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Seasonal Changes in the Biochemical Composition of Liver in *Garra mullya* (Sykes)

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Seasonal changes taking place in the biochemical constituents of liver of *G. mullya* are reported. An inverse relationship was noticed in the variation of fat and water. Maximum fat contents were observed during June–July. Reserve fat was utilised through gluconeogenesis during the spawning months. Protein and glycogen percentages were comparatively higher in liver than in the muscles and gonads. Decline in the glycogen content was associated with spawning during July to November. Nutritive values have shown more energy contents in the liver during pre-spawning months.

Liver being one of the main organs of the body controlling the metabolism of the fish, studies on its chemical composition and food value are of paramount importance. Studies on chemical composition of liver of fresh water as well as marine fishes of India have been carried out by various workers (Jafri & Qasim, 1965; Jafri & Khawaja, 1968; Savant & Bal, 1969). However the information on seasonal changes in various biochemical constituents of the liver in hill stream fishes is scanty. Hence an attempt has been made to investigate quantitative changes in water, fat, protein and glycogen content of the liver in hill stream fish, *Garra mullya* (Sykes) during different months.

Materials and Methods

Freshly caught fishes from Kham river near Aurangabad were brought to the laboratory every fortnight and liver samples were collected sexwise. After removing the water from the surface of liver samples with blotting paper, the weights were recorded to the nearest milligram. The samples were then dried in an oven at 100°C till constant weights were obtained. The experimental methods employed for the estimation of water, fat, protein and glycogen were that followed by Somvanshi (1978)

Results and Discussion

The seasonal changes in the biochemical composition of liver of male and female fish (Figs. 1 to 4) were significant and had some correlation with various activities of the fish like feeding and spawning.

Variations in the fat and water percentages in the liver of males and females are shown in Fig. 1. Percentage of water varied from 69.32 (in June) to 74.67 (in January) in males and 69.23 (in July) to 75.35 (in January) in females, whereas the percentage of fat fluctuated between 2.83 (in March) and 5.54 (in June) in males and 2.28 (in March) and 4.97 (in July) in females.

In general, the changes in the liver fat and water are similar to that observed by Somvanshi (1978). The percentage of water in liver of both the sexes was comparatively high during the spawning season, namely, June to November (Somvanshi, (1976). This indicated that the percentage of water was more in the spent, immature and the maturing specimens. Jafri & Khawaja (1968) and Mehta (1974) have also observed similar trends in the variation of water content in liver of *Ophiocephalus punctatus* and *O. gachua* respectively.

The values for fat were high during the pre-spawning and spawning months, thus showing that the mature specimens which

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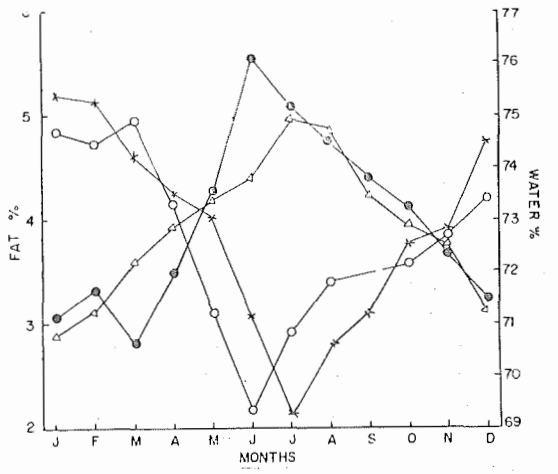

Fig. 1. *Percentage variation of fat and water in the liver of males and females*

O—O Water (in males); ●—● Fat (in males); ×—× Water (in females); △—△ Fat (in females)

are ready for spawning have maximum accumulation of liver fat. A fall in the fat value was observed towards the end of the spawning season, indicating that a major part of the accumulated fat is used up owing to spawning. It is known that the sexual maturation in fishes is related to the muscle and liver glycogen (Greene, 1926 and Black *et al.*, 1961). Fish during its breeding migration and spawning act requires more of glycogen and the depletion of liver fat may be due to the conversion of fat into carbohydrate through metabolic pathways (gluconeogenesis) which leads to the maintenance of an adequate glycogen level required both by the increased muscular activity and the spawning exertion. It is also noticed that during spawning, feeding is less in *G. mullya* (Somvanshi & Bapat, 1978) and the increased demand for glycogen is met by the conversion of stored liver fat into glycogen.

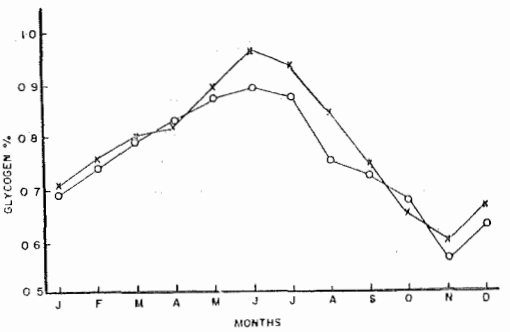

Fig. 3. *Percentage variation of glycogen in males and females*

O—O Males; ×—× Females

A rise in liver fat was noticed from February onwards which indicates restorage in the liver fat consequent on increased feeding activity. Jafri & Khawaja (1968) have noted highest value for liver fat during the peak ripening period of eggs and thereby decreasing with the onset of spawning. It may also be added that for meeting the energy demand of gonads during development, the utilization of muscle fat alone is insufficient. The liver fat also is used up. It can be inferred that the liver in *G. mullya* acts as a store house of energy reserves, the fat and water have inverse relationships.

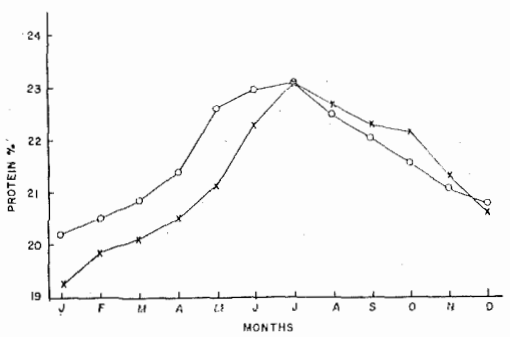

Fig. 2. *Percentage variation of protein in males and females*

O—O Males; ×—× Females

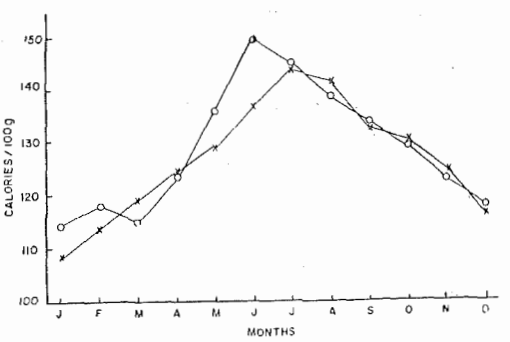

Fig. 4. *Seasonal variation of energy values in males and females*

O—O Males; ×—× Females

The variation of protein in the liver of *G. mullya* is shown in Fig. 2, for males and females separately. The protein values for males varied from 20.19% (in January) to 23.08% (in July) and in females from 19.25% (in January) to 23.08% (in July). In general, the values for liver protein are comparatively higher than that in muscles and gonads of both the sexes (Somvanshi, 1976). Fig. 2 shows that there is a steady increase in the liver protein from May onwards reaching its peak in July in both the sexes, subsequently decreasing during spawning season. Low liver protein values were recorded during the post-spawning months. The accumulation of protein in liver during the process of ripening of eggs indicates that the liver as the major source of nitrogen for the fish for spawning.

The changes in liver glycogen values in different months are presented in the Fig. 3. The percentage of glycogen in liver varied from 0.56 to 0.99 and 0.59 to 0.96 in males and females respectively. The highest values were recorded in June and the lowest in November. The liver glycogen increased gradually from December onwards, reaching the maximum in June which coincides with the attainment of maturity. It declined thereafter consequent on spawning and reached its lowest value in November towards the end of the spawning season. Thus it is clear that the glycogen accumulated during the pre-spawning months in liver is used up for spawning from July to November.

Besides water, fat and protein are the major constituents of liver of *G. mullya*. Hence the calorific values are chiefly due to protein and fat whereas glycogen accounts very less in energy value. However, maximum glycogen was noticed in liver when compared to the other tissues of the fish (Somvanshi, 1976). The sexwise seasonal variations in energy values are presented in Fig. 4. The liver calorific values varied from 114.35 (in January) to 149.63 (in June) in males and 108.71 (in January) to 144.49 (in July) in females. The energy values for protein, fat and glycogen were high during the pre-spawning months and decreases while spawning (June-November).

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