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Carotenoids Pigmentation in Polyacanthus *Fasciatus* during Spawning Period

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Abstract—Development of pigmentation during the spawning seasons in Polyacanthus fasciatus, a freshwater ornamental fish, has been studied from January till the end of the spawning season or the spent phase of the fish. The fish showed the development of colouration from the end of January and a high concentration of the same has been observed from March, April and May. The pigmentation i.e the total carotenoids was measured from the visible absorption at 450 nm taking 2500 $E^{1\%}_{1cm}$ value from the lipid extracts of scales, fins, muscle and ovary . There is high deposition of carotenoids pigmentation in their eggs. In all tissue, organs, scales and fins the pattern of accumulation of carotenoids started from the beginning of February till the end of spawning season

Keywords—Carotenoids, Ornamental fish, Polyacanthus fasciatus, spawning season

I. INTRODUCTION

The bright external colouration of animals, plants and fish in particular has attracted the attention of biologists and aquaculturists since time immemorial. Fishes are unable to synthesise carotenoids, which has to be obtained from food containing these compounds. The food containing colouration i.e. carotenoids, plays a significant role in the synthesis of vitamin A in fish (Barua and Goswami, 1977; Goswami and Barua, 1981,a,b,c; Goswami 1984).

The diversity of freshwater fish, including ornamental fish belonging to various groups, provides excellent resources from different ecological niches. It has been known that the magnificent colouring particles of ornamental fishes are due to the presence of a lipid class of molecules known as carotenoids which provide the red, yellow, orange or green colouration of the fish. It has been found (Goodwin 1984) that carotenoid pigments are widespread in fish dwelling in both marine and freshwater habitats. These lipid soluble pigments colour the fish integuments, muscle and gonads of the fish. Different pigments or carotenoid molecules such as β-carotene, β-apocarotenals, lutein, cryptoxanthin, astaxanthin, echinenone etc. provide brilliant lusture of a mixture of several pigments of colouration in various species of freshwater fish (Goodwin, 1984; Barua and Goswami, 1977; 2012; Goswami, 2003; 2007;2011). During metabolism, the biogenesis of the carotenoid pigment and its conversion and absorption into various retinoids depend upon several environmental factors such as water quality, monsoon, temperature**,** pH etc.(Parker, 1996; Goswami 2003;Sharma and Goswami 2011) The pigmentation of carotenoids accumulation has been studies from the fish collected from the wetlands and as well as compared with the aquarium rearing fish during the same period . Males attain more carotenoids in muscles, scales, and fins, while there is high deposition of the same in ovary.

The provitamin A status carotenoids are converted into retinol and dehydroretinol (Barua and Goswami 1977; Goswami and Barua 1981, a,b,c; Goswami and Bhattacharya 1982;Goswami 1984; 2011; Krinsky 1993). The manifold function of carotenoids has been reviewed by Krinsky (1993).

II. MATERIALS AND METHODS

Collection of fish:Fishes, *P fasciatus,* were collected from different wetlands from January onwards till the end of the spawning period. In each collection, emphasis has been made to collect both sexes. The scales, fins muscle and gonads from each month were dissected out and the pigments were isolated following the procedure referred from our earlier studies (Barua and Goswami, 1977; Goswami and Barua 1981,a,b,c; Goswami 1984; Sharma and Goswami, 2005) . The lipids were extracted through light petroleum (40-60°C)

ether using anhydrous sodium sulphate The uv-visible spectroscopy were made and total carotenoids pigments were measured from its absorption at 450 nm and taking the $E^{1\%}_{1cm}$ value 2500.

Further a set of experiments were conducted after keeping the fish in 3 aquariums (90 cm x 60 cm, 60 fish in each aquarium) from January till the end of the spawning period . The fishes were provided the aquarium feed as referred (Goswami 2011). Fishes from each aquarium containing both sexes were taken and their carotenoids were isolated, as referred above, from scales, fins muscle and gonads.

III. RESULTS

The lipid extract of scales, fins muscle and ovary were subjected to visible absorption spectroscopy at 450 nm and the same were measured. In Table 1-2 the amount of total carotenoids from January, February onwards has been presented.

Source	Sex	Scales							
		January	February	March	April	May	June	July	August
WL	M	15.5±1.5	30.5±1.5	115±2.5	130.5±1.5	135±1.5	130±0.5	125±0.5	118±1.5
	F	10.0±0.5	15.5±0.5	110±1.5	129.5±3.5	132.5±2.5	128±2.5	120±2.5	100±1.5
Aq	M	12.5±1.2	25.2±2.5	100.5±2.5	120.5±2.5	129±1.5	120.5±1.5	115±2.5	98.5±2.5
	F	9.5±0.5	20.5±1.5	95.5±2.5	115±2.5	125±1.5	120±1.5	110±1.5	90.5±1.5
	Sex	Fins							
		January	February	March	April	May	June	July	August
WL	M	9.5(±0.5)	20.5(±1.5)	107(±2.5)	112(±3.2)	128(±2.5)	122(±3.5)	118(±4.0)	90.5(±3.5)
	F	7.5(±0.5)	18.5(±1.5)	98.5(±2.5)	115(±2.5)	120(±3.0)	100(±1.5)	85(±3.5)	75(±3.5)
Aq	M	7.5(±0.5)	11.5(±1.5)	75.5(±2.5)	98.2(±1.5)	115(±1.5)	110(±2.5)	105(±2.5)	80.5(±0.5)
	F	8.5(±2.5)	15.0(±3.5)	92.5(±4.0)	112(±5.3)	125(±5.5)	98.5(±1.5)	100(±2.0)	90.5(±3.5)
Source	Sex	Muscles							
		January	February	March	April	May	June	July	August
WL	M	10.5(±1.5)	19.0(±0.5)	105(±7.5)	115(±5.2)	125(±2.5)	115(±4.5)	99.5(±7.2)	80.5(±305
	F	8.5(±0.5)	15.0(±1.5)	90.5(±2.5)	98.5(±1.5)	110.5(±7.2)	100.2(±5.2	89.2(±1.5)	75.5(±1.)
Aq	M	8.0(±1.5)	12.5(±0.5)	98.2(±2.5)	107.5(±7.2)	119.2(±6.5)	112.5(±5.0	90.2(±3.5)	75.5(±1.)
	F	7.2(±1.0)	11.0(±2.5)	90.2(±4.5)	95.5(±6.2)	101.2(±7.5)	95.5(±9.5)	80.5(±2.5)	65.5(±1.)

Table 1. Carotenoids (µg /100g) content in *P.fasciatus*(5-6.5 cm) from wetlands (n=15/month)and aquarium (n=15/momth) rearing. The carotenoids are measured from scales, fins, muscles, and ovary.15 fishes were taken from each month from both sexes. (WL = Wetland, Aq = Aquarium, M=Male, F =Female

Sources	Ovary							
	January	February	March	April	May	June	July	August
WL	15.5(±3.2)	18.5(±1.5)	120.2(±7.2)	130.5(±4.5)	135.2(±5.5)	130.0(±2.5)	25(±1.5)	10.0(±0.5)
Aq	12.5(±1.5)	15.5(±2.5)	110.5(±1.5)	125.2(±2.5)	130.5(±1.5	55.0(±3.5)	1.5(±1.5)	9.0(±0.5)

Table 2 Carotenoids (µg/100 g) content in *P.fasciatus* (5-6.5 cm) from wetlands (WL) an Aqurium (Aq) (n=15/month)and

IV. DISCUSSION

Various factors such as hormones, nervous control, nutritional status, overall physiological responses and environmental factors control the retinoids reserve as well as its synthesis. Besides these, changes of season, presence of xenobiotics, age, sex and geographical isolation are responsible for the occurance, physiological actions of retinoids (Goswami, 2003; 2011). Temperature, salinity and internal factors such as reproductive physiology also influence the lipid content of freshwater organisms. Dynamic interactions between these factors produce the temporal patterns in the lipid content of the fresh.

In the present studies, it has been seen that the fish *P.fastiatus*, a freshwater ornamental fish developed the carotenoids pigmentation for February onwards and attained maximum accumulation in March to May. *P. fasciatatus* usually breed once in a year during the pre monsoon and monsoon periods. Gonads start gametogenesis from the end of January and with the metamorphosis, eggs develop full maturity during April, May and breed during that period. Several factors such the beginning of pre monsoon or monsoon, temperature of fresh water and clean aquabodies etc are some significant factors (Goswami,2003) for the successful maturation and spawning of the fish. The concentration of pigments are initiated along with the maturation of gonads. The carotenoids pigment injested from the feed of the fish such as different algae, crustaceans are absorbed by the intestinal epithelium and are transported to the different parts of the body and accumulate in muscles, scales fins, liver and further transported to the gonads. The LDL, transport the lipid containing the pigments and stored in the ovary (Parker, 1996; Christine, *et.al*.,2006; Connor *et.al*.,2007**;** Goswami,2011) Pigmented eggs are essential for the development of the fishes after these fertilizing (Goswami,2011). In the present studies, it has been found that fish collected from the wetlands contain more deposition of carotenoids than the fish reared in the aquariums, The carotenoids provide the ornamental characteristics of the fish. *P. fasciatus* is a high valued ornamental fish. Male fish attain more carotenoids the female Ovaries contain considerable amount of carotenoids.

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