lipids and the lipid amount of the fish for its economical importance is of utmost necessary. However, little is known about the variations in the lipid profile in local fish fauna. Therefore, the present study was aimed to investigate the impact of both the seasonal and habitat variations in the amount of total lipid in muscle and liver of *Labeo gonius*.

II. MATERIALS AND METHODS

The fishes were collected in Guwahati (Assam, India) from river Brahmaputra and nearby Lentic Habitat in different seasons of the year and were anaesthetised by applying diethyl-ether and then dissected to collect the muscle and liver tissue. The tissues were dried over a filter paper and immediately weighed and recorded. .

PREPARATION OF TISSUE SAMPLE

Little amount of propanol (0.5 ml) was added to the tissue and macerated to make the homogenate. The mixture was centrifuged

for 10 minutes. Supernatant was taken and then made the requisite volume as 10mg/ml.

The total lipid was estimated following the method of Frings and Dunn's modification for determination of tissue-total-lipid based on sulfophosphovanilline reaction.

TABLE I: Total Lipid (mg/g of tissue) content of Muscle & Liver tissues of *Labeo gonius* in different seasons under Lotic & Lentic habitats.

Total Lipid (mg/g of tissue)			Premonsoon	Monsoon	Retreating Monsoon	Winter
Muscle	Lotic	Mean	126.77	294.77	301.00	103.17
		SD±	20.19	49.69	12.22	5.15
		SEM±	4.52	11.12	2.73	1.52
	Lentic	Mean	97.5	146.3	82.6	43.2
		SD±	9.06	20.62	11.04	8.68
		SEM±	2.03	4.61	2.47	1.94
Liver	Lotic	Mean	127.5	74.51	63.23	208.50
		SD±	20.12	5.47	13.25	8.21
		SEM±	4.50	1.22	2.96	1.84
	Lentic	Mean	103.01	76.65	81.39	24.82
		SD±	11.43	8.10	8.72	3.37
		SEM±	2.56	1.81	1.95	0.75

TABLE II: Showing the significance of variation of total lipid in muscle and liver tissues of *Labeo gonius* in different seasons under two habitats (Lotic and Lentic).

Significance of Variation	**TISSUES**	**HABITATS**	Total Lipid	
			t	p
t-between Premonsoon and Monsoon	Muscle	Lotic	13.99	<0.001
		Lentic	9.68	<0.001
	Liver	Lotic	11.37	<0.001
		Lentic	8.42	<0.001
t-between Premonsoon and Retreating Monsoon	Muscle	Lotic	33.10	<0.001
		Lentic	4.66	<0.01
	Liver	Lotic	11.92	<0.001
		Lentic	6.71	<0.001
t-between Premonsoon and Winter	Muscle	Lotic	26.21	<0.001
		Lentic	19.00	<0.001
	Liver	Lotic	18.16	<0.001
		Lentic	10.99	<0.001
t-between Monsoon and Retreating Monsoon	Muscle	Lotic	0.54	>0.01
		Lentic	12.18	<0.001
	Liver	Lotic	3.53	<0.01
		Lentic	1.78	>0.01
t-between Monsoon and Winter	Muscle	Lotic	17.08	<0.001
		Lentic	20.62	<0.001
	Liver	Lotic	51.58	<0.001
		Lentic	26.46	<0.001
t-between Retreating Monsoon and Winter.	Muscle	Lotic	61.82	<0.001
		Lentic	12.55	<0.001
	Liver	Lotic	35.89	<0.001
		Lentic	27.07	<0.001

Table III: Showing the significance of variation of total lipid between lotic and lentic habitats in muscle and liver tissues of *Labeo gonius* in different seasons.

Tissue	t P df	Premonsoon	Monsoon	Retreating monsoon	Winter
Muscle	t	5.91	12.34	59.34	24.37
	p	<0.01	<0.001	<0.001	<0.001
	df	38	38	38	38
Liver	t	4.73	0.98	5.12	92.76
	p	<0.01	>0.01	<0.01	<0.001
	df	38	38	38	38

III. RESULTS AND DISCUSSION

Fishes show a marked seasonal variation in chemical composition. The lipid fraction is the component showing the greatest variation. West African shad (Ethmalosa dorsalis) shows a range in fat content of 2-7% (wet weight) over the year with a maximum in July (Watts, 1957). Corvina (Micropogon furnieri) and pescada-foguete (Marodon ancylodon) have a fat content range of 0.2-8.7% and 0.1-5.4% respectively (Ito and Watanabe, 1968). It has also been reported that the oil content of these species varies with size. Watanabe (1971) examined freshwater fish from Zambia and found a variation from 0.1-5.0% in oil content of four species including both pelagics and demersals.
Two to three folds of higher lipid content was reported in some cultured marine fishes than wild types (Cakli, 1994; Aoki et al. 1991; Funuyama et al. 1991; Nakagawa et al. 1991; Hatae et al. 1989). Kunisaki et al. (1986) showed 10-12 fold higher fat content in cultured horse mackerel than wild type. Dikel (1999) showed higher lipid content in fish grown in salt water (1.45%) than in freshwater (0.96%).

In the present study the amount of total lipid from Labeo gonius in four different seasons of the year under two habitat conditions was investigated and it was observed that the values of all the three components of lipid profile were significantly higher in the lotic habitat ($p<0.01$; Table:II and III). In the tissues of Labeo gonius the lipid contents were found to be affected by the seasonal variation and the habitat of the fish. Similar studies have also shown that lipid and fatty acid composition was influenced by seasonal variation (Agren et al., 1987; Dutta et al., 1985).

The present study also depicts that the variations of the levels of lipids both in the liver and muscle tissues may be the result of seasonal variation which affect the fish diet. Increased amount of total lipid content was observed in monsoon and retreating monsoon in both lotic and lentic habitat. At the same time, it was observed that the liver stores more amount of total lipid than that of the muscle; but this trend was not so prominent in monsoon and retreating monsoon. The variations may have resulted from different metabolic efficacies of these two tissues. The fish generally stores lipid in their liver and muscle tissues, but the fishes inactive or moderately active living at the bottom zone of water store their lipids in liver (Castell et al., 1972). In the present study Labeo gonius exhibited more amount of total lipid in muscle as it is a mid-column feeder which supports the findings of the previous workers.

Storage of lipids vary during breeding and nutrition period. In the breeding season the lipid mobilized from the liver and muscle for the development of gonads (Castell et al., 1972) and the results of the present investigation, the decrease in the amount of total lipid content of liver in monsoon and retreating monsoon (breeding season) in both lotic and lentic habitat justifies our results supporting the suggestions of the earlier workers. But in muscle tissue the picture is not clear, though in lentic habitat apparently low lipid content was observed in retreating monsoon and lowest content was found in winter season. In lotic habitat, more amount of lipid content was observed in muscle tissue in winter season but significantly lower values were observed in monsoon and retreating monsoon which agrees with the findings of the previous workers.

In the present investigation the highest amount of total lipid content in muscle tissue was observed in monsoon and retreating monsoon. In lotic habitat, however, in lentic habitat relatively higher mean values were observed in premonsoon and monsoon season (97.51±2.03; 146.3±4.61mg/g; Table:I). Habitat variation shows to have a significant impact on the lipid content of these particular tissue of *Labeo gonius.* In liver tissue highest amount of total lipid (208.50±1.84mg/g) was observed in winter season under lotic habitat with gradual decrease from premonsoon showing a minimum value of 63.23±2.96mg/g in retreating monsoon. However, the trend was found to be different in lentic habitat. The liver tissue possesses highest value in premonsoon and then gradual decrease with the advancement of season towards winter exhibiting a minimum of 24.82±0.75mg/g of total lipid. A significant variation from 103.01 to 24.82mg/g ($p<0.001$) was observed in liver lipid content in this particular freshwater fish from lentic habitat. However, in lotic habitat though the trend was similar, but highest lipid content was observed in winter. A drastic difference of lipid content in lotic and lentic habitat was an important observation of the present study. It may be noted that habitat condition and change of season have a significant impact on fat synthesis of the fish.

REFERENCES

[1] Ackman RG and Eaton CA (1976). Fatty acid composition of the decapod shrimp, pandulus borealis, in relation to that of the euphasiid, *Meganyctiphanes noruegica* . J. Fish. Res. Bd. Can., 33: 1634-1638.

[2] Ackman RG and Takeuchi RF (1986). Composition of FA and lipids of smolting hatchery fed and wild atlantic salmon (Salmo salar). Lipids 21:117.

[3] Aoki T, Takada K and Kunusaki N, (1991). On the study of proximate composition, mineral, fatty acid, free aminoacid, muscle partness and color difference of 6 species of wild and cultured fishes. Nippon suisan gakk. Published by Japanese Soc. Fish. Sci., 57 (10): 1927-1934.

[4] Argen J, Mute P, Hannmen O, Harranen J and Pentila I (1987). Seasonal variations of lipid fatty acids of Boreal freshwater fish species. Comp. Biochem. Physiol., 88B: 905-909.

[5] Bieniarz K, Koldras M, Kaminski J and Mejza T (2000). FA and cholesterol in some freshwater fish species in Poland. Folia Unniv. Agric Stetin 27:2-44.

[6] Buckley DJ, Gray JI, Ashar A, Price JF, Crackle RL, Booren AM, Pearson AM and Miller ER. (1989). Effects of dietary antioxidants and oxidized oil on membrane lipid stability and pork product quality. J. Food Sci. 54:1193-1197.

[7] Cakli S, (1994). An investigation on the quality of meat of wild and cultured gilthead seabream (*Sparus aurata* L.1758). Ph.D Thesis, Ege Univ., Institute of Applied Science. Deparment of Sea Products, Izmir / Turkey, pp: 80.

[8] Castell JD, Sinnhuber RO, Wales JH and Lee DJ (1972). Essential fatty acids in the diet of rainbow trout (*Salmo gairdnerii*): Growth, feed conversion and some gross deficiency symptoms. J. Nutr., 102: 77-86.

[9] Dikel S (1999). Comparative analysis of carcass composition and nutritive contents of rainbow trouts (*Oncorhyncus mykiss*) were producted in fresh and sea water. Symposium of 10th National Sea Products, Adana / Turkey, pp: 97-111.

[10] Dutta H, Das AB and Farkas T (1985). Role of environmental temperature in seasonal changes of fatty acid composition of hepatic lipid in an air breathing Indian teleost, *Channa punctatus* (Bloch). Comp. Biochem. Pysiol., 81 (B): 341-347.

[11] El-Sayed MM, Ezzat K, Kandeel M and Shaban FA. (1984). Biochemical studies on the lipid content of *Tilapia nilotica* and *Sparatus auratus*. Comp. Biochem. Physiol., 4: 589-594.

[12] Freeman DW and Heamsberger JO (1993). An instrumental method for determining rancidity in frozen catfish fillets. J. Aquat. Food Prod. Technol.2, 35-50.

[13] Funuyama K, Ushio F and Tomomatsu T (1991). Comparison of nutritive component between cultured and wild striped jack. Ann. Rep. Tokyo Mettr. Res. Lab. P . H., 42:185-190.

[14] Halver JE (1980). Lipids and FA. In fish Feed Technology United Nation Development Programs, p41, Food and Agriculture Organisation of the United Nations, Rome.

[15] Hatae K, Lee KH, Tsuchiya T and Shimada A (1989). Textual properties of cultured and wild fish meat. Nippon suisan gakk. Published by Japanese Soc. Fish. Sci., 55 (2): 363-368.

[16] Ito Y and Watanabe K (1968). Variations in chemical composition in fillet of corvina and 'pescada-foguete'. Contrib. Inst. Oceanogr. Univ. Sao Paolo (Ser. Technol.), 5, 1-6.

[17] Kunisaki N, Takada K. and Matsuura H (1986). On the study of lipid contents, muscle hardness and fatty acid compositions of wild and cultured horse mackerel. Bull. Japan. Soci. Sci. Fish., 52 (2): 333-336.

[18] Nakagawa H, Nishino H, Nematipour GH, Ohya S, Sheimizu T, Horikawa Y and Yamomoto S (1991). Effects of water velocities on lipid rezerves in ayu. Nippon suisan gakk. Published by Japanese Soc. Fish. Sci., 57 (9): 1737-1741.

[19] Simopoulos AP, Kifer RR, Martin RE and Barlow SW (1991). Health Effects of w3 polyunsaturatedfatty acids in seafoods. Karger, Basel.

[20] Stansby ME and Hall AS (1967). Chemical composition of commercially important fish of the USA. Fish. Ind. Res., 3, 29-34.

[21] Suzuki H, Okazaki K, Hayakawa S, Wadw S and Tamura S (1986). Influence of commercial dietary FA on PUFA of cultured freshwater fish and comparison with those of wild fish of the same species. J. Agric. Food Chem 34:58-60.

[22] Takama K, Love RM and Smith GL (1985). Selectivity in mobilisation of stored fatty acids by maturing cod, *Gadus morhua*. L. Comp. Biochem. Physiol. SOB, 713-718.

[23] Viola S, Mokady S, Behar D and Cogan U (1988). Effects of PUFA in feeds of tilapia and carp I. Body composition and FA profiles at different environmental temperatures. Aquaculture 75:127-137.

[24] Viswanathan PG and Gopakumar K (1984). Lipid and FA composition of fish and shell fish. J. Food Sci. Technol. 21:389.

[25] Watanabe KO (1971). Physical characteristics and chemical composition of fresh bream, mud sucker, tiger fish and barb from Lake Kariba. Fish. Res.Bull., 5, 153-173.

[26] Watts JCD (1957). The chemical composition of West African fish. 2. The West African shad (*Ethmalosa dorsalis*) from the Sierra Leone river estuary. Bull. Inst. Fondam. Afr. Noire (A Sci. Nat.), 19, 539-547.

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