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IMPACT OF AGRIMIN AND FISHMIN ON THE CARBOHYDRATE METABOLIC PROFILES IN SELECTIVE FISH SPECIES

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ABSTRACT

The present study was aimed at investigating the effect of selective synthetic feed like Agrimin and Fishmin on carbohydrate metabolic profiles of the cultivable fish species like *Catla catla, Labeo rohita* and *Cirrhinus mrigala*. The fishes selected for the study were divided into two groups viz. control group and experimental group: age, two years. The control group was fed with control feed i.e. groundnut cake, rice bran. The experimental group divided into two sub-groups was fed Agrimin / Fishmin mixed with control feed twice a day at 10 a.m. and at 5 p.m. for 30 days. Thereafter, fishes were killed and isolated the tissues like muscle, liver and blood at 4°C and estimated the total carbohydrates, blood glucose and glycogen. In agrimin and fishmin fed fish, muscle and liver showed enhanced levels of total carbohydrate content over their corresponding control values. Agrimin and fishmin fed fishes serum showed increased levels of glucose content and the changes were found to be statistically significant ($P<0.001$) over their control values. Glycogen was increased ($P<0.001$) in the liver and muscle over the control fishes.

INTRODUCTION

The most important and characteristic element in all living organisms is carbon. Carbon atoms participate in the formation of an almost infinite variety of molecules because of the ability of carbon atoms to combine with one another to form long chains and double covalent bonds. Carbohydrates are one such group of carbon compounds which are essential to life. Almost all organisms use carbohydrates as building blocks of cells and as a matter of fact, exploit their rich supply of potential energy to maintain the life.

Impairment of carbohydrate metabolism has been observed in a variety of physiological disorders and pathological conditions (Harper et al. 1979). This may prove to be of negative survival value for the affected organisms. Investigations were conducted earlier on carbohydrate metabolism during pathological conditions in different animals following exposure of some kinds of pesticides (Dikshit et al. 1975). Glucose in the blood shows most striking alternations in its concentration in response to change in environmental factors (Umminger 1975). More over in several fishes blood glucose level has been correlated to their level of activity and thus ultimately the level of blood glucose is attributed to and indirect level of B.M.R. in fishes (Umminger 1977).

Glucose is the principal sugar in blood of fishes, serving the tissues as a major metabolic fuel. Besides yielding energy through glycolysis and TCA cycle, pentose sugars are also formed in the hexose monophosphate shunt from glucose, which are important constituents of nucleotides, nucleic acids and many coenzymes. In general, glucose level in the blood of an animal is maintained through active absorption of glucose from the digested food stuffs, and also is formed from glycogen, amino acids and glyceral through glycogenolysis and gluconeogenesis under certain stress conditions. In several fishes, blood glucose level has been correlated to their level of activity and hence to their level of metabolism. There are evidences that in fish's blood glucose level shows most striking alterations in response to the change in environmental factors (Umminger 1975, Hattinght 1977). The levels of it may even be affected under toxic stress, which reflects the variations in the entire carbohydrate metabolism (Tewari et al. 1987). Blood glucose level has been reported as a reliable and sensitive indicator of environmental stress in fishes (Silberged 1974).

Glycogen, commonly called as animal starch is the main storage polysaccharide and a great source for blood glucose. Maintenance of glycogen reserves is one of the important features of the normal metabolism (Mong and Poland 1981).

Alterations in liver and muscle glycogen under situations of stress have been reported, and a significant depletion of tissue glycogen is said to reflect the state of strenuous activity on the part of the fish (Tewari et al. 1987). In many of the fishes red muscle is known to be predominantly oxidative whereas white muscle is known to be predominantly glycolytic (Gordon 1968). Hence the white muscle which is more active anaerobically could accumulate more inert metabolic glycogen than the red muscle (Bilinski 1969). Fish capture, handling, nutritional status all have profound effects on the carbohydrate metabolism and blood electrolytic balance (Mazeaud and Mazeaud 1981, Donaldson 1981). Further, depletion of glycogen indicates the rapid utilization of energy stores to meet the energy demands warranted by the environment (Githa and Yeragi 1998, Basha Mohideen and Sudharshan Reddy 2003). Sonawane et al. (2001) studied seasonal variations in tissue glycogen content in exotic fish *Cyprinus carpio*. But, studies involving carbohydrate energy reserves in fishes exposed to different nutritional media are few. The effects of diet supplements Agrimin and Fishmin on carbohydrate metabolism of selected fish species are reported in this communication.

MATERIALS AND METHODS

For the present study, Stocking/Breeders pond, Breeding tubs, Hatching tub and Nursery cum Rearing ponds were used at the Government fish farm at Nandyal (Kurnool District), Andhra Pradesh. The fish were fed with shellar rice bran and ground nut oil cake regularly at the rate of 2% body weight of the fish. The fishes (age: two years) selected for the study were divided into two groups viz. control group and experimental group. The control group were fed with control feed i.e. groundnut cake and rice bran. The experimental fishes were further divided into two sub-groups, and were fed commercially available diet supplement Agrimin (Glaxo, Mumbai) and Fishmin (Arias Agro-vet industries Pvt. Ltd., Mumbai) respectively along with control feed twice a day at 10 a.m. and 5 p.m. for 30 days. Thereafter, fishes were sacrificed and their muscle, liver and blood isolated at 4^0C were stored at - 80^0C.

Table 1. Effects of Agrimin & Fishmin on total carbohydrates content of the liver and muscle tissue of *Labeo rohita, Catla catla* and *Cirrhinus mrigala* (Value expressed as mg/gm wet wt. of tissues)

Treatments	*Labeo rohita*		*Catla catla*		*Cirrhinus mrigala*	
	Muscle	Liver	Muscle	Liver	Muscle	Liver
Control Feed	10.5±0.7	24.7 ±1.7	12.1±0.9	26.1±1.2	9.7 ±0.7	20.4 ±2.3
Control Feed + Agrimin	15.1 ±0.5* (44)	30.2±0.7* (22)	16.7±0.7* (38)	31.62 ±0.84* (21)	11.08 ±1.10* (14)	26.4 ±1.0* (30)
Control feed + fishmin	13.11 ±0.44* (25)	22.52 ±0.52* (-9)	14.69 ±0.36* (21)	29.78 ±2.12* (14)	12.49 ±0.37* (29)	22.52 ±0.22* (10)

Each value is the mean ± SD of 7 samples, data in parenthesis indicate percent change in comparison to control; * P<0.001

Table 2. Effect of Agrimin & Fishmin on the blood Glucose level (Mean ± SD) of various fish species *Labeo rohita, Catla catla, Cirrhinus mrigala* (Values expressed as mg of Glucose / 100ml of blood).

Treatments	Name of the Parameter Blood Glucose		
	Labeo rohita	*Catla catla*	*Cirrhinus mrigala*
Control Feed	105.27 ±1.24	108.19 ±3.16	109.15 ±2.14
Control Feed + Agrimin	114.45 ±3.16* (8.72)	118.37±0.94* (9.40)	119.96 ±2.99* (9.90)
Control feed + fishmin	110.27 ±1.24* (4.74)	110.91 ±2.16* (2.51)	114.52 ±4.13* (4.91)

Each value is the mean ± SD of 7 samples, data in parenthesis indicate percent change in comparison to control; * P<0.001

Table 3. Effect of Agrimin and Fishmin on Muscle and Liver tissue Glycogen levels of various fish species *Labeo rohita, Catla catla, Cirrhinus mrigala* (Value expressed as mg glycogen/g wet wt. of tissue)

Treatments	*Labeo rohita*		*Catla catla*		*Cirrhinus mrigala*	
	Muscle	Liver	Muscle	Liver	Muscle	Liver
Control	2.29±0.055	11.56±0.34	2.54±0.051	12.72±1.02	2.43±0.67	12.10±1.25
Control Feed + Agrimin	2.40±0.055* (4.8)	12.72±0.75* (10.03)	2.87±0.025* (12.99)	14.05±1.49* (10.45)	2.74±0.074* (12.75)	13.36±1.08* (10.41)
Control feed + fishmin	2.33±0.074* (1.74)	12.45±0.77* (7.6)	2.60±0.15* (2.36)	13.41±1.67* (5.42)	2.56±0.027* (5.34)	12.72±1.45* (5.12)

Each value is the mean ± SD of 7 samples, data in parenthesis indicate percent change in comparison to control; * P<0.001

Carbohydrate content was estimated by the method of Carrol et al. (1956). Values were expressed as mg carbohydrates/ gm/wet weight of the tissue. Glucose in the samples was determined by colorimetric method as described by Nelson and Somogyi (1952). Glucose content was expressed as mg of glucose / 100 ml of blood. Glycogen content in liver and muscle of fish was estimated using the anthrone reagent method as described by Carrol et al. (1956) and is expressed as mg/g wet wt of the organ.

Statistical Analysis:

Statistical analysis has been carried out using INSTAT software. The data was analyzed for the significance, the results were presented with the P-value.

RESULTS

The agrimin and fishmin fed fish species had higher levels of total carbohydrate in their muscle and liver in comparison to control values and the increment was found to be statistically significant (P<0.001). Liver possessed more carbohydrate content compared to the muscle tissue (Table 1).

Liver tissue of the three fish species appeared to possess higher glycogen content in the present study (Table 2). Agrimin and fishmin fed fishes serum showed increased levels of glucose content and the changes were found to be statistically significant (P<0.001) over their control values (Table 3).

DISCUSSION

Carbohydrate metabolism is essentially the metabolism of glucose and substances related to glucose. Glucose occupies central position of carbohydrate metabolism in an organism, representing complex groups, sequences and cycle of reactions which integrate at various points. The reactions concerned with metabolism of lipids and proteins as these molecules serve the source of carbon in the synthesis of cellular components (Nelson and Cox 2000). Glycogen is the chief carbohydrate present in tissues, while glucose is of the blood and other body fluids. Glycogen a storage carbohydrate from intestinal absorption is inadequate. Glycogen breakdown into glucose is governed by the extrinsic and intrinsic factors which also controls the physiology of an organism.

Carbohydrate metabolism essentially constitutes two segments namely synthesis of carbohydrates which includes gluconeogenesis and catabolism which includes glycolysis, glycogenolysis, pentose pathway and Krebs cycle. The catabolic pathways not only fulfill the needs of energy demands but also supply the amphibolic intermediates and reduced nucleotides (NADPH) required for protein and lipid metabolism (Nelson and Cox 2000).

The mechanism by which glycogen is synthesized and broken down in tissues is initiated by phosphorylase enzymes. The process of glycolysis in tissues commences with the consent of glycogen breakdown and the glucose released is fragmented into three carbon compounds, pyruvic acid and lactic acid by a series of enzymes under anaerobic conditions. The end products lactate and pyruvate are interconvertible by the enzyme lactate dehydrogenese (LDH). Pryuvate undergoes oxidative de carboxylation by pyruvate dehydrogenese to provide acetyl Co-A.

Acetyl-Co-A is an essential substrate for Kreb's cycle, which generates reduced nucleotides for the ultimate generation of ATP molecules through electron transport. Amphibiolic intermediates formed in the Krebs cycle may be channeled

into amino acid or fatty acid synthesis. Channeling of carbohydrate precursors into energy yielding reactions or synthetic reactions depends on the biochemical make up of an organ system concerned or physiological alterations dependant on changed environmental conditions. Pyruvate utilisation for energy requirements is tissue specific and varies according to environmental conditions imposed on the animal. Since biological system has some flexibility, animals use this capacity to divert metabolic pathways to an alternate source to synthesize energy to overcome the energy crisis created by the stress. The increased levels of total carbohydrates, glycogen (Table 1,3) in the muscle and liver of agrimin and fishmin fed fishes (Table 2) indicate that these tissues and blood show an upsurge in glycogenesis and glycogenolysis and this situation was more in the tissues and blood of agrimin and fishmin fed fishes. This trend further may be due to accumulation of feeding capacity of the fish species selected for the study. The overall results on glycogen and glucose in the present study supports an upsurge of carbohydrate metabolism in the fish tissues and blood fed on either agrimin or fishmin.

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