SEASONAL CHANGES IN THE BIOCHEMICAL COMPOSITION OF A HILLSTREAM FISH *GARRA MULLYA* (SYKES)

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ABSTRACT

In the hillstream fish *Garra Mullya* (Sykes) marked seasonal variations in phosphorus, water, fat, protein and glycogen were observed during a one-year study. The fat and water contents were inversely related; maximum fat was observed during the prespawning months, while the minimum after the breeding. The relationship between fat and protein was a direct one. The muscle glycogen was in assocation to feeding and spawning activity. High energy values were found throughout the prespawning period.

INTRODUCTION

Earlier investigations show that there are substantial differences in the chemical composition of different fish species, and among individuals of the same species, with their age, sex, habitat and fishing season. It has been now realised that these changes occur due to various physiological and other factors like maturation, spawning and feeding (Love 1957 and Jacquot 1961).

Among studies on the biochemical composition of freshwater fishes of India are Saha and Guha (1940) and Jafri and Khawaja(1968). However, as information on biochemical composition of the locally relished hillstream fish, *Garra mullya*, is not available the present investigation was carried out.

MATERIAL AND METHODS

Fish samples were collected monthly during the year 1974, from the Kham at Aurangabad. The freshly caught *G. mullya* were dissected out, the males and females segregated and muscle was removed without scales, skin, and pieces of bones. The muscle samples of each sex were analysed separately in order to assess any possible differences in the seasonal cycle of the two sexes.

Preweighed muscle samples were dried in a thermostat kept at 100°C. to constant weight and the water percentage was computed. Fat was estimated

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by extracting the dried muscle samples with solvent ether for about 10 to 12 h in a Soxlet apparatus. Method described by Gornell et al (1949) was employed for the protein estimation. Glycogen was estimated by the method of Kemp et al (1954).

The dried muscle samples were ashed at 600°C in a muffle furnace and were further analysed for minerals. To the weighed ash sample was added aquaregia (conc. HNO_3 and conc. HCl in 1 : 2 proportion) and diluted to 30 ml with distilled water. This ash solution was then subsequently used for the estimations of minerals — calcium (Clark and Collip 1925), phosporus (Fiske and Subbarow 1925) and iron (Elvenhjem 1930). Energy values were calculated using the factors 9 for fat, 4 for protein and 4 for carbohydrates.

Results and Discussion

G. mullya has a prolonged spawning season (June to November) and attains maturity for the first time at about 88 mm length (Somvanshi 1980). For the biochemical analysis, therefore, only specimens above 88 mm length were considered so as to avoid inclusion of the juvenile specimens. The males and females were analysed and the results are presented separately.

Fat-water cycle

Water, being the important constituent, contributes maximum to the chemical composition in fish tissues and may show high degree of variations. Fat and water percentages in males and females are shown in Fig.1. The percentage of water varied from 77.91 (in June) to 81.24 (in January) in males and 76.08 (in July) to 81.46 (in January) in females. The percentage of water was high from December to March and low from April to October. The Fig. 1 shows the changes in water percentages are more or less alike in both the sexes.

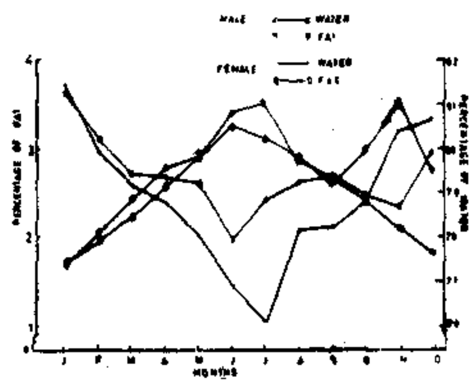

FIG. 1. Monthly variations of water and fat in the muscle of *G. mullya.*

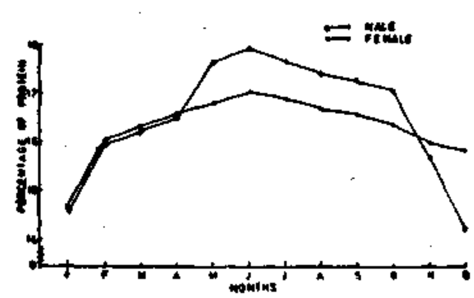

FIG. 2. Monthly variations of protein in muscle of *G. mullya.*

The percentage of fat in muscles varied between 1.69 (in January) and 3.51 (in July) in females. It should be noted that this fish is a medium-fatty fish and the cycle of fat is well defined in both the sexes (Fig. 1). The fat percentage was maximum in July in females and in November in males. In general, the high values for fat were observed during the pre-spawning and spawning months and low during the post-spawning months. The fat reserves are more in a fully ripe fish which has to perform breeding migration (Jones 1941) and undergo the spawning exertion. It can be noted that the low values of fat coincided with the high values of water and vice versa.

During the biological studies of *G. mullya* the percentage occurrence of mature females was found high during May to November (Somvanshi 1980). However, the percentage of water is low during these months, indicating thereby that the water content decreases as the fish advance towards maturity. On the contrary, when comparatively high water level was maintained from December to March, the mature specimens were totally absent in the catches which comprised prominently of immature and maturing individuals (Somvanshi 1980). The percentage occurrence of all the food items in guts of *G. mullya* were found low during June to October, which corresponds with the spawning season, and low percentage of water and high percentage of fat. Jafri (1968) on a similar observation in common carp, *Cirrhina mrigala,* states "ripening of gonads was accompanied with a rapid increase in fat, the highest values being observed during the period of peak ripeness".

Protein cycle

Seasonal variations in the protein content in muscles of males and females are shown in Fig. 2. It can be seen that the protein percentage varied from 14.56 (in January) to 17.03 (in June) in males and 14.08 (in December) to 17.87 (in June) in females. A steady increase in percentage of protein from January to June and thereafter a decline till December in both the sexes are observed. Like fat, protein values are also inversely proportional to water, suggesting thereby that the depletion in water content is made up by fat and protein. However, in herring Milroy (1908) noted lowest percentage of protein when fat content is at its highest, whereas Bruce (1924) found decrease in muscle protein with advancing age and progressive maturation of gonads when the fat content was found to rise. Jafri and Khawaja (1969) noted high values of muscle protein in *Ophicephalus punctatus* with ripe gonads.

Glycogen cycle

The glycogen variations studied in both the sexes are presented in Fig. 3. Muscle glycogen varied from 0.28 to 0.53% in males and 0.28 to 0.54% in females. The high glycogen values in both the sexes were recorded in June and thereafter a decreasing trend with advancement of spawning season was noticed. Low levels in the glycogen contents were observed during October to February with lowest value in November (0.28%) in males, and October and January in females (0.28%). It appears that the muscle glycogen cycle is associated with the feeding in addition to the spawning activity. The moderate values of glycogen during the post-spawning period may be due to the high feeding activity during these months (Somvanshi 1976). The accumulation of glycogen starts from February and attains its peak in June which is associated with the attainment of maturity. The dimunition in glycogen in females in April shows utilisation of glycogen as an energy source in addition to fat for the ripening of the gonads.

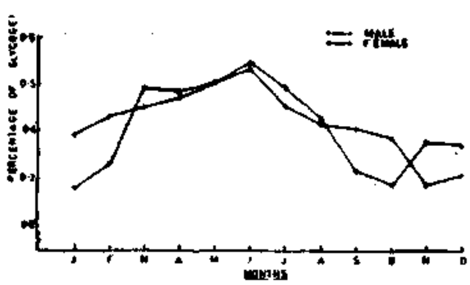

FIG. 3. Monthly variations of glycogen in the muscle of *G. mullya*.

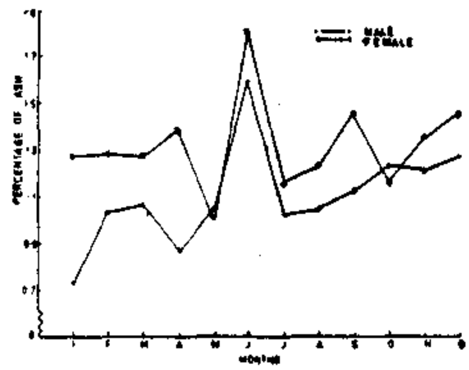

FIG. 4. Monthly variations in the ash content of muscle of *G. mullya*.

Mineral cycle

The changes in the ash percentage of muscles of males and females are shown in Fig. 4. The percentage of ash in males varied from 0.73 to 1.59 and in females from 1.01 to 1.8. The highest value of ash was recorded in June. Thus, the high ash content in both the sexes coincides with the attainment of maturity showing thereby that the mineral content is more in ripe fishes. It is also interesting to note that the high percentage of ash observed also coincides with the maximum percentage of organic constituents and low percentage of water. However, Jafri ((1968) stated that there was no direct relationship between the ash cycle and feeding or spawning activities of *Cirrhina mrigala*.

The calcium, phosphorus and iorn content in both the sexes were calculated as milligram percentages.

Calcium: The percentage of calcium in muscles of male and female fish are given in Fig. 5, which varied from 114.31 (in July) to 344.59 mg (in June) and 92.83 (in November) to 277.59 mg (in June) respectively. The steady rise in calcium content from March to June coincides with the advancement of maturity in both the sexes, indicating the accumulation of calcium during this period.

Phosphorus: The seasonal changes in the phosphorus content in muscles are shown in Figure 6. The phosphorus was found to vary from 886.62 (in May) to 1846.61 mg (in April) in males and 737.01 (in August) to 1935.35 mg

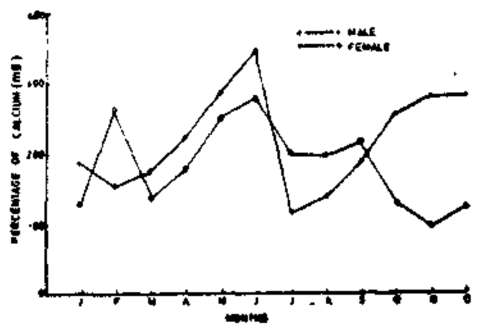

FIG. 5. Monthly variations in the calcium content of *G. mullya.*

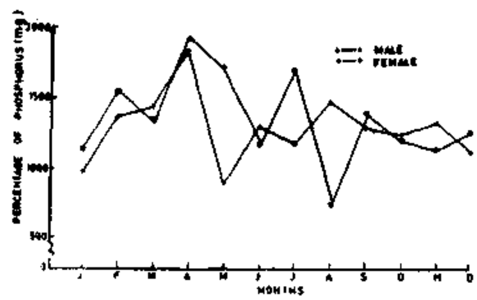

FIG. 6. Monthly variations in the phosphorus content of *G. mullya.*

(in April) in females. However, the fluctuations in the phosphorus percentage could not be correlated either with spawning or feeding activities.

Iron: The iron content in muscles ranged from 4.56 (in February) to 13.48 mg (in January) and 3.15 (in August) to 16.41 mg (in September) in males and females respectively (Fig. 7). Like phosphorus, fluctuations in iorn content cannot be correlated with the spawning and feeding activities.

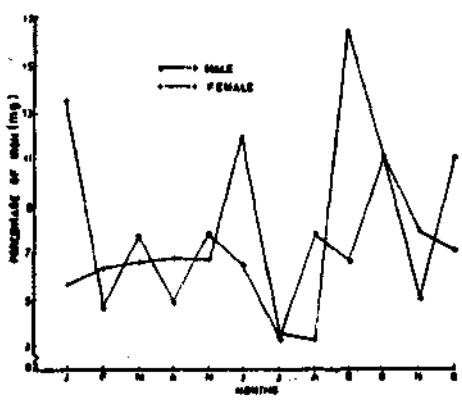

FIG. 7. Monthly variations in the iorn content of *G. mullya.*

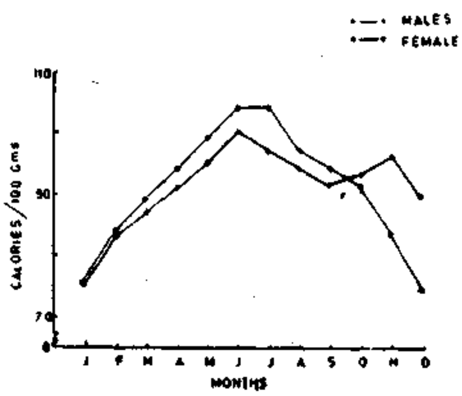

FIG. 8. Monthly variations in the energy content of muscles of *G. mullya.*

Energy value

The calorific values of *G. mullya* were studied during different months and are presented in Fig. 8. These values were computed for 100 grams of fresh muscles. It was observed that the total energy content in muscles changed from 75.01 (in January) to 99.58 calories (in June) in males. In females the calorfic values fluctuated between 74.63 (in January) and 103.97 (in June). Thus it may be seen from Fig. 8 that the fish is more nutritious during prespawning and spawning months.

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