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 LC$_{50}$ and LC$_{95}$ 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
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 ≤ 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 μg/mg protein/min, respectively. After exposing the fish to the 24 hr LC50 of isazofos and diazinon, AChE and BChE (data in parentheses) activities were 1.85 (0.05) and 1.83 (0.05) μg/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 ≤
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 \( \mu g/\text{mg protein/min} \) for AChE and 2.32, 3.70, 0.36, 0.39, 0.45 and 0.42 \( \mu g/\text{mg protein/min} \) 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 \( \mu g/\text{mg protein/min} \) 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.