

Seasonal variations in the phosphorus contents of the muscle of catfish *Clarias batrachus* L.

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Abstract. Seasonal variations were observed in total acid soluble phosphorus, inorganic phosphorus and phospholipid in the muscle of *C. batrachus* L. The maximum concentration of these constituents were recorded during April, May and June. Thereafter values decreased and the levels remained low during winter months. The observed changes have been correlated with feeding intensity, gonad maturation and spawning. The rise and fall of different phosphorus contents were found to coincide with high and low rate of feeding. There was a gradual rise in the values when gonads advanced towards maturity. The maximum concentration corresponded to the period of peak ripeness (April, May and June). The values declined during the spawning period which possibly indicate the utilization of these reserves for energy. The low phosphorus contents observed in post-spawning and winter appear to be the result of exhaustion of spawning.

Keywords. Seasonal variations ; phosphorus contents ; *C. batrachus*.

1. Introduction

Although phosphorus has been studied in tissues of many fish species (Nakano 1960 ; Nakano and Tsuchiya 1960 ; Chang and Idler 1960 ; Jafri 1965 ; Bhushana Rao 1965), there seems to be no earlier account on the changes in muscle phosphorus contents with season except that in some fish such changes were reported on blood (Shell 1961 ; Siddiqui and Siddiqui 1965 ; Siddiqui and Naseem 1971 ; Siddiqui 1972). In this paper similar observations are being reported in the muscle of catfish *Clarias batrachus* L. a commercially important freshwater fish. In earlier papers seasonal variations in other chemical constituents of this fish have been reported (Bano 1977 ; Bano and Hameed 1979).

2. Materials and methods

Specimens of *C. batrachus* ranging from 18-26 cm in length were procured at monthly intervals from a freshwater pond at Aligarh and maintained alive in a large laboratory aquaria. The fish were left for twenty-four hr for acclimatization before starting the sampling. After that they were removed, killed by decapitation and tissue taken out constantly from anterior trunk region taking

care that only white muscle is removed. The maturity stage of gonad was determined arbitrarily from the scheme suggested by Qayyum and Qasim (1964). The two sexes were analysed separately and it was ensured that the muscle were free of bones. The total acid soluble phosphorus, inorganic phosphorus and phospholipid were determined by the methods described earlier by Bano (1975). Extractions of these fractions were made at cold temperatures.

3. Results and discussion

Monthly values of different phosphorus contents showed a wide range of fluctuation. The mean values are given in the form of annual cycle in figure 1. As is

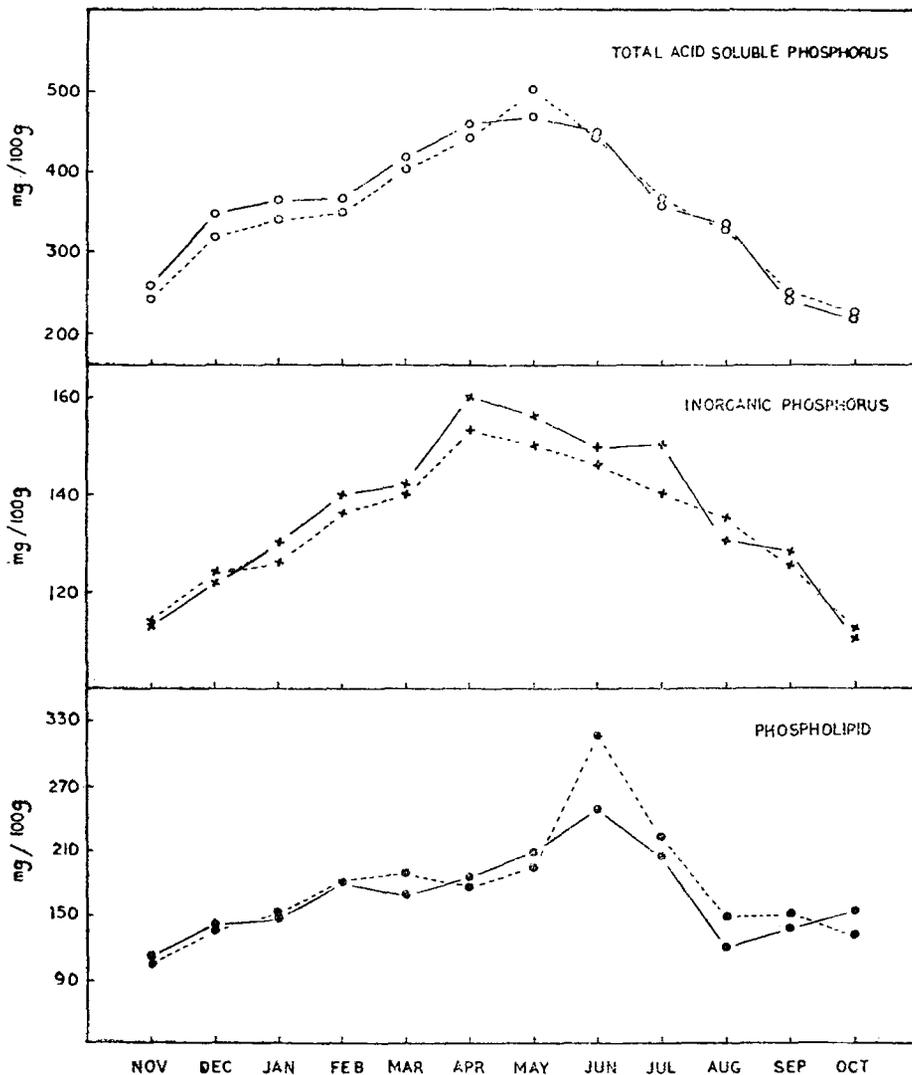


Figure 1. Seasonal variations in the phosphorus contents of the muscle of *Clarias batrachus* L.

evident from the figure, in both the sexes, the total acid soluble phosphorus values in the muscle were higher from April to June, the maximum being recorded in May. From June onwards there was a gradual decrease and the minimum values were recorded in October. Thereafter a regular rise was noted. Almost a similar trend of change was followed by inorganic phosphorus, being highest in April and lowest in October. The phospholipid content was highest in the month of June, the values in females were relatively higher than in males. A subsequent fall in phospholipid content occurred during July and August and the level remained low during winter period (September to January).

Mineral contents are influenced by a number of factors such as age, sex and sexual maturity (Vinogradov and Odum 1953). The present observed variations appear to be correlated mainly to feeding, gonad maturation and spawning. Though the synthesis of phosphorus contents takes place inside the body, their chief source outside the body is food. In *C. batrachus* higher values of total acid soluble phosphorus, inorganic phosphorus and phospholipid were recorded in the period (April, May and June) when feeding intensity of fish was high. This high rate of feeding indicates increased metabolic activity of fish during these months. Similar observations have been reported by other investigators (Siddiqui and Siddiqui 1965 ; Siddiqui 1972). Similarly low values observed during winter period appear to be the result of less active feeding.

There was a marked relationship between the muscle phosphorus contents and the cycle of gonad maturation. A gradual increase in total acid soluble phosphorus, inorganic phosphorus and phospholipid was recorded when gonads advanced towards maturity. The highest concentration in the muscle from April to June coincided with the period of peak ripeness. Thereafter the constant decline corresponded to the period of spawning and in spent fish, values were quite low (September, October). The fall in phospholipid content was from June to August. These findings are in accordance with the observation of Siddiqui and Siddiqui (1965) and Siddiqui and Naseem (1971). They reported maximum value of phosphorus content in the fish with ripe gonad and declining values in spawning fish.

It has been observed that during spawning period, feeding activity of fish is restricted and fish needs a great amount of energy. This energy is derived from various sources. Phosphorus content may be one of the sources as the inorganic and organic phosphorus play a very important role in energy transfer and enzyme system (Harper 1963). Hence a gradual depletion in different phosphorus contents during spawning is quite justifiable. Besides, through intermediary formation of lecithin, phosphorus is associated with fat metabolism and through the formation of hexosephosphates of adenylic acid and of creatine phosphate it plays a primary role in carbohydrate metabolism. During maturation cycle, variations have been reported in carbohydrate and fat contents (Valtonen 1975; Petersen and Emmersen 1977 ; Fernandez and Planas 1980).

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References

- Bano Y 1975 Variations in the chemical composition of different sections of the flesh of *Clarias batrachus* L.; *Indian J. Zool.* 3 39-42
- Bano Y 1977 Seasonal variations in the biochemical composition of *Clarias batrachus* L.; *Proc. Indian Acad. Sci.* 85 147-155
- Bano Y and Hameed T 1979 Seasonal changes in cholesterol content of the muscle of catfish *Clarias batrachus* L.; *Indian J. Exp. Biol.* 17 214-215
- Bhushana Rao K S P 1965 Biochemical studies on red and white muscles of *Caranx sexfasciatus* Quoy and Gaimard; *Proc. Indian Acad. Sci.* 62 87-91
- Chang V M and Idler D R 1960 Biochemical studies on sockeye salmon during spawning migration. XIII. The distribution of phosphorus compounds, creatine and inositol in the major tissues; *J. Fish. Res. Bd. Can.* 17 565-582
- Fernandez J and Planar J 1980 Annual variation of some carbohydrate and lipid parameters in the fish *Spicara chryselis* during captivity; *Comp. Biochem. Physiol.* 67 383-389
- Harper H A 1963 *Review of physiological chemistry* (Bombay: Lange Medical Publication)
- Jafri A K 1965 *Studies on the biochemical composition of some freshwater fishes*; Ph.D. Thesis, Aligarh Muslim University, Aligarh
- Nakano T 1960 Studies on the physiological chemistry of phosphorus compounds in fish muscle. II. On the individual and regional variations of phosphorus compound contents in fish muscle; *Bull. Jpn. Soc. Scient. Fish.* 26 1192-1197
- Nakano T and Tsuchiya Y 1960 Physiological chemistry of phosphorus compounds in fish muscle. I. Distribution of various phosphorus compounds in fish muscle; *Nippon Suisan Gekkaishi* 26 1095-1098
- Petersen I M and Emmersen B K 1977 Changes in serum glucose, lipids, liver glycogen and phosphorylase during vitellogenesis in nature in the flounder *Platichthys flesus* L.; *Comp. Biochem. Physiol.* B58 167-171
- Qayyum A and Qasim S Z 1964 Studies on the biology of some freshwater fishes. Part I. *Ophicephalus punctatus* Bloch; *J. Bombay Natl. Hist. Soc.* 61 74-98
- Shell E W 1961 Chemical composition of blood of small mouth bass; *U.S. Fish Wildlife Serv. Res. Rep. No.* 57 1-36
- Siddiqui A Q and Naseem S M 1971 Seasonal variations in the biochemical composition of blood serum of *Heteropneustes fossilis* (Bloch) (Telostomi, Heteropneustidae); *Kashmir Science* 8 41-50
- Siddiqui M A and Siddiqui M A 1965 Seasonal variations in calcium, inorganic phosphate and alkaline phosphatase content of *O. punctatus* (Bloch); *Indian J. Exp. Biol.* 4 122-123
- Siddiqui N 1972 *Studies on the chemical constituents of the blood plasma of some freshwater fishes*; Ph.D. Thesis, Aligarh Muslim University, Aligarh
- Vinogradov A P and Odum V 1953 The elementary chemical composition of marine organisms; *Sears Foundation for Marine Research, Yale Univ., New Haven, Connecticut*
- Valtonen T 1974 Seasonal and sex bound variation in the carbohydrate metabolism of the liver of white fish; *Comp. Biochem. Physiol.* A47 713-727