CHAPTER IV

DISCUSSION

Effect of Astaxanthin and Canthaxanthin on the Coloration of Juvenile Giant Tiger Prawns

The present study found that the addition of astaxanthin and canthaxanthin to the prawn diets could slightly enhance the growth rate. Though there was no significant difference on growths among the groups fed different levels of either astaxanthin or canthaxanthin, the higher levels of these two carotenoids were seemed to enhance the growth. The moulting rates also showed a similar trend. The groups fed higher levels of either astaxanthin or canthaxanthin were seemed to increase the moulting rate. Up to the present time there is no report on the beneficial effect of astaxanthin and canthaxanthin on growth of giant tiger prawns. However Torrissen (1984) reported that an addition of 30 mg astaxanthin in 1 kg feed was seemed to result in the growth enhancement of a salmonid fish.

Increase in prawn size as a result of growth is another factor that can dilute the carotenoid pigmentation, if the amount of carotenoids in the food is not sufficient.

With this reason, the increase of pigmentation could be done by increasing carotenoids in the feed to the level which the carotenoid uptake is relatively higher than the growth rate. The current study found that the addition of astaxanthin in feed at the level between 50 ppm and 100 ppm and the addition of canthaxanthin in feed at the level between 100 ppm and 200 ppm could increase the pigmentation of giant tiger prawns to the normal level or even more intense than the normal. Menasveta *et al.* (in press) also reported that the level of 50 ppm astaxanthin could correct the prawn coloration after one month of feeding.

The level of carotenoids deposited in the body of the prawn was directly related with the duration of feeding and the amount of carotenoids in the diet. Normally, the optimal level of carotenoids the diet will result in an asymptote accumulation, i.e. a saturation level at which any increase in dietary astaxanthin will not significantly affect the pigment response. McKay (1987) reported the use of astaxanthin to increase the pigment response in American Lobster (*Homarus americanus*) and suggested that an optimal dietary astaxanthin concentration should be between 40-100 ppm in feed. Yamada *et al.* (1990) also suggested that the optimal levels of astaxanthin in *Penaeus japonicus* should be 200-400 ppm. In the current study total carotenoids in

prawns fed with the high levels of astaxanthin and canthaxanthin still increased steadily even after 2 months of feeding. This result suggest that the high levels of both carotenoids used in this experiment may not be the optimal ones.

The current study also proved that astaxanthin was more effective than canthaxanthin in pigmentation of the prawn. The amount of canthaxanthin had to be 1.85 times of astaxanthin to give the same degree of pigmentation as astaxanthin. This finding was in agreement with that of Yamada *et al.* (1990) which reported that astaxanthin was more effective that ß-carotenoid and canthaxanthin for the pigmentation in *Penaeus japonicus*.

The reasons why astaxanthin is more effective than canthaxanthin might be because more than 90 % of carotenoids in the prawn is astaxanthin . Because of this astaxanthin could be readily deposited in the prawn body. Canthaxanthin itself is the precursor of astaxanthin. It take one more step to change to astaxanthin. This is also the reason why canthaxanthin is less effective. D'Abramo *et al.* (1983) demonstrated that lobsters *(Homarus americanas)* use dietary ß-carotene, echinenone and canthaxanthin as precursors of astaxanthin. The pathways of carotenoid transformation is

crustaceans is shown in Figure 14.

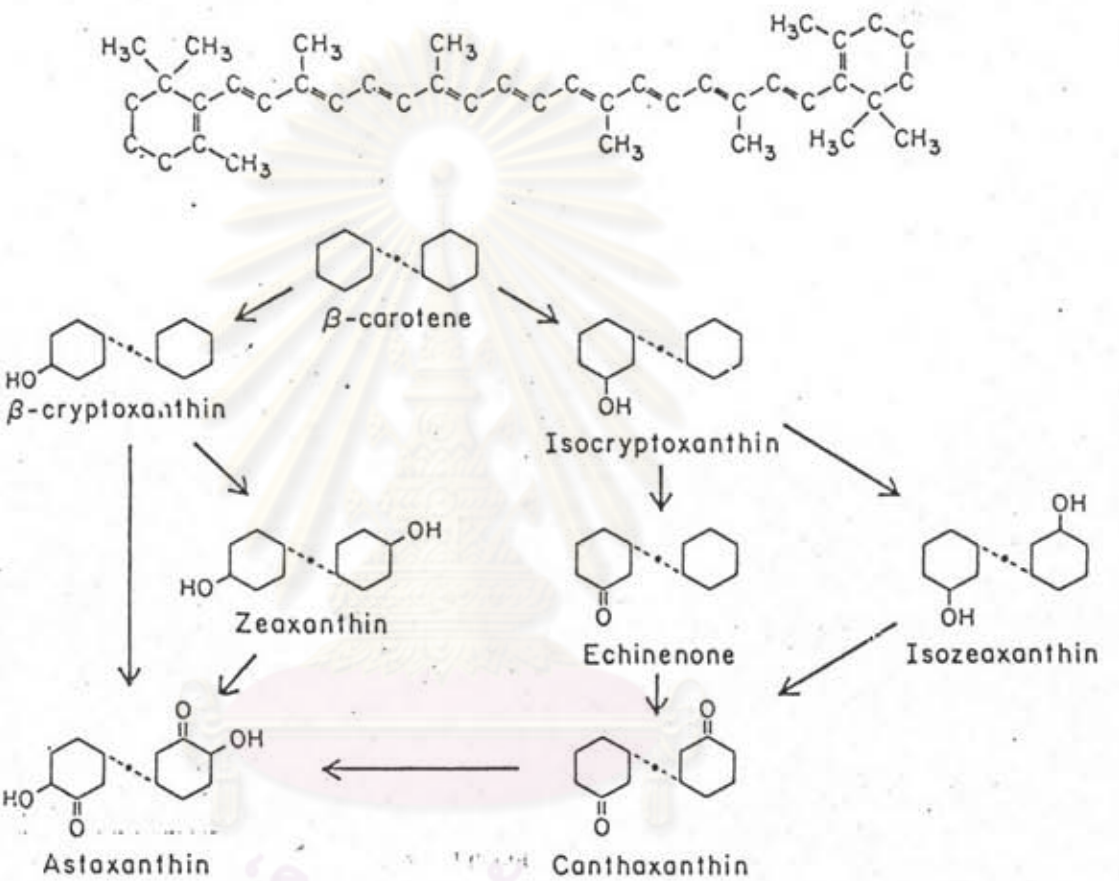

Figure 14. Biosynthetic pathways used by Crustaceans in the transformation of dietary carotenoid (source: D'Abramo *et al.*, 1983).

Effect of Astaxanthin on Gonad Maturation and Spawning of *P. monodon*

Since the effect of carotenoids on decapod maturation has not been studied, the current study presents an introductory account for this topic. Nevertheless, the study revealed the benificial effect of astaxanthin on gonad maturation and spawning. The prawns when fed with maturation diet containing astaxanthin could become gravid and have spawning success more than the control group. Besides they produced significantly higher egg production than the control group. The study in fishes also had a similar result. Deufel (1965) reported that the addition of canthaxanthin in feed could significantly improve the maturation of trout (*Salmo gairdnerii*).

The egg quality in terms of percent fertilized eggs, percent hatching and percent metamorphosis from egg to protozoea of the current study varied greatly and there was no significant difference between the astaxanthin group and the control group. These variation might possibly due to the low mating or unsuccessful spermatophore transfer. Several investigators reported the low mating of penaeid prawns in captivity. Lueng-Trujells and Lawrence (1985) suggested that low mating of *P. vannamei* might had been due to widely fluctuating environmental condition. The water temperature of

the current study was low for a certain period (24.9°c) and this might cause the low mating.

Although the egg quality had a wide variation, the over-all results of this experiment was better than the previous experiments executed at the same place. The improvement might be due to the improved nutritional value of the maturation diet. In this study, highly unsaturated fatty acid was incorporated into the basal diet.

Only the egg quality in term of egg diameter had a significant difference between the astaxanthin group and the control. Egg diameter in the group fed astaxanthin added diet was bigger than the control(0.278 v.s. 0.271 mm). This finding agrees with Harris (1984) which reported that the trout eggs of the control group were slightly smaller than those fed with diet containing canthaxanthin for six months.

The mobilization of carotenoids from hepatopancreas to ripening ovaries were very well documented (Smith, 1911; Abeloos and Fisher, 1926; Fisher, 1926 Green 1957). In the current study it was found that carotenoids significantly increased in the hepatopancreas of the prawns fed with the diet containing astaxanthin for a period of time. Besides, the ovaries also showed the increase in carotenoids but the

levels were much lower and seemed to be comparable between the control and the astaxanthin fed group. This circumstance suggested that the ovaries might have much lower satuation point of carotenoids than the hepatopancreas and carotenoids in the ovaries might be transferred from several sources so that the amount would not directly proportional to the level in the hepatopancreas.