Fresh Water Fish as Biomarkers for Pesticide Pollution*

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Introduction

Although pesticide usage is desirable for the control of pests, it has resulted in unprecedented chemical pollution affecting non-target organisms: In Malaysia, endosulfan and carbofuran are examples of widely used insecticides in agricultural spraying operations. Uncontrolled applications of the pesticides have contaminated the aquatic environment. Fish and other aquatic organisms can accumulate these chemicals and could result in spontaneous or delayed mortality. These chemicals can also end up in the final user, i.e. man. Hence, it is imperative that information be obtained to assess the toxicological and biochemical effects of these pesticides on aquatic organisms. Among the main objectives of the project are: to determine the toxic effects on fish and other aquatic organisms; to determine the toxicity levels of the pesticides; and to use the information obtained as biochemical markers to assess potential exposure to trace levels of pesticides in the aquatic environment.

Materials and Methods

Estimation of LC_{50} of carbofuran and endosulfan for the freshwater grass carp, *Ctenopharynogdon idellus* and the African catfish, *Clarius gariepinus;* the two species of fresh water fish were separately exposed to various concentrations of carbofuran and endosulfan to determine the toxicity of the pesticides to the fish.

Lethal and sublethal effects of carbofuran and endosulfan on key enzyme activities in the skeletal muscles of grass carp and the liver of African catfish.

Separate experiments in which fish was exposed to lethal (1.0ppm carbofuran) and sublethal concentrations of carbofuran and endosulfan (0.33ppm and 10.2 ppb respectively) for 24, 48 and 72 hours were carried out. Key enzyme activities (acetylcholinesterase, AchE, Glutamate pyruvate transaminase, GPT and Glutamate Oxaloacetate transaminase, GOT) were determined at the specified time intervals. The toxic effects on long exposure of endosulfan were also carried out in which fish were exposed for three weeks instead of a maximum of 72 hours.

Sublethal effects of endosulfan on the protein pattern of the African catfish.

Liver obtained from fish exposed to sublethal concentrations endosulfan were analysed electrophoretically.

Results and Discussion

The LC_{50} of carbofuran for the freshwater grass carp was estimated to be 0.54 ppm. The lethal concentration for 100% mortality was 1.0ppm while the safe concentrations in which there was no mortality was 0.4ppm. The figures for endosulfan for the African catfish were 21.47ppb, 30 ppb and 16ppb respectively.

Short-term exposure of the two species of fish sublethal concentrations of carbofuran and endosulfan had e different effects on the various enzyme activities. AchE activity was inhibited by 54, 65 and 75% at 24, 48 and 72 hours respectively when exposed to sublethal concentrations of carbofuran. Both GPT and GOT activities increased at 24, 48 and 72 hours; 80, 25 and 70% for GPT and 87, 17 and 67% for GOT respectively. Short-term exposure to lethal concentrations of carbofuran resulted in similar pattern. AchE activity was inhibited while GPT and GOT activities were enhanced. A similar pattern was observed when the African catfish was exposed to sublethal concentrations of another pesticide, endosulfan, for a short exposure period (up to 72 hours) and a longer exposure period of three weeks in which AchE activity was inhibited while GPT and GOT activities were enhanced.

The protein pattern in the liver of the African catfish exposed to sublethal concentrations of endosulfan changed when compared to the control fish. In the treated samples, some protein bands disappeared while new bands appeared. The changes were time and dose dependent.

Conclusions

The present results indicated that although carbofuran and endosulfan are less toxic than the other pesticides, they have delayed effects and can cause alterations in the activity of key enzymes in fish tissue even at low concentrations where there was no mortality. The results also suggest that selected enzyme activity in fish can be used as biological markers for the assessment of pesticide pollution and their potential hazards.

Benefits from the study

The information is important for the diagnosis of the status of the environment.

Consumers should be made aware of the potential hazards of these pesticides through the consumption of fish where pesticides are indiscriminately used.

There is a possibility of using fresh water fish as biological indicators of hazardous chemicals.

Literature cited in the text

None.

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