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ASCORBIC ACID TURNOVER IN THE OCULAR TISSUES OF SOME FISHES

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ABSTRACT

The ascorbic acid turnover from the ocular tissues of 11 species of fishes from a culture pond and the river Godavari has been studied. The free ascorbic acid and ascorbigen contents were more in the case of bottom or deep dwelling fishes and the least in the case of surface living forms, depending upon the light penetration in the area that each species inhabits. The enzymic utilization and ascorbic acid-macromolecule complex varied among the fishes possibly depending upon individual energy requirements and not upon light intensity. No size-related or sex-related variation was observed. No variation was observed between riverine and pond-reared fishes of the same species.

INTRODUCTION

It has been shown (Dey and Raghuvarman, 1988) that frogs inhabiting well lighted areas contained a small amount of ascorbic acid in the eye lens whereas members living in shaded areas had comparatively higher amounts of lens ascorbic acid; among the mammals, nocturnal bats were reported to contain higher amounts of ascorbic acid in the lens. Rawal and Rao (1977) observed fishes which swim on the surface or on the upper strata of water had smaller amounts of ascorbic acid in the lens compared to those fishes from deeper, or bottom, waters. Similar changes in the ascorbic acid content related to the availibility of light was shown in two prawns, one from brackishwter and another from freshwater habitats by Dey and Raghuvarman (1988).

The concept of composite or polyculture of fishes involves the growing of fishes which inhabit different depth strata so that all the available ecological niches in a pond are effectively utilized. However, despite the presence of clear-cut euphotic and aphotic zones in any culture pond, the vertical magnitude of these light zones are considerably reduced compared to a riverine or lacustrine area which the cultured fishes normally inhabit.

The present study was taken up to ascertain the light related changes in the ascorbic acid content of the ocular tissues of certain fishes from two different habitats namely a polyculture pond and the Godavari river. Except that of Rawal and Rao (1997) there are no other works on this aspect on fishes especially the commonly cutured craps.

MATERIAL AND METHODS

1) Species studied:

The following fishes from a polyculture pond of the Freshwater Fish Farm (CIFE) Balabhadrapuram, Andhra Pradesh, were collected during February to April 1991 and used for this study. 5 specimens belonging to both sexes in each size group of each species were studied.

i) *Catla catla* (14.0 cm/45.0g to 47.0 cm/1095.0g).

ii) Hybrid catla (av.size:15.5cm/35.0g).

iii) *Labeo rohita* (18.0 cm/50.0g to 35.0 cm/650g).

iv) *Cirrhina mrigala* (15.5 cm/30.0g to 34.0 cm/500g).

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v) *Hypophthalmicthys molitrix* (14.0 cm/30g to 39.0 cm/500g).

vi) *Ctenopharyngodon idella* (10.0 cm/10g to 23.0 cm/200 g).

vii) *Cyprinus carpio communis* (10.0 cm/20g to 33.0 cm 750 g).

The following fishes were collected from landing centres of the river Godavari at Doleshwaram and Bobarlanka, Andhra Pradesh; 10 specimens of both sexes of each of the following were used for the present study:

i) *Catla catla* (av.size : 25.5 cm/200.0g).

ii) *Labeo rohita* (av.size:30.0 cm/300.0g).

iii) *Cirrhina mrigala* (av. size : 29.0 cm/ 250.0g).

iv) *Cirrhina reba* (av. size : 20.0 cm/60.0g).

v) *Mugil corsula* (av.size : 9.0 cm/10.0g).

vi) *Rita hastata* (av.size : 10.0 cm/10.0g).

vii) *Mystus aor* (av.size : 37.5 cm/227.5g).

A few specimens in each case were refrigerated for varying periods upto 96 hours but the bulk of the study was based on freshly killed specimens in both categories:

2) Ascorbic Acid Turnover:

Ascorbic acid turnover in the ocular tissues of these fishes have been studied by simultaneous determination of

i) free form of ascorbic acid (AA);

ii) bound form of ascorbic acid (ASG);

iii) enzymatic utilization of ascorbic acid (AAU); and

iv) association of ascorbic acid with macromolecules (AA-MM)

following the method of Chinoy *et al.* (1976).

RESULTS

The ascorbic acid turnover in the ocular tissues of the pond- reared fishes are presented in table I and those of the riverine species in Table II.

Table I : *Showing ascorbic acid turnover in the ocular tissues of pond-reared fishes*

SPECIES	AA mg/g	ASG mg/g	AAU mg/g	AA-MM mg/g
Catla catla	0.20 ± 0.09	0.20 ± 0.08	0.69 ± 0.20	0.35 ± 0.10
Hybrid catla	0.39 ± 0.09	0.38 ± 0.07	0.75 ± 1.23	5.10 ± 1.02
Labeo rohita	0.49 ± 0.12	0.53 ± 0.09	18.14 ± 1.01	9.75 ± 1.25
Cirrhina mrigala	0.62 ± 0.10	0.68 ± 0.04	6.30 ± 0.30	7.00 ± 0.09
Hypophthalmicthys molitrix	0.16 ± 0.14	0.15 ± 0.09	0.88 ± 0.14	0.78 ± 0.09
Ctenopharyngodon idella	0.58 ± 0.14	0.60 ± 0.09	10.80 ± 0.09	0.89 ± 1.00
Cyprinus carpio	2.50 ± 0.98	0.99 ± 1.03	8.01 ± 0.52	6.50 ± 0.53

AA : Free ascorbic acid. ASG : Ascorobigen. AAU : Enzymic utilization of ascorbic acid. AA-MM : Ascorbic acid-Macromolecule complex. All values are means of 10 experiments with Standard Deviation.

Table II : *Showing ascorbic acid turnover in the ocular tissues of riverine fishes*

SPECIES	AA mg/g	ASG mg/g	AAU mg/g	AA-MM mg/g
Catla catla	0.19 ± 0.09	0.23 ± 0.07	0.80 ± 0.09	0.36 ± 0.13
Labeo rohita	0.50 ± 0.13	0.55 ± 0.07	17.89 ± 1.11	9.00 ± 1.36
Cirrhina mrigala	0.68 ± 0.07	0.68 ± 0.09	6.73 ± 0.43	6.93 ± 0.15
Cirrhina reba	0.70 ± 0.50	1.73 ± 0.57	4.98 ± 3.13	4.34 ± 2.98
Mugil corsula	0.70 ± 0.09	4.50 ± 3.00	35.48 ± 4.43	45.39 ± 14.62
Rita hastata	1.48 ± 0.61	1.51 ± 0.91	6.59 ± 0.48	22.12 ± 15.91
Mystus aor	0.29 ± 0.07	0.15 ± 0.09	3.50 ± 1.01	0.70 ± 0.05

AA : Free ascorbic acid. ASG : Ascorobigen. AAU : Enzymic utilization of ascorbic acid. AA-MM : Ascorbic acid-Macromolecule complex. All values are means of 10 experiments with Standard Deviation.

No variation was noticed in the four different types of ascorbic acid content among the various size categrories such as fingerlings, yearlings, adults etc. of any given species. Similarly there were no differences in the values of these components between males and females. Refrigeration (upto 96 hours) had not altered the results in any way.

Little or negligibly small variations were noticed in the ascorbic acid turnover between pond-reared and riverine specimens of the same species.

The lowest levels of AA were recorded in the case of *Hypophthalmichthys molitrix*, followed, in increasing order, by *Catla catla, Mystus aor, Hybrid catla, Labeo rohita, Cirrhina mrigala, Cirrhina reba, Mugil corsula* and *Rita hastata.*

The levels of ASG in the different species followed a trend very much similar to that of the AA, whereas the levels of AAV and the AA-MM were highly variable from those of AA content in the different species.

DISCUSSION

i) Free Ascorbic Acid (AA) :

Rawal and Rao (1977) reported that fishes such as *Barbus pinnuratus* which swim on the surface or on the upper strata of water had a small amount of ascorbic acid in the lens; in contrast to this, fishes which inhabit deeper or bottom waters, for eg. catfishes, had significantly higher amounts of ascrobic acid in the lens.

Dey and Raghuvarman (1988) observed a similar phenomenon in the case of two prawns: *Macrobrachium biramanicum* inhabiting clear streams had lower amounts of ascrobic acid while *Metapenaeus* sp. from turbid brackish-water areas had higher quantities of ascorbic acid in the compound eye.

Similar results had been obtained in the present study also. The lowest levels of ascrobic acid were found in the ocular tissues of surface dewlling forms such as *Hypophthalmicthys molitrix* and *Catla catla* while the highest amount of ascrobic acid was recorded from *Rita hastata*, a bottom dewlling form. The low levels of ascorbic acid in the case of *Mystus aor* could be due to their active predatory habits whereby they feed upon teleost fishes; such a habit would make them spend a considerable time in well lighted zones of the aquatic habitat. The amount of ascorbic acid found in each case clearly conforms to the depth-related light zones which each species inhabits.

ii) Ascorbigen (ASG) :

The level of ascorbigen in each case was very much close to the corresponding free ascorbic acid level, in contrast to the findings of Dey and Raghuvarman (1988) who reported ASG values very much different from the corresponding AA values in the two prawns they have studied. However, the present results agree well with the findings of Dey and Raghuvarman (1988) in that the ascorbigen levels also showed a light oriented increase or decrease exactly similar to the variations exhibited by free ascorbic acid levels.

iii) Enzymic Utilization of Ascorbic Acid (AA) and Ascorbic Acid Macromolocule Complex (AA-MM) :

These two components exhibited wide variations among the species but failed to conform to the light oriented pattern (as exhibited by AA and ASG) as reported in prawns by Dey and Raghuvarman (1988).

Ascorbic acid is continuously acted upon by a number of oxidising enzymes, which include a special peroxidase which catalyses the formation of its free radical (FR), mono dehydroascorbic acid (Gurevich, 1963). Mono dehydro ascorbic acid, by virtue of possessing an unpaired electron, has stronger reducing properties than ascorbic acid. It is known that it participates in several oxidation reduction in some tissues and acts as a source of electron energy in addition to the energy obtained by those tissues through the conventional break-down of ATP (Chinoy *et al.* 1978) . Therefore, there are grounds to assume the variaitions observed in the present study to have been influenced more by the individual energy requirements than by a general light oriented pattern which was reported in prawns by Dey and Raghuvarman (1988).

iv) Other variations :

The fact that the pattern of variations observed in the riverine forms persist in the pond-reared forms also, and the fact that there are no size or sex-related variations may indicate that these essentially ecotypic variations could have become implanted to the level of being genetic in these fishes.

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