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Ontogenic Development of Amylase Activity in Three Species of Indian Major Carps, *Catla catla, Labeo rohita* and *Cirrhinus mrigala,* in Relation to Natural Diet

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Abstract

Three species of Indian major carps, catla, rohu and mrigal, were reared from 4th day after hatching to 32 days in a recirculating system. Final average weight was 27.80 ± 2 mg and 31.53 ± 1.24 mg for catla and rohu, respectively, in the first experiment. In a second trial, the final weights for rohu and mrigal were 35.90 ± 3.44 mg and 23.39 ± 1.27, respectively. Amylase activity was very low during transition period from endogenous to exogenous feeding. Enzyme activity increased with age in all three species. It can be con-cluded that these three species of cyprinid larvae can easily hydrolize starch and digest glycogen present in animal tissues a few days after the initial feeding.

Introduction

In nature, most fish larvae use zooplankton as a food source regardless of their adult feeding habits. The short and less differentiated intestine is adapted to accept diets which are of high nutritive value and are easily digestible (Hofer and Nasir Uddin 1985). With differentiation of the digestive tract, the fish changes slowly to their species-specific feeding habits, a development which also includes the adaptation of digestive enzymes. Among the three species of Indian major carps, catla (*Catla catla*) and rohu (*Labeo rohita*) are planktiphage, whereas mrigal (*Cirrhinus mrigala*) is omnivore in adult stage (Jhingran 1988). But like other teleosts in their early stages, they prefer zooplankton as natural food. Little is known about the digestive enzyme profile of these three species of Indian major carps (Dhage 1968), specially of larvae (Chakrabarti and Sharma 1997). An understanding of basic digestive physiology will enhance interspecific comparisons and should assist in comprehending species ecology and development of more efficient diets and rearing techniques. The aim of this study was to determine the amylase activity in the digestive tracts of these three species of Indian major carps at various stages of ontogenic development.

Material and methods

Larvae of three species of Indian major carps, *Catla catla* (catla), *Labeo rohita* (rohu) and *Cirrhinus mrigala* (mrigal), were obtained from a local fish farm after 72 hrs. of hatching. They were supplied with recirculating water which had been filtered through foam (30 cm) and pebble (30 cm) filters. Water temperature and pH ranged between 27° to 30°C and 7.2 to 7.5, respectively. The oxygen level was maintained above 7 mg/L with the help of aerators. Two experiments were conducted from June to September 1996. In the first trial, studies were made with catla and rohu and in the second, with rohu and mrigal. In both experiments, each species was reared separately in triplicate groups. An initial stocking density of 500 larvae/aquaria was used. Fish larvae were fed with live zooplankton, consisting primarily of *Brachionus calyciflorus, Moina micrura* and *Ceriodaphnia* sp. Ten carp larvae were collected every day from each aquaria at a fixed time (8 a.m.) before morning food distribution. Dissections under microscope were conducted on a glass maintained at 0°C. Thus, digestive tracts of ten larvae comprised a set and each species had three sets. Digestive tracts were homogenized in 10 volumes (v/w) of ice-cold distilled water and centrifuged at 4°C at 10,000 xg. The supernatants were taken for analysis. Amylase activity was assayed according to the method of Bernfeld (1955), in which the increase in reducing power of buffered starch solution was measured with 3,5-dinitrosalicylic acid at 540 nm.

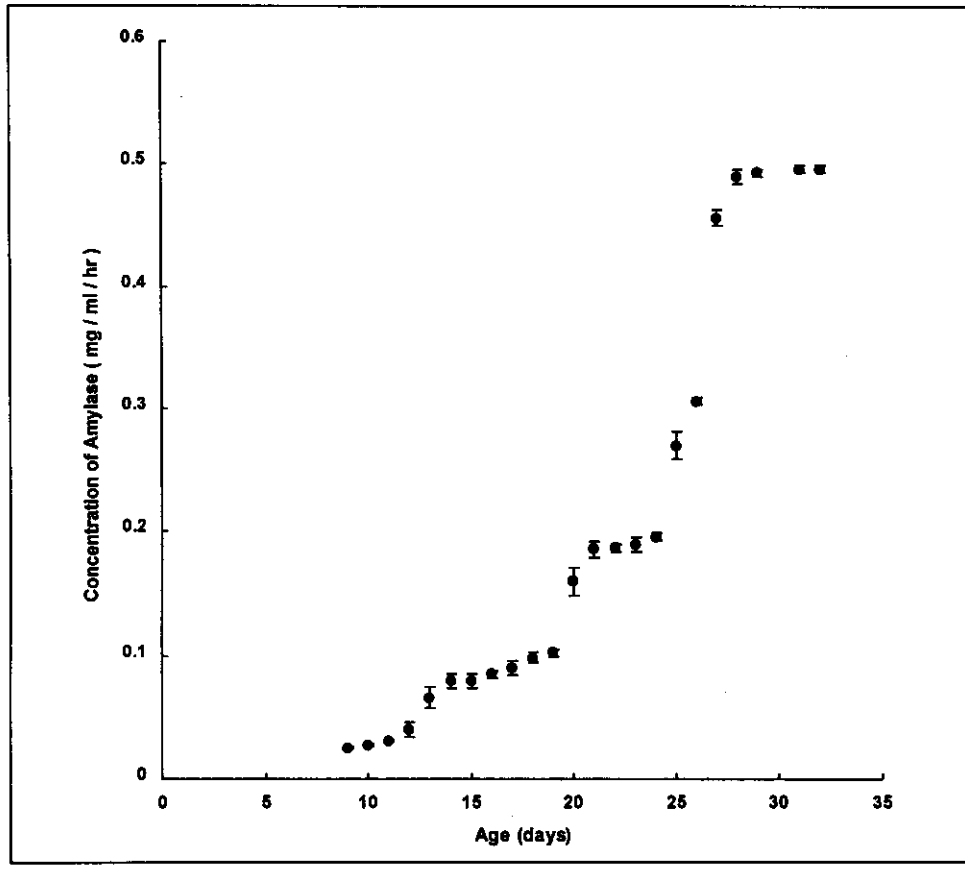
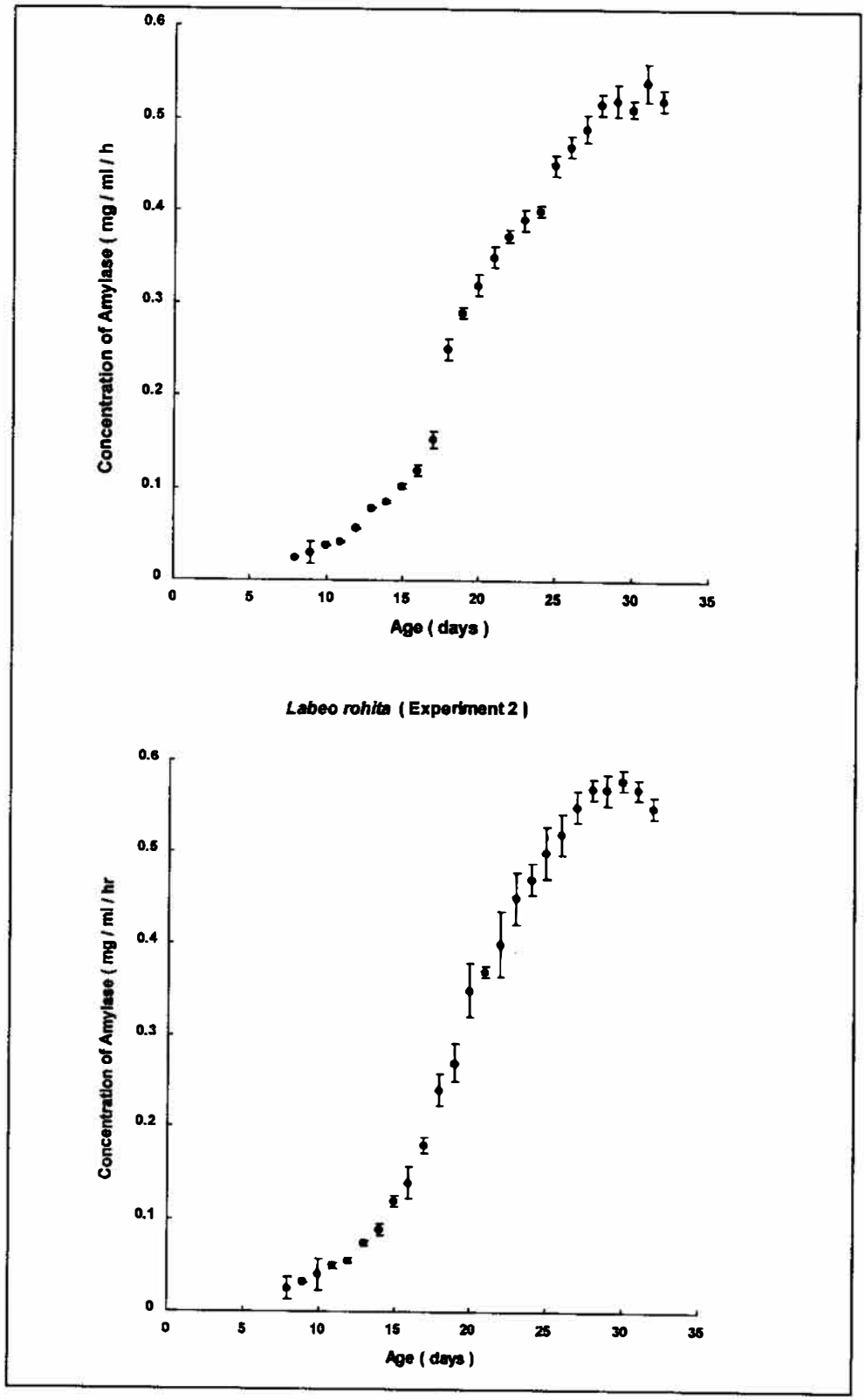


Fig. 1. Ontogenic changes in amylase activity in *Catla catla*.



Figs. 2 & 3. Ontogenic changes in amylase activity in *Labeo rohita*.

Amylase activity was expressed in term of mg of maltose liberated from starch by 1 ml of sample material per hour at 37°C.

Results are given as means ± SEM (n=3).

Results and Discussion

In the first experiment, the weight of catla and rohu increased from 2 mg and 3 mg to 27.80 ± 2 mg and 31.53 ± 1.24 mg, respectively, during the 32-d culture period. In the second experiment, the final weight of rohu (initial weight=1 mg) and mrigal (initial weight=1 mg) were 35.90 ± 3.44 mg and 27.39 ± 1.27 mg, respectively. Amylase activity was measured in these three species on the fourth day after hatching but the amount was negligible (0.01 ± 0.0115 mg·ml^{-1}·hr) during this transition period. Detectable amylase activity was observed on day 9, 8 and 5, in catla (0.025 ± 0.0006 mg·ml^{-1}·hr), rohu (0.024 ± 0.0006 mg·ml^{-1}·hr, 0.025 ± 0.0115 mg·ml^{-1}·hr) and mrigal (0.025 ± 0.0012 mg·ml^{-1}·hr), respectively. As the larvae grew, enzyme activity also increased. In catla, amylase activity showed a curvilinear relationship along with ontogenic development (Fig.1). In both trials in rohu, it was sigmoid type (Figs. 2 & 3), whereas a polynomial (6) type of change was obtained in the case of mrigal (Fig. 4).

In larval walley pollock, enzyme activities increased with age after the transition period and the specific enzyme activities became constant (Oozeki

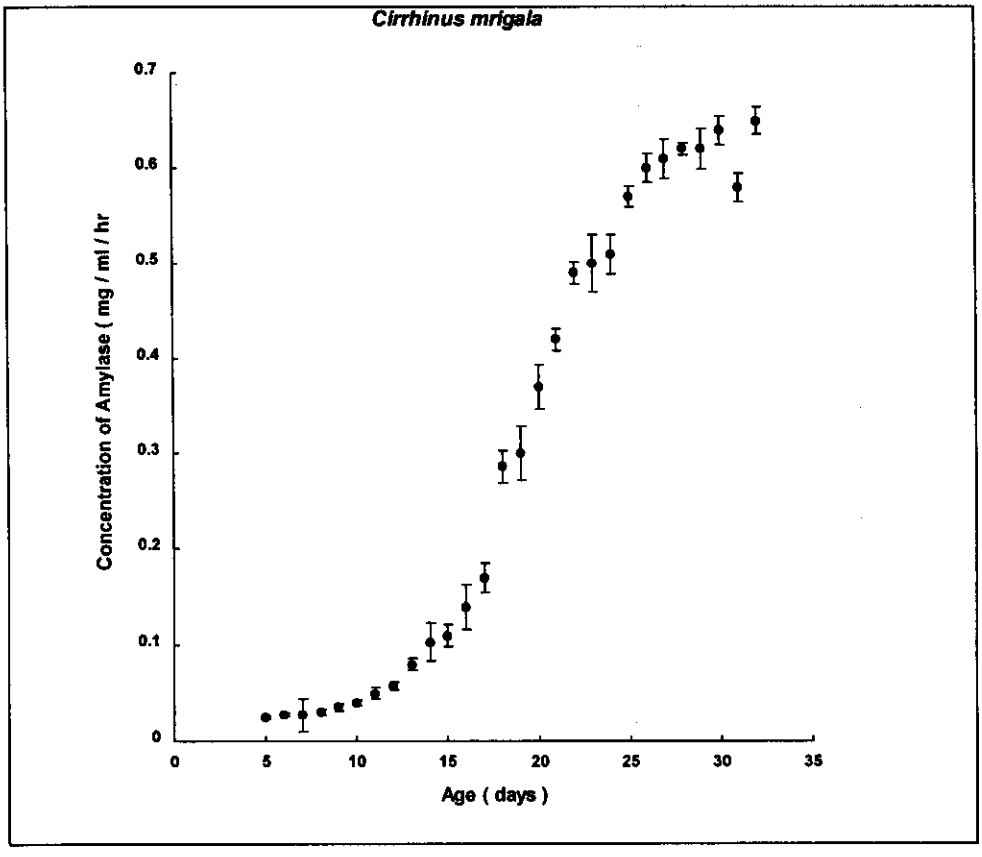


Fig. 4. Ontogenic changes in amylase activity in *Cirrhinus mrigala*.

and Bailey 1995). The present investigation revealed similarities in the development of digestive processes among the three species of Indian major carps. The digestive enzyme in these species can be correlated with their feeding habits. Anderson and Lipovsek (1996) also suggested that the digestive enzyme reflects feeding habits in silver perch. High amylolytic activity was measured in seabream *Sparus aurata* along larval development. This high enzyme activity may be closely related to the ability of digesting carbohydrates occurring in microalgae which are used as food for zooplankton (Moyano et al. 1995). According to Kuz'mina (1996), in freshwater teleosts, digestive enzyme activity was affected by feeding behaviour and biochemical composition. In *Acipenser fulvescens*, amylase activity was low prior to active feeding and, when feeding was initiated, concentration increased in the alimentary canal extract ($P<0.0005$) and attained their highest levels during the larval feeding period (Buddington 1985). Age-related changes in the amount of digestive enzymes appear to represent evolutionary adaptations to the various diets and nutritional requirements of a particular life history stage. The results of the present study indicate that starch can be readily hydrolyzed and, even in zooplanktivore fish, helps digest glycogen which is present in animal tissues.

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