

ABSTRACT

No-Observable-Effect-Concentrations (NOECs) and Lowest-Observable-Effect-Concentrations (LOECs; data in parentheses) of isazofos, profenofos and diazinon for red hybrid tilapia were 0.15 (0.2 ppm); 0.5 (1.5 - 3.0 ppm) and 24 - 49.99 (50 ppm), respectively. LOECs caused typical organophosphorous-poisoning symptoms ranging from darting, shuddering, unco-ordinated movement to lethargy. The acute toxicity concentrations as reflected by the 24 hr LC₅₀ and LC₉₅ were 0.36 and 0.46 ppm of isazofos, 4.69 and 17.23 ppm of profenofos and 71.65 and 120.81 ppm of diazinon, respectively.

When exposed for 1-72 hr to a sub-lethal concentration of 0.15 ppm of isazofos, the fish accumulated maximum residues of 68.21 ppm within 8 hrs. The concentration then significantly ($P \leq 0.05$) declined to 25.56 ppm over the next 16 hrs. Similar exposures to a sub-lethal concentration of 17.6 ppm of diazinon resulted in significant ($P \leq 0.05$) and maximum accumulation after 4 hrs of 56.61 ppm followed by significant ($P \leq 0.05$) and rapid decline to 17.17 ppm over the next 4 hrs. Both insecticides were accumulated significantly ($P \leq 0.001$) differently from each other over time. The concentration of the insecticides in the exposure water showed minor and insignificant ($P > 0.05$) fluctuations during the experimental period.

After 24 hr exposure to the sub-lethal concentration of the isazofos followed by 1-72 hr exposure to uncontaminated water, only 1.5% of the 25.56 ppm accumulated after 24 hrs was eliminated during the first hour. At the end of the 72 hr elimination period, the fish eliminated insignificant ($P > 0.05$) levels of the insecticide. Significant

($P \leq 0.05$) amounts of diazinon were rapidly eliminated from the fish as evidenced by a concentration of 12.52 ppm after 1 hr of the elimination experiment and 0 ppm at the end of the elimination experiment. However, the insecticides were not eliminated significantly differently ($P > 0.001$) from each other and isazofos was at a significantly ($P \leq 0.001$) higher concentration in the fish than diazinon throughout the exposure period. The concentration of the insecticides in the exposure water fluctuated insignificantly ($P > 0.05$) throughout the exposure intervals.

The number of metabolites found in fish and water samples analysed at intervals of the accumulation experiments of isazofos and diazinon (data in parentheses) were 9 (2) and 2 (8), respectively, while the numbers found at intervals of the elimination experiments were 50 (3) and 1 (0), respectively.

Distribution of isazofos within the experimental fish after 24 hrs of exposure to the sub-lethal concentration was maximal in the gut (50.47%) followed by gills (24.99) > skin-muscle-bone fraction (SMB, 16.1%) > gonads (8.44). However, following the 24 hr exposure to the sub-lethal concentration of diazinon residues partitioned mainly into the SMB (60%) > gut > gills > gonads.

Mean acetylcholinesterase (AChE) and butyrylcholinesterase (BChE) activities in the brain and liver of control fish were 19.08 ± 9.8 and 7.75 ± 3.0 $\mu\text{g}/\text{mg}$ protein/min, respectively. After exposing the fish to the 24 hr LC_{50} of isazofos and diazinon, AChE and BChE (data in parentheses) activities were 1.85 (0.05) and 1.83 (0.05) $\mu\text{g}/\text{mg}$ protein/min, respectively. Exposure of red hybrid tilapia to the sub-lethal concentration of isazofos for 1, 4, 12, 24, 48 and 72 hrs, resulted in significant ($P \leq$

0.05) inhibition of the enzymes. The specific activities of the enzymes were 17.31, 11.48, 5.03, 5.39, 8.10 and 5.19 $\mu\text{g}/\text{mg}$ protein/min for AChE and 2.32, 3.70, 0.36, 0.39, 0.45 and 0.42 $\mu\text{g}/\text{mg}$ protein/min for BChE. Throughout the exposure period the activity of BChE was significantly ($P \leq 0.05$) lower than that of AChE. Recovery of the enzymes following exposure of fish poisoned by isazofos to insecticide free water for 7 days was significant ($P \leq 0.05$) but incomplete as evidenced by activities of 5.80 and 1.27 $\mu\text{g}/\text{mg}$ protein/min for AChE and BChE, respectively. Reduced glutathione (GSH) as well as protein levels in fish exposed to sub-lethal and lethal concentrations of the insecticides fluctuated insignificantly ($P > 0.05$). At the end of the recovery period, there was insignificant ($P > 0.05$) increase in GSH and protein levels in the fish.