Carotenoid Metabolism in Fancy Red Carp, *Cyprinus carpio*—II Metabolism of ^{14}C -Zeaxanthin

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The absorbed free form zeaxanthin, partially stored in the intestine and hepatopancreas, is transferred to the integument directly or through the hepatopancreas. In the integument, zeaxanthin is esterified and converted to astaxanthin via adonixanthin to maintain the equilibrium among zeaxanthin ester, adonixanthin ester and astaxanthin ester.

Recently it has been confirmed that fancy red carp has the ability to convert zeaxanthin to astaxanthin.¹⁾ However the detailed metabolism of zeaxanthin in fancy red carp is unknown. This paper deals with the distribution and change of radioactivities in the various organs and carotenoid fractions of the integument of fancy red carp administered ^{14}C -labeled zeaxanthin.

Experiments

Administration of ^{14}C -Zeaxanthin ^{14}C -labeled zeaxanthin (1.8×10^5 dpm/mg) prepared from physalis was administered to the fancy red carp, 0.2 ml, about 0.3 mg per fish, with polyethylene catheter.²⁾ The water temperature was kept at 25°C.

Analysis of carotenoids Carotenoids were extracted with acetone and separated by silicic acid column chromatography and thin layer chromatography.³⁾ The contents of the intestine were washed out before extraction. The radioactivity was counted by a liquid scintillation spectrometer after discolouration with benzoyl peroxide.⁴⁾

Autoradiography of acetone extracts of the hepatopancreas and intestine The acetone extracts of the hepatopancreas and intestine were subjected to silica gel thin layer chromatography with petroleum ether-ethyl ether (9:1). After chromatography, the plate was placed on Sakura nonscreen type industrial X-ray film for 112 days.

Results and Discussion

The distribution of radioactivities in the various organs is shown in Fig. 1. The autoradiograms of acetone extracts of the hepatopancreas and intestine are shown in Fig. 2. Only one spot corresponding to free form zeaxanthin was recorded on the X ray film. This result suggests that in the hepatopancreas and intestine the absorbed zeaxanthin will not be esterified nor metabolized to any other fatty substance. Therefore, the radioactivities shown in Fig. 1 show the behavior of absorbed ^{14}C -labelled zeaxanthin

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Fig. 1

Fig. 1. The change of radioactivities of acetone extracts in the various organs of fancy red carp administered ^{14}C -zeaxanthin (two fishes/group)
 ○: integument, △: intestine, ×: hepatopancreas

Fig. 2

Fig. 2. Autoradiogram of acetone extracts of the hepatopancreas and intestine of fancy red carp a week after the administration of ^{14}C -zeaxanthin.
 A: hepatopancreas, B: intestine

Fig. 3

Fig. 3. The change of radioactivities of carotenoid fractions in the integument of fancy red carp administered ^{14}C -zeaxanthin (two fishes/group)
 ○: fraction 1 (zeaxanthin ester), △: fraction 2 (adonixanthin ester), ×: fraction 3 (astaxanthin ester), □: total of these three fractions

Fig. 4

Fig. 4. The change of ratio of radioactivities of carotenoid fractions in the integument of fancy red carp administered ^{14}C -zeaxanthin (only one fish was used in ten days)
 ○: fraction 1 (zeaxanthin ester), △: fraction 2 (adonixanthin ester), ×: fraction 3 (astaxanthin ester)

itself. After the administration, the radioactivity in the intestine increased during the first two days and then decreased gradually. Comparing the phenomenon with that in the integument where the accumulation of the dosed radioactivity was more rapid and ever increasing, the intestine seems to be an organ for only temporal accumulation. Thus the capacity of the temporal accumulation of fancy red carp intestine was smaller than that of goldfish.²⁾

The constant low level radioactivity of the hepatopancreas suggests that the hepatopancreas stores zeaxanthin on some level. The excess zeaxanthin would pass through the hepatopancreas rapidly.

The distribution of radioactivities of carotenoid fractions of the integument is shown in Fig. 3. Increase of radioactivity was observed in all fractions. The increasing rate of fraction 1, ¹⁴C-zeaxanthin ester, however, was very different from others. The radioactivity of fraction 1 increased rapidly during the first two days and then slowed down thereafter. On the other hand, the radioactivities of fraction 2, adonixanthin ester, and fraction 3, astaxanthin ester, increased gradually during the experiment. The change of the ratio of these fractions are shown in Fig. 4. The ratio of radioactivity among three fractions became constant after a week. The results of Fig. 3 and Fig. 4 suggest that zeaxanthin is converted to astaxanthin via adonixanthin to maintain the equilibrium among these carotenoids. Existence of equilibrium among these carotenoids was already observed in goldfish.³⁾ These conversion phenomena of carotenoids seem to take place in the ester form in the integument because the ketocarotenoids have not been found in the other organs and the most parts of these carotenoids occur in ester form in the integument.

References

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