EFFECTIVENESS OF BETA-CYPERMETHRIN ON GLUTAMIC-PYRUVIC TRANSAMINASE (GPT) AND GLUTAMIC-OXALOACETIC TRANSAMINASE (GOT) ACTIVITIES FROM CRUCIAN CARP (*CARASSIUS AURATUS*) SERUM

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Abstract: Beta-cypermethrin is one of the synthetic pyrethroid, which is widely used to control insect pests and is found to be more effective than organphosphates and carbamates. However, it is also reported to be more toxic than organphosphates and carbamates. It has been suggested that synthetic pyrethroids are readily absorbed by the gills of fish even at very low concentrations. Glutamic-pyruvic transaminase (GPT) and glutamic-oxaloacetic transaminase (GOT) exist in the cells of every tissue, particularly in the liver. If the liver is damaged, the enzymes are discharged from the cells into the serum. It increases the GPT and GOT metabolic activities quickly. It is, therefore, proposed that the effects of toxicants on serum GPT and GOT could be used as indexes in toxicological assessments. In this experiment, the effectiveness of beta-cypermethrin on the acute toxicity and on serum GPT and GOT concentration of crucian carp was studied. The LC_{50} of beta-cypermethrin for crucian carp was 11.4μg/L. The crucian carp serum was treated against beta-cypermethrin levels of 0.114μg/L, 0.57μg/L and 1.14μg/L for exposure times of 0d, 5d, 10d, 15d and 20d, at all concentrations. The results show that when the beta-cypermethrin concentration increases and the exposure time is prolonged, the GPT and GOT activities of serum increased also. The results proved that beta-cypermethrin could cause great damage to crucian carp and its biochemical functions.

Key words: Beta-cypermethrin; Acute toxicity; GPT; GOT
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Synthetic pyrethroids are considered as possible substitutes for some organophosphate carbamates or organochlorine insecticides, and have been used extensively for more than two decades[1]. Pyrethroids are preferred over other insecticides because of their easy degradation into non-toxic or less toxic metabolites under natural conditions. Consequently, there has recently been a dramatic increase in the use of pyrethroid pesticides to control insect pests. However, synthetic pyrethroids were also reported to be more toxic than organophosphates and carbamates, especially to aquatic organisms[2].

Beta-cypermethrin is a synthetic pyrethroid insecticide dealing with a wide range of pests in agriculture, public health and animal husbandry. Like other insecticidal synthetic pyrethroids, it is highly toxic to aquatic ecosystems at concentrations as low as 10ng/L, destroying aquatic invertebrates[3—5]. Although the mechanism of beta-cypermethrin to interfere metabolically with several species of fish is still unknown, it has been suggested that it is readily absorbed by the gills of the fish even from very low concentrations in the water[6]. There are numerous sources for cypermethrin such as residues and run-off from land[7]. Most studies on synthetic pyrethroid deal mainly with its acute toxicity rather than its physiological

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and biochemical responses to environmental stress[8]. Therefore, it is essential to understand the effects of various concentrations on acute and sublethal toxicity while also trying to understand its influence on specific metabolic processes in animals, particularly in fish.

Glutamic-pyruvic transaminase (GPT) and glutamic-oxaloacetic transaminase (GOT) can be widely found in mitochondria of many organs, particularly in the liver cells, thus indicating the hepatocytes injury. Normally, the activities of GPT and GOT are not very high in the sera. However, if liver cells are damaged, a remarkable increase of the enzyme activities in the serum will be observed. It has already been reported that SOD activity was remarkably affected in hepatocytes of grass carp after exposure to cypermethrin[9]. It is documented that synthetic pyrethroids can damage hepatocytes in fish. Therefore, the effectiveness of such toxicants as cypermethrin on serum GPT and GOT can be used as indexes for toxicological assessment of beta-cypermethrin[10]. In this experiment, the effect of beta-cypermethrin on acute toxicity, and on serum GPT and GOT activities of crucian carp at different concentrations and different exposed times were studied.

1 Materials and methods

Crucian carp (22±2.5cm) were bought from a fish farm in Wuhan and transferred to the laboratory where air temperature was kept about 25℃. The tap water used throughout the experiment had been stored for at least 3 days to reduce chlorine. During the experiment, water were at 7.8, temperature is 22℃ and an oxygen concentration is 9.36mg/L. The fish were allowed to acclimatize for 7 days to these conditions[11].

Beta-cypermethrin used in this experiment was commodity grade. Its concentration was 4.5%, and its density was 0.927g/ml.

Experiments were carried out in glass aquaria sized 60cm×40cm×50cm using tap water through all experimental periods, and every 10L water. The water were aerated by the simple airstones, and the aquaria water was renewed every two days during the experimental periods[11].

In the acute toxicity experiment, fish were exposed to 9.13, 12.3, 14.6, 18.2μg/L of beta-cypermethrin for 96 hours. The mortality was observed and noted, and the LC_{50}/96h was calculated.

In the later experiment new fishes were divided into 4 groups. They were exposed to 10%, 5%, 1% of LC_{50}/96h of beta-cypermethrin. And the fish were fed everyday. The GPT and GOT activities were measured in the first day with 3 fish, then 3 fish were sacrificed each group after 5, 10, 15 and 20d to examine the effectiveness of beta-cypermethrin on the GPT and GOT activities. About 5ml blood was collected by cutting the caudal peduncle followed by centrifugation at 3500r/min for 10min. Supernatants obtained were used to measure GPT and GOT activities.

GPT & GOT activities and these standard curves were measured by the spectrophotometer at 520nm. Then the activities in 100ml serum could be deduced according to the standard curves[12].

2 Results and discussion

LC_{50}/96h values of beta-cypermethrin to crucian carp are presented in Fig. 1.

Fishes showed hyperactivity when exposed to beta-cypermethrin. At higher concentrations, fish started vigorous movement and tried to jump out of the water, immediately after applying the dose of beta-cypermethrin[13]. Death appeared after 12 hours exposed to beta-cypermethrin in the highest concentration. At lower concentrations, the fish responded slower and effects were delayed.

From Fig. 1, it is clear that the LC_{50}/96h of beta-cypermethrin was determined with 11.4μg/L. According to classification of pesticide toxicity in China[14], beta-cypermethrin was allocated to the group of high-toxicity pesticide (LC_{50}/96h<1mg/L).

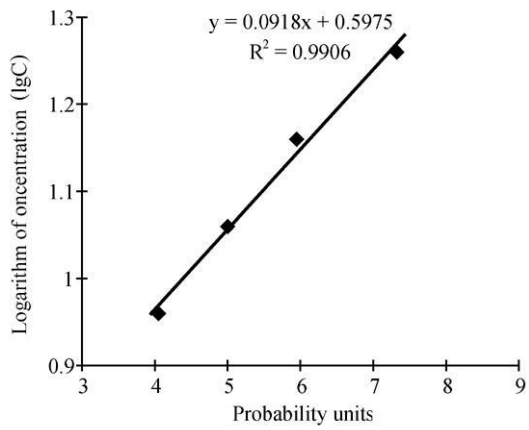

Fig. 1 LC_{50}/96h values of beta-cypermethrin determined in crucian carp (*Carassius auratus*) in aquaria experiments at 22℃. Test fish were unfed

Effectiveness of beta-cypermethrin on GPT activities of crucian carp serum is given in Fig. 2. As Fig. 2 shown, GPT activities increased significantly when exposed for 5days; and continuous increase were observed, nevertheless, compared with lower concentration groups, the higher ones were affected more obviously. 20 days later, GPT activities of 3 concentration groups (0.114μg/L、0.57μg/L、1.14μg/L) had risen by 134.5%、162.6% and 177.7% respectively; among them, it increased 145.3%、149.6%、160.4% and 177.7% when exposed for 5、10、15 and 20 days in the highest concentration group (1.14μg/L). It indicated that the GPT activity increased with the rising of exposing concentration and time.

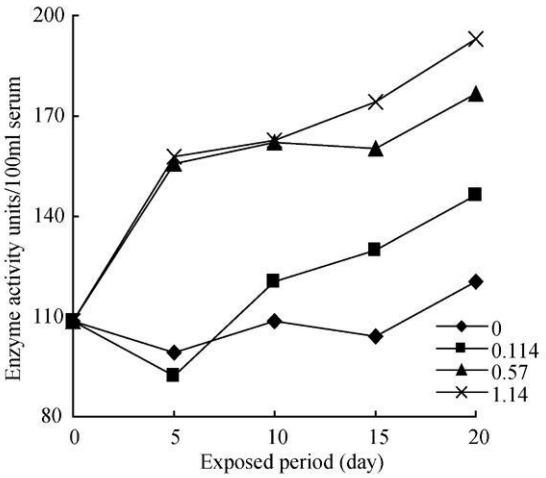

Fig. 2 Effectiveness of beta-cypermethrin on GPT activities of crucian carp (*Carassius auratus*) serum (n=5 for each data point; P<0.01)

Effectiveness of beta-cypermethrin on GOT activities from crucian carp serum is given in Fig. 3. As Fig. 3 shown, GOT activity increased significantly when exposed for 5 days; and continuous increase were observed, most remarkable increase achieved on the 15th day, nevertheless, compared with lower concentration groups, the higher ones were affected more obviously. 20 days later, GOT activity of 3 concentration groups (0.114μg/L、0.57μg/L、1.14μg/L) had increased by 125.9%、135.2% and 137.1%, respectively; among them it increased 114.8%、118.5%、137.1% and 137.1% when exposed for 5、10、15 and 20days in the highest concentration group (1.14μg/L). It indicated that GOT activity increased with the rising of exposing concentration and time.

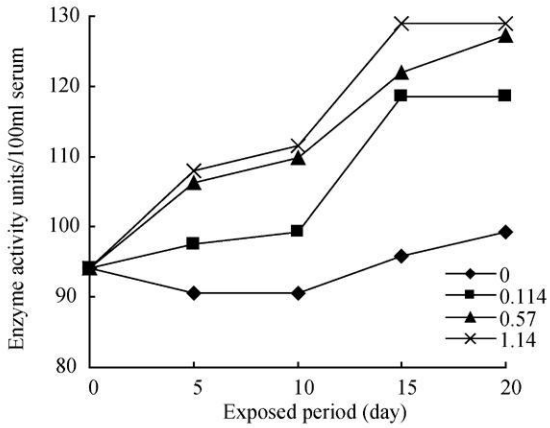

Fig. 3 Effectiveness of beta-cypermethrin on GOT activities from crucian carp (*Carassius auratus*) serum (n=5 for each data point; P<0.01)

The serum activities of GPT and GOT could preferably reflect the liver function[15]. The mechanisms of liver function induced by beta-cypermethrin might be speculated from literature to also apply to crucian carp as follows: hepatic cells were injured, and then the GPT and GOT transported into blood, resulting in an increase of their activities in the serum.

Serum GPT and GOT activities increased in crucian carp after being exposed to beta-cypermethrin. This effect occurred even in the low dosage group after 5 days of exposure. This result indicated that even low-dosages can cause damage in liver functions[16]. Nevertheless, with the beta-cypermethrin concentration increasing and the exposure time extending, the GPT and GOT activities enhanced significantly.

Pyrethroids belong to the class of lipophilic insecticides which are very easily degraded in the natural environment, but they were proven to be highly toxic to fish because of their poor ability to metabolise these compounds[17]. Hill[18] reported that due to high lipophilic properties cypermethrin became absorbed on the particulate matter in natural environment which reduced the bioavailability of this compound. The authors also reported the mortality of fishes by cypermethrin in natural environment[19,20]. In Saxena &Seth's[11] investigations, the mortality of fish at a concentration of 0.5 ppm had been observed, whereas lower concentrations were not fatal up to 30d. The present study indicated that a significant change in the GPT and GOT activities of the fresh-water crucian carp occurred after its exposure to beta-cyperme-

thrin. It may be one of the potential reasons causing the mortality.

In conclusion, beta-cypermethrin does enhance GPT and GOT activities in liver cells and damages the hepatocytes. The enhancement of GPT and GOT in serum by beta-cypermethrin might be one of the mechanisms involved in the impairment of liver function.

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