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Toxicity Effect of Temephos on *Bulinus globossus* and *Lymnaea natalensis*

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Abstract: The acute toxicity of temephos on freshwater pulmonate snails *Bulinus globossus* on *Lymnaea natalensis* was determined in short-term toxicity test. The 24h LC50 (95% Confidence intervals) was 0.021 mg l^{-1} (0.01-0.03 mg l^{-1}) for the adults of *B. globossus* and 0.021 mg l^{-1} (0.007-0.066) mg l^{-1} for the juveniles of the same species. While 24h LC50 (95% Confidence intervals) was 0.021 mg l^{-1} (0.007-0.064) mg l^{-1} for the adults of *L. natalensis* and 0.019 mg l^{-1} (0.011-0.032) mg l^{-1} for the juveniles respectively. Abate was also found to be ovicidal to the eggs of both species at 0.03 mg l^{-1} and above where it gave a 100% mortality. However, the 1 mg l^{-1} concentration used in killing Cyclops in the control of dracunculus is higher than the lethal concentration to the snails, which are not really focused in the application of Abate. Abate is therefore found to be toxic to the intermediate hosts of *Schistosoma* species and *Fasciola* species which coexisted with the cyclopoid copepoids against which the chemical has been widely used to eradicate guinea worm. Abate can therefore be said to be effective in controlling Schistosomiasis, Fascioliasis as well as Dracunculiasis.

Key words: Abate *Bulinus globossus* · *Lymnaea natalensis* and toxicity

INTRODUCTION

Temephos is an non-systemic organophosphorus insecticide used to control mosquito, midge and black fly larvae (). It is used in lakes, ponds and wetlands. It also may be used to control fleas on dogs and cats and to control lice on humans.

Temephos is a General Use Pesticide. Abate has been widely used as an insecticide for the control of insect larvae in portable water stores and have been shown to have good residual action and to be extremely safe [1]. It was found to be most active when tested against Cyclops, an intermediate host to the nematode parasite, *Dracunculus medinensis* in the laboratory [2]. Lyons [1] found that 1-ppm concentration was effective and the effect lasts over 5 weeks. Temephos containing products are moderately toxic compounds that carry the signal word warning on their labels despite the relatively high LD50 of the technical compound. This is due to the high toxicity of xylene, one of the components (or carriers) found in many of the trade products. This Pesticide Information Profile is oriented to the toxicity of the technical product temephos and not the different trade products unless specifically noted. The synthetic chemical was found to have a great advantage in that it has a low mammalian toxicity, is easy to apply and it is also cheap, has a good residual effect and can easily be store under tropical conditions. One recommended rate of 1 ppm of temephos to water bodies is odourless, tasteless and harmless to plant and fish life [1, 3].

Freshwater pulmonate snails of the genus *Bulinus* and *Lymnaea* are of medical importance as they have been widely implicated in the transmission of Schistosomiasis and fascioliasis-water borne disease caused by blood parasite of the digena *Schistosoma sp* and *Fasciola sp* respectively. In the attempt to use pesticides for disease/insect control or any other agricultural purpose, these snails which are intermediate hosts of Schistosoma and Fasciola, not really focused in the application, may also be affected.

Guineaworm eradication strategies in Nigeria include the application of Abate to water bodies. The aim of this study is therefore to evaluate the effects of the synthetic Abate on *Bulinus globossus* and *Lymnaea natalensis* as non-target species.

MATERIALS AND METHODS

Collection of test organisms: *Bulinus globossus,* the species that transmit schistosomiasis and *Lymnaea*

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natalensis that transmit fascioliasis were used in the test. They were collected from the pond in the zoological garden of the University of Ibadan and kept in 500 ml beakers. The *Bulinus sp* was reared in the laboratory for twelve weeks during which time they lay eggs and the eggs hatch. The juveniles were collected from the pond and kept in aquarium tanks for at least two weeks to acclimatize before being used for the experimentation. The snails were fed with blanched dried lettuce *(Lactuca sativa)* every two days. Snails of 10-13mm shell diameters were used for adult experiment while 2-5mm shell diameter was used for juvenile test.

Evaluation of molluscicidal activity of abate: The chemical used, Abate (temephos) was in a liquid form (500 mg l^{-1}). Stock solution was prepared by taking 1 ml of the chemical into 999 ml of pure water making 1000 ml serial dilutions into varying grades of concentrations were made from the stock solution.

Ten field snails each of the two species were exposed for 24h in jars half-filled with test solution. Some of the snails crawled out of the solution and were pushed back. Snails still alive after this period were rinsed and transferred to clean dechlorinated tap water for further 24h observation period (recovery period). To minimize error, 3 replicates of ten snails each were set up and a snail is considered dead if no movement could be elicited by mechanical prodding of the head-foot [4]. Controls were kept in dechlorinated tap water with no toxicant added. All tests were carried out at room temperature and feeding was discontinued during this period.

Collection of egg masses: The adult snails of each species collected were transferred into 500m1 beakers lined with polythene. About 5-8 snails were introduced into each beaker. The snails were fed with dried lettuce and allowed to lay eggs. The snails were then removed and water poured out of the polythene, the egg masses were then located. The polythene was cut around each egg mass with a blade and then used for ovicidal test.

Ovicidal test: Ovicidal activity was tested according to WHO [5]. Eggs found on the polythene were cut and submerged in experimental molluscicidal solution(E.M.S). Five eggs were submerged in each concentration of the EMS.

Data analysis: The bioassay with each species was separately analyzed for the 25h LC50 for each test was determined by probit analysis [6]. This was calculated by finding the probit value of the percentage mortality from the probit table and plotting it against the logarithm of different concentrations. A horizontal line was drawn from the 50% (5% probit value) to meet the line graph. The intersection point on the abscissa corresponded to the 24h LC50.

RESULTS

Table 1 and 2 show the effects of the various concentrations of abate on adults and juveniles of both snail species exposed for 24h. The two snail species attempted to crawl out of the containers used, but they were pushed back. It was observed that *Bulinus globossus* movement out of the container is much slower than the other species *Lymnaea natalensis*. This may be the reason why the rate of mortality in this species is higher than that observed in *L. natalensis*, as the snails remain longer in the toxicant to receive the lethal dosage. At 0.05 mg l^{-1}, all the snails of both species, adults and juveniles, died. At 0.04 mg l^{-1} 96.7 mg l^{-1} mortality was recorded for the adults of *L. natalensis* and 80% mortality was recorded for the juveniles while there was 100% mortality for both adults and juveniles of both *B. globossus*. And at 0.03 mg l^{-1} 70% mortality was recorded for *L. natalensis* and 73.3 mg l^{-1} mortality for *B. globossus* adults respectively. For their juveniles, 53.3 mg l^{-1} mortality was recorded for *L. natalensis* and 90%for *B. globossus*. While at 0.02, 16.7 mg l^{-1} mortality was recorded for *L. natalensis* and 30%for *B. globossus* adults. And for their juveniles 16.7% mortality was

Table 1: Mollusciudal effect of various concentrations of abate on adults and juveniles of *Lymnaea natalensis* exposed for 24 h

Conc. (mg l^{-1})	No.of snails	Adult snails (10-13mm)	Mortality (%)	Juvenile snails (2-5mm)	Mortality (%)
Control	10	0	0	0	0
0.01	10	0	0	0.33+0.58	33.00
0.02	10	0.64+0.58	16.67	0.67+0.58	16.70
0.03	10	0.00+1.00	70.00	0.33+0.58	53.30
0.04	10	0.67-0.58	96.67	0.00+1.00	80.80
0.05	10	0.00+0.0	100.00	0.00+0.00	100.00

Table 2: Mollusciudal effect of various concentration of adults and juveniles of *Bulinus globossus* exposed for 24 h

Conc. (mg l^{-1})	No. of snails	Adult snails (10-13mm)	Mortality (%)	Juvenile snails (2-5mm)	Mortality (%)
Control	10	0	0	0	0
0.01	10	0	0	0	0
0.02	10	3.00+0.00	30	4.33+0.58	43.3
0.03	10	7.33+0.58	73.3	9.00+1.00	90
0.04	10	10.00+0.0	100	10.00+0.00	100
0.05	10	10.00+0.00	100	10.00+0.0	100

Table 3: Ovicidal effect of abate on 24h old eggs of *L. Natalensis* and *B.globossus* exposed for 24 h

Conc. (g ml^{-1})	No. of egg masses in EMS	Hatchability of *L. natalensis* (%)	Hatchability of *B. globossus* (%)
Control	5	100	100
0.01	5	100	20
0.02	5	20	0
0.03	5	0	0
0.04	5	0	0
0.05	5	0	0

NOTE: DTW = Dechlorinated Tap Water

recorded for *L. natalensis* and 43.3% for *B. globossus* respectively.

Table 3 shows the ovicidal effects of abate on the eggs of *L.natalensis and* B. globossus when kept in different concentrations of EMS and then transferred to Dechlorinated Tap Water (DTW) for incubation. The percentage hatchability for 24h old egg in concentrations 0.03-0.05 mg l^{-1} was zero for both species. At 0.02 mg l^{-1}, 20% hatchability was recorded for *L. natalensis* and 20% hatchability in *B.globossus.* 0.01 mg l^{-1} gave 100% hatchability in *L.natalensis* and 20% hatchability in *B.globossus*.100% hatchability was recorded in the controls for both species.

DISCUSSION

The introduction of toxicants into water bodies causes a wide range in behavioural responses of organisms [7]. This is observed in this experiment, as *B. globossus* remained longer in the toxicant than *L. natalensis*.

Evaluation of the toxic effect of Abate may be useful because of its use in the control of Cyclops, the intermediate host of *Dracunculus medinensis* in Nigeria. The use of Abate (temphos) at 1 mg 1^{-1} level has been recommended for the control of Cyclops [1]. This concentration is a little bit higher than the LC50 at 24h period recorded for both species of snails used as non-target organisms. For *Lymnaea natalensis* adult snails, the 24h LC50 was 0.02 and 0.019 mg 1^{-1} for their juveniles. For both adults and juveniles snails of *B. globossus* the 24h LC50 were 0.021 mg 1^{-1}. This shows that if a concentration of 1 mg 1^{-1} is used in the field in a bid to control the transmission of Dracunculiasis, not only will this aim be achieved, other disease-transmitting intermediate host like the snails will be effectively controlled.

Effective molluscicides should destroy cercariae and kill all or nearly all the snail hosts and snails eggs [7]. Abate is observed to be a good ovicide to the eggs of both snail species used in this experiment, with the eggs of *B. globossus* being more susceptible than those of *L. natalensis.* Similar report was made on rats, fed small amounts of temephos showed any reproductive difficulties in the test animals. The maximum dose (25 mg kg^{-1}) had no effect on the number of litters, litter size, or variability in the young and produced no congenital defects in the offspring. The concentration of temephos in the diet of the test animals was, however, sufficient to produce cholinesterase inhibition and some toxic symptoms [8].

In case of future use in the field, focal application of chemical control should be investigated in relation to transmission sites, human-water contact behaviour and coordinated with the use of more efficient delivery systems. The findings may in addition to improving cost-effectiveness, also limit or eliminate environmental damages.

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