they differ in having a different type of sex mechanism. Whereas the present material exhibits an XY-type of male sex-determination like many other dermapterans[1,2,5,6,12–15], *Allodahlia macropyga* reveals an XO-type of sex-determining mechanism.

The authors are grateful to Prof. G. P. Sharma and Prof. S. Khera for providing laboratory facilities.

June 16, 1980.

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ORIGIN OF RETINOL IN FRESHWATER FISH

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THE origin of retinol in mammalian and avian species is well established. Of the several carotenoids β-carotene is considered as the best precursor of retinol and the conversion of β-carotene into retinol takes place in the small intestines (Mitson *et al.*[9], Thomson *et al.*[10], Glover *et al.*[6]). However the picture is not clear in the case of freshwater fish which contain a second form of vitamin A, *viz.*, 3,4-dehydreretinol. We have reported that *Heteropneustes fossilis* can convert lutein (β, ε-carotene-3, 3-diol) into dehydroretinol (Barua *et al.*[1,3]). The fish can further convert 3-hydroxyretinol (Barua *et al.*[4]). When β-carotene is fed to *H. fossilis*, a dehydroretinol predominant fish evidence was obtained of the conversion of β-carotene into retinoic acid and only occasionally into retinol (Barua and Goswami[2]). *H. fossilis* can therefore convert lutein into dehydroretinol either to compensate the toxic effect of large quantities of retinoic acid formed from β-carotene which can support growth (Krishnamurthy *et al.*[7] Malathi *et al.*[8], Zile and Deluca[11]) only or to take active part in vision (Dowling and Wald[5]) and reproduction (Thomspon *et al.*[10]), the two important functions which cannot occur in the absence of retinol.

All the freshwater fishes are not dehydroretinol predominant, some like the mammalian and avian species contain mainly retinol. We therefore, considered that the study of conversion of β-carotene into vitamin A in retinol rich freshwater fish would be interesting. We report here that *Channa gachua*, a retinol rich fish like other mammalian and avian species, can convert β-carotene into retinol.

The sources of solvents, chemicals and other experimental methods like administration of carotenoids, extraction of lipids and chromatography etc. were described in our previous report (Barua and Goswami[2]).

Channa gachua, a retinol predominant freshwater fish (murrel) were acquired from local fish market and were kept in earthenware vessels with perforated lids. The fishes were kept alive and starved for 25-30 days. The intestinal extract of *C. gachua* maintained in starved condition was found free of any detectable amount of vitamin A or carotenoid after 25–30 days. Only those groups of fish which were found free from any vitamin A or carotenoid were used in the metabolism of β-carotene.

The intestines of the starved fish which were found free from carotenoid and vitamin A as judged from the ultraviolet and visible absorption spectra fail to produce any colour with antimony trichloride reagent confirmed that the intestines were free from any vitamin A or carotenoid. Aqueous suspension of β-carotene in Tween–80 (1000 μg/ml) as described by Barua and Goswami[2], was administered. The fish were killed 4-6 hours after the administration of β-carotene. The carotenoids and any vitamin A formed were separated by column chromatography of the intestinal extracts on water deactivated (5%) alumina columns and characterised by their ultraviolet and visible spectra and antimony trichloride blue colour. It was possible to isolate or detect retinyl ester (Table I) in most of the experiments.

In continuation of our previous findings (Barua and Goswami[2]) that *H. fossilis*, a dehydroretinol

TABLE I

Isolation of retinyl ester from the intestines of Channa gachua *after administration of β-carotene*

No. of fish used	Total amount of β-carotene administered (μg)	Time between administration and killing (h)	Total amount of β-carotene recovered (μg)	Total amount of retinyl ester formed (μg)
2	1160	4	33	52
5	1740	4	24·8	80·2
4	2320	4	696	116·4
1	580	5	22	65·9
4	2320	5	51·2	83·5
1	580	6	..	40·6
6	3480	6	756	178·5
7	4060	6	864	68·5
8	4640	6	584	145

predominant fish could convert β-carotene into retinoic acid and occasionally into retinol, it was considered worthwhile to study the metabolism of β-carotene in *C. gaucha* a retinol rich freshwater fish in the same way as was done in the case of *H. fossilis*.

Channa gachua like other mammalian and avian species can convert β-carotene into retinol. Here we fail to isolate retinoic acid which may form from β-carotene in the intestines of β-carotene administered fish. From these experiments it can be seen that *C. gachua* behaves like most animal species. The exception found in *H. fossilis* which appears to lack of retinaldehyde reductase to have a lot of aldehyde oxidase and not so much enzymes catabolising retinoic acid. There may be every possibility of formation of retinoic acid, but probably it has much less aldehyde oxidase; and the small amount of retinoic formed is rapidly catabolised, so it was not easy to detect in the intestinal extracts after the administration of β-carotene in *C. gachua*.

Although it cannot be generalised from the present and the previous studies that retinol predominant fish can convert β-carotene into retinol, yet we think that like other mammalian and avian species β-carotene may act as best precursor in retinol predominant freshwater fish. Further it can be concluded from the present studies that fish are capable of conversion of β-carotene into either retinol or retinoic acid, but are unable to convert β-carotene into dehydroretinol.

Authors like to thank Professor N. N. Siddhanta, Head of the Department of Chemistry, Gauhati University, for providing the necessary facilities and Professor J. Ganguly, Chairman of Biochemistry Department, Indian Institute of Science, Bangalore, for useful discussions.

June 20, 1980.

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EFFECT OF ZINC ON ADENOSINE TRIPHOSPHATASE ACTIVITY IN THE GILLS OF *CHANNA FUNCTATUS* (BLOCH)

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SOME of the freshwater reservoirs in and around Udaipur receive zinc and other electrolytes from industrial effluents[1]. The toxic effects of zinc ions on edible fishes are poorly understood[2]. Further, very little is known about the zinc toxicity induced enzymological changes in the vital organs such as gills[3].

The present work reports the changes in the histochemical activity and distribution of adenosine triphosphatase (ATPase) in the gills of an edible teleost *Channa punctatus* (Bloch).

Fish weighing 2·4 g with total length of 58 mm were collected locally and acclimatised to laboratory regimen for 10 days. They were challenged with 56 ppm of Zn for 8 and 24 hr of exposures. Controls