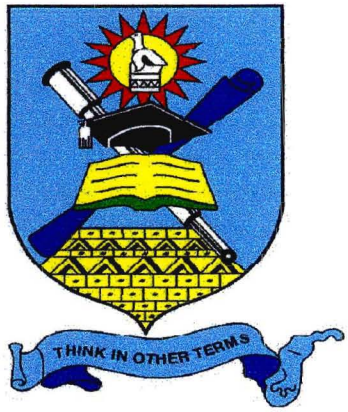

Effect of pesticides on esterase activity of two species of freshwater snails *Helisoma duryi* and *Lymnaea natalensis*

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ABSTRACT

Routine applications of synthetic chemicals in agricultural fields present risks of environmental degradation to natural resources worldwide. There is a need to make available sensitive techniques to monitor and mitigate impacts of these man-made chemicals. The present study sought to investigate the possibility of using altered esterase activity in aquatic snails *Helisoma duryi* and *Lymnaea natalensis* as potential biomarkers for detection of pesticides in contaminated waters. Groups of snails were exposed to single or varying concentrations of insecticides, herbicides or fungicides for different durations before determining esterase activity in post mitochondrial fractions using five different substrates. Effects of pesticide mixtures and commercial pesticide formulations on esterase activity in the two snail species were also investigated. The results obtained showed that esterases in the aquatic snails were significantly inhibited in all pesticide treated snails. Generally, insecticides caused higher inhibition than herbicides or fungicides. The results also indicated that esterases in the two aquatic snail species were highly sensitive to the pesticides used in the study with as low as 0.1 ppb pesticide concentrations causing inhibitions of up 80% depending on the substrate used in enzymatic assay and depending on the snail species. Significant time dependent reductions in esterase activity were also observed and the inhibitory effect continued for the duration of the experiment (a maximum of 28 days). Inhibitions in the range 8-96% were observed and the degree of inhibition depended on the pesticide and substrate used in the enzymatic assay. In the two snail species, the sensitivity of esterases to exposure to pesticides was supported by reductions in esterase activity of up to 37%, depending on substrate and snail species, observed 8 hr post exposure to 5 ppb of carbaryl or dimethoate. Recovery of esterase activity was very slow as shown by significant inhibitions of up to 48% 28 days after exposure to 0.5 ppb repeated doses of different pesticides had been terminated. The results reflect the need for time gap exposures to pesticides to allow non target organisms to recover from previous pesticide exposures. Snails exposed to binary mixtures of insecticides and fungicides or herbicides, showed additive or synergistic inhibition of esterase activity. Fungicides and herbicides which appeared relatively non toxic as individual compounds appeared to have the ability to potentiate the effects of the insecticides revealing the increased potential risk that non-target species face when exposed to pesticide mixtures. Commercial pesticides were shown to cause more than double the inhibitions caused by only the active ingredient(s) of the pesticide. It was concluded from the results that in order to evaluate the risks non target organisms encounter in the field, toxicological evaluations of pesticides should include information on effects of pesticide formulations on non-target organisms. The overall conclusion to be drawn from this study is that esterases from the two freshwater species have a potential use as biochemical markers for the detection of pesticides in water samples. However, prior knowledge of the contamination of the area under study is required to effectively identify the pollutant pesticide. Future studies will focus on assessing the sensitivity of the biomarkers under field conditions as well as test them against a wide range of pesticide mixtures and formulations.