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Biochemical Composition and Gonadosomatic Index of Three Major Carps in Hatnoor Reservoir, Maharashtra, India

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Abstract

Three major carps captured from Hatnoor reservoir were studied over a period of June 2008 to May 2010 to evaluate seasonal changes in muscle biochemistry and gonadosomatic index (GSI). During pre-breeding, breeding and post-breeding seasons, each fish species were captured and samples of muscle tissue were collected and processed for estimation of its protein, lipid and glycogen content. Weight of body and gonads of each fish species were noted. Protein, lipid and glycogen content in muscles of each carp species exhibited seasonal variations. The protein and lipid contents of three fish species showed successive decrease in their estimated values during the study period ($p<0.05$). Whereas muscle glycogen content in fish species under study shown significantly increased trend from June 2008 to May 2009 as well as from June 2009 to May 2010, which might be due to increased glycogenesis in muscles and accelerated conversion of liver glycogen into muscle glycogen. Low GSI of carp fish reported during October to January may be due to dormancy of gonads in post-breeding season. The GSI values correlated with increased amount of protein and lipids in both pre-breeding and breeding seasons of the fish under study may be due to augmented vitellogenesis in ovary and spermatogenesis in testes that require large amount of lipoproteins.

Key Words: Carp fish, seasonal variations, muscle protein, lipid, glycogen, gonad somatic index

Introduction

Wild fish undergo seasonal changes in growth and energy storage as energy from diet and body reserves is partitioned between maintenance, somatic growth, and reproduction. During somatic growth, lipid, protein and ash are typically accumulated while protein and lipid are depleted during gonadal growth [19, 3 and 8].

Knowledge of biochemical composition of muscles of major carps, *Labeo rohita, Catla catla* and *Cirrhinus mrigala*, is of great help in evaluating not only its nutritive value but also helps in quality assessment and optimum utilization of these natural recourses [13]. This in turn can help in processing the fish into products and other byproducts without wastage or loss of constituents such as free amino acids, proteins and fats. Biochemical investigations on fish help to evaluate the impact of environment. Pampatwar et al [10] studied effect of activity levels on glycogen content in different tissues of *Channa gachua* and *Labeo rohita.*

Pertaining to available literature, the present investigation was undertaken to emphasize on the seasonal variation in some biochemical parameters and gonadosomatic index (GSI) of major carps, *Labeo rohita* and *Catla catla* and *Cirrhinus mrigala* inhabiting Hatnoor reservoir since there was scarcity work in this field. The present study may also assist in evaluating some taxonomical characterization of freshwater fishes, specifically the major carps, which are economically significant because of their food value.

Materials and Methods

River Tapi is one of the two westerly flowing rivers of peninsular India arising from Satpura ranged and flows westward through Madhya Pradesh, Maharashtra and Gujarat covering the distance of about 857 km. The total catchment area of Tapi and its tributaries is about 65,145 sq.km of which 25% falls in Madhya Pradesh, 40% in Maharashtra, and 35% in Gujarat. River Tapi joins the Arabian Sea at Dumas near Surat [9]. Hatnoor reservoir is formed due to a Ware (Dam) on river Tapi consisting 41 curved doors near Hatnur village near Bhusawal city in Jalagon district of Maharashtra, India.

Matured fish were collected from Hatnoor reservoir (75^0 90'E, 21^0 12'N) using casting net. Fish were identified with standard fish identification key [6 and 7] and processed for biochemical estimations as described by Plummer [12] and calculation of GSI.

Before dissecting out the gonads the fish, body weight of each fish species was recorded and then biochemical estimations were carried out using the fresh muscles of three major carps collected from Hatnoor reservoir as follows:

a) Protein estimation by Lowry method

b) Carbohydrates estimation (Glycogen content) using anthron reagent

c) Lipids present in muscles estimated by soxhlet method.

The gonadosomatic index (GSI) of individual major carp was calculated by the formula:

GSI = W / WI x 100

Where, W is the weight of the gonad collected from freshly dissected fish and WI, is the weight of fish. Difference in weight of body and gonads of each fish species, as well as GSI between the fish were tested by student 't' test and also by Smirnov's elimination test [4].

Results and Discussion

The biochemical composition of test fishes collected from Hatnoor reservoir of river Tapi shown species specific pattern in their muscle protein, glycogen and lipid contents. The protein and lipid contents of three fish species showed successive decrease in their estimated values from June 2008 to May 2009 ($p<0.05$). Whereas muscle glycogen content in fish species under study shown significant increase during June 2008 to May 2009 (Table 1). The fluctuations in biochemical composition of muscles of fish species may also be attributed to alterations in the ecology of the sampling site [1 and 16]. Similarly, during June 2009 to May 2010, the muscle protein and lipid contents in three fish species showed successive decrease in their values whereas glycogen content in the muscles of three fish species showed increasing trend during the same period (Table 2). This might have been happened due to increased glycogenesis in muscles and accelerated conversion of liver glycogen into muscle glycogen during June 2008 to May 2009 and June 2009 to May 2010 [11]. The observations indicated that variations in biochemical parameters in test fishes were not only species specific and season specific but it also linked to their habitat and nutritive values [2].

In the present investigation, the cyclic changes in gonadosomatic index of *Cirrhinus mrigala, Catla catla* and *Labeo rohita* (with an average weight of 1.10 ± 0.50 Kg) collected from Hatnoor reservoir showed that weight of the gonads followed regular cyclic changes that were correlated with the reproductive activities of fish during June 2008 to May 2009 (Graph 1). The lowest GSI values in all three female fish species collected from Hatnoor reservoir recorded during Oct 2009 to January 2010 indicated that during this month the weight of the ovary in fish was minimum (Graph 2). The GSI in *Cirrhinus mrigala* was at its peak value in month of June during both years of study i.e., in the year 2008 and 2009. Similar results were obtained in relation to GSI of *Catla catla* and *Labeo rohita.* The lowest GSI values, in all three fish species collected from sampling site were recorded during January 2010 indicated that during this month the weight of the ovaries in female fish was minimum, possibly due to dormancy of gonads in post-breeding season.

In Hatnoor reservoir, almost all fish show seasonal variation in reproductive physiology. Since the gain in weight was recorded in the gonads of each fish species during months of June to September every year, it can be clearly correlated with the breeding season of fish [5]. On the basis of observed values of GSI in all fish species, it can be concluded that in a reproductive life cycle of an adult carp fish, February to May is pre-breeding season, June to September is breeding season and October to January is post-breeding season in each year [13]. The GSI values also correlated with increased amount of protein and lipids in both pre-breeding and breeding seasons of the fish under study, which may be due to augmented vitellogenesis in ovary and spermatogenesis in testes that require large amount of lipoproteins under impact of hormones [14, 15 and 17].

Steven et al. [18] studied seasonal changes in the reproductive condition and body composition of free-ranging red drum, *Sciaenops ocellatus.* They reported evidence for testicular recrudescence (proliferation of spermatogonia) in March, with the first spermiating male in July. Wilson and Nieland [20] found that male red drum *Sciaenops ocellatus* captured from the neritic waters of the northern Gulf of Mexico shown increased GSI in July. Resembling observations in GSI values of three carp species were recorded during the present study.

Table 1: Biochemical composition of three major carps collected from Hatnoor reservoir (Fish collected during June 2008 to June 2009)

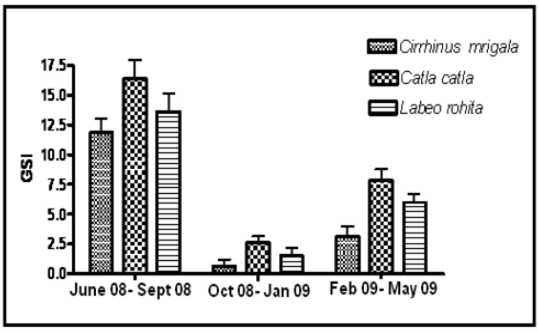
Fish species	Season	Protein content (mg/gm of tissue)	Glycogen content (mg/gm of tissue)	Lipid content (mg/gm of tissue)
Cirrhinus mrigala	June 08- Sept 08	110.2 ± 5.1	13.6± 3.8	12.4± 5.3
	Oct 08 - Jan 09	101.3 ± 1.2	16.4 ± 5.6	9.5± 2.1
	Feb 08- May 09	95.4 ± 2.8	19.7 ± 3.1	7.4± 4.2
	June 09	121.3 ± 2.2	11.8± 2.9	14.5± 3.2
Catla catla	June 08- Sept 08	109.6 ± 2.8	15.6 ± 3.7	14.8± 3.9
	Oct 08 - Jan 09	98.5 ± 5.4	18.7 ± 2.9	11.7± 4.2
	Feb 08- May 09	94.4 ± 3.6	19.4 ± 4.3	9.3± 2.2
	June 09	118.2 ± 2.2	16.3 ± 4.2	13.4± 2.4
Labeo rohita	June 08- Sept 08	127.5 ± 6.8	17.8 ± 4.3	18.0 ± 7.3
	Oct 08 - Jan 09	122.3 ± 4.7	19.2 ± 2.5	14.4 ± 4.6
	Feb 08- May 09	114.1 ± 3.5	21.9 ± 3.6	10.3 ± 3.2
	June 09	129.4 ± 4.2	18.3 ± 5.2	17.1 ±3.7

Each figure is Mean ± S.D. of 6 observations.

Table 2: Biochemical composition of three major carps collected from Hatnoor reservoir
(Fish collected during Sept 2009 to May 2010)

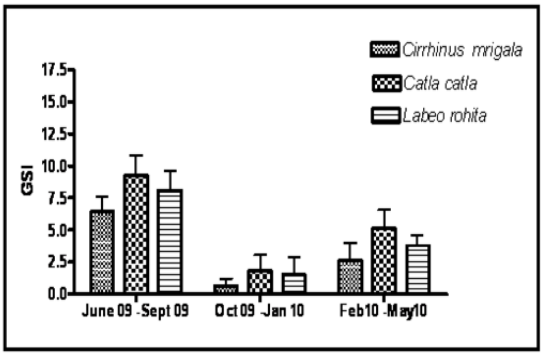
Fish species	Month and Year	Protein content (mg/g of tissue)	Glycogen content (mg/g of tissue)	Lipid content (mg/g of tissue)
Cirrhinus mrigala	Sept 09	121.3 ± 2.2	11.8± 2.9	14.5± 3.2
	Oct 09- Jan 10	104.2 ± 1.4	15.9 ± 3.4	10.3± 2.7
	Feb 10- May 10	98.5 ± 3.5	18.5± 3.3	8.3± 2.1
Catla catla	Sept 09	118.2 ± 2.2	16.3 ± 4.2	13.4± 2.4
	Oct 09- Jan 10	104.1 ± 5.1	19.8 ± 1.3	9.6± 3.3
	Feb 10- May 10	99.6 ± 1.9	21.7 ± 2.3	7.3± 2.7
Labeo rohita	June 09- Sept 09	129.4 ± 4.2	18.3 ± 5.2	17.1 ±3.7
	Oct 09- Jan 10	123.5 ± 2.5	21.4 ± 2.5	12.5 ± 1.7
	Feb 10- May 10	104.8 ± 3.3	23.5 ± 3.3	10.6 ± 2.1

Each figure is Mean ± S.D. of 6 observations.



Each figure is Mean ± S.D. of 6 observations.

Graph 1. Gonadosomatic index (GSI) of three major fishes collected from Hatnoor reservoir during June 2008 to June 2009



Graph 2. Gonadosomatic index (GSI) of three major fishes collected from Hatnoor reservoir during June 2009 to May 2010.

Conclusion

Knowledge of biochemical composition of fish assists in elucidating its environmental, physiological and nutritive status. Gonadosomatic index (GSI) is the ratio of fish gonad weight to body weight. The GSI is particularly helpful in identifying days and seasons of spawning, as the ovaries of gravid females swiftly increase in size just prior to breeding season. This information can be helpful for better management of inland fisheries and prevention of fish capture in breeding season to conserve the diversity of fish.

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