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EVALUATION OF THE EFFECTIVENESS OF ABATE™ USED FOR THE TREATMENT OF COMMUNITY DRINKING PONDS IN THE NIGERIA GUINEAWORM ERADICATION PROGRAM.

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ABSTRACT

A study was carried out to ascertain the effectiveness of the Abate™ (0-0-0^1-0^1-tetramethyl – 0-0^1-thiodi-P-phenylene phosphorothiote) an organophosphorous compound used for the treatment of community drinking ponds in the Nigeria Guinea Worm Eradication Programme in South-West Zone of Nigeria. The Abate™ was used in treating 3 large rectangular concrete tanks lined with pond mud, and filled with pond water harbouring cyclops, the crustacean vector of guinea worm disease. A fourth tank containing untreated water served as control. The initial and final cyclops populations of each tank was determined daily for seven days and then weekly up to the 28th day after Abate™ treatment. The standard concentration used in guinea worm eradication program (0.1ml of Abate™ to 50 litres of water) was added. At this concentration, cyclops is known to become paralysed within 72 hours. It was deduced that the population of cyclops, *Thermocyclops decipiens*, was not effectively controlled since it took more than 5, 6 and 14 days to eliminate them from tanks A, B and C respectively. The population of cyclops however, increased in the control tank over the study period. In the control of guinea worm disease vectors, it is necessary to take into cognisance the potency of the chemical used in order to achieve the desired result.

Keywords: Abate™, community drinking ponds, cyclops, *Thermocyclops decipiens*, guinea worm disease

INTRODUCTION

Abate™ is an organophosphorous compound, which was introduced in 1965 by the American Cyanamid Company, Atlanta as a mosquito larvicide, and was later found to be effective in the killing of cyclops responsible for the transmission of guinea worm disease. Abate™ have been shown both experimentally and in field trials to be effective and safe for controlling cyclops in the ponds (Muller, 1970; Lyons, 1973).

Properly applied at monthly intervals, Abate is colourless, tasteless and odourless with a high margin of safety (Hopkins, 1983). The American Cyanamid Company in Atlanta announced the donation of an estimated $2.6 million worth of Abate™ to endemic African countries in March 1990, of which Nigeria was expected to receive about $1.5 million worth over five years (Nwobi, 1991).

The Abate™ received by the health office of Akinyele Local Government Area of Oyo State, Nigeria from the Nigeria Guinea Worm Eradication Programme (NIGEP) South-West zonal office was manufactured in January 1992 with expiry date of 1st January 1994. It was used to treat village ponds as from February 1995.The WHO/CDC Manual for Chemical Control (WHO/CDC, 1992) used by the NIGEP South West Zone, recommends that Abate™ with the closest expiry date should be used always. This work studies the effectiveness of this Abate™ in the elimination of cyclops from community drinking ponds.

MATERIALS AND METHODS

Test material: Abate, –0-0-0^1-0^1-tetramethyl-0-0^1-thiodi-P-phylene phosphorothiote is an organophosphorous compound with the molecular weight of 466.4.The Abate™ used in this study is in a brown viscous liquid presented as a 50% emulsifiable concentrate (EC). It is also available as white crystalline water dispersible powder, with granular formulations (1SG). It

has a specific gravity of 1.32, melts at 30.0 to 30.5^0 C, is insoluble in water and stable indefinitely at room
temperature. Abate™ inhibits irreversibly the cholinesterase enzyme by alkyl phosphorylation, thus causing paralysis of the Cyclops and ultimate death.

Tank preparation and collection of cyclopoid copepods: Four large rectangular concrete tanks were used for the study. The first 3 (A, B and C) were treated with the Abate™, while tank
D remained untreated and served as control. Pond substratum, water and cyclops were got from the pond in Alagba, a village in Akinyele Local Government of Oyo State, Nigeria known to have a long experience of guinea worm disease (Falode and Odaibo, 1995). Previous studies by Falode, (1998), shows that *Thermocyclops decipiens* is the species of Cyclops present in Alagba pond. Pond substratum was collected with buckets to line the tanks before pond water collected in kegs was added to the tanks.

Large amount of pond water was passed through a monofilament nylon filter (pore size, 100 × 100 micrometers) and the cyclops retained on the sieve were washed into containers containing pond water and thereafter transferred to the tanks. Some of the water plants found on the surface of the village pond were also transferred to the tanks in order to simulate a short-term pond environment. Physico-chemical parameters of the water in the tanks such as pH, dissolved oxygen and temperature were measured at the beginning and at the end of the experiment.

Establishment of cyclopoid copepod population in tanks: To ensure that the cyclops population was well established in the tanks, 2 liters of water was collected at intervals (for about 2 weeks) from the 4 tanks. The number of cyclops per 2 liters was counted and poured back into the various tanks.

To do this, the 2 litres of water from each tank was filtered with a monofilament nylon filter (100 µm pore size) and a small amount of filtered tank water was used to wash the cyclops into a petri dish. The number of cyclops in 2 litres was determined using a dissecting microscope and a counter.

Application of Abate™ to ponds: The volume of water in the tanks was calculated (volume =length x breadth x depth). For this study, Abate™ in the form of 50% emulsifiable concentrate (EC) was used at the standard concentration recommended by NIGEP (0.1ml of Abate™ to 50litres of water) (WHO/CDC, 1992). The treatment design is shown in table 1.

Appropriate volume of Abate™ was measured out and poured into bowls containing water from the tanks to be treated. After the Abate™ had been thoroughly mixed in this bowls, they were poured evenly on the water surface in the tanks. This was done for all the tanks except the control tank. Cyclops count and motility per 2 litres of water was recorded everyday up to a week and then weekly.

Table 1: Water volume, average cyclops count and Abate treatment of experimental tanks

	Tank A	Tank B	Tank C	Tank D
Volume of water (liter)	165.3	240.6	139.9	140.9
Volume of Abate (ml)	0.33	0.48	0.28	-
Av. Cyclop/2 liter of water	18	28	38	16

RESULTS

Tables 2 showed cyclops population variations and motility patterns in tanks A, B and C treated with Abate™ compared to the variations in the control tank D. At the concentration of 0.1ml of Abate™ to 50 litres of water, cyclops movement became sluggish on the 5th and 6th days in tanks A and B respectively and on the 14th day in tank C. There was a significant decrease in cyclops population (18 – 0 cyclops/ 2 litres of water) from day 1 to day 6 of the experiment in Tank A. The cyclops population decreased from 28 cyclops/2 litres of water to nil after a week in Tank B. There was however a prolonged and slow effect of Abate™ on cyclops in tank C with their population decreasing from 38 cyclops/2litres of water to 4 cyclops per 2 litres of water 14 days after the application of Abate™. There was an increase

in the cyclops population in the control tank D from 16 to 40 Cyclops/2litres of water over a period of 28 days. The motility of the cyclops in the control tank was also not affected. Table 3 shows that there was no significant difference in the amount of dissolved oxygen and pH before and after Abate™ application in tanks A, B and C. There was also no significant difference in the average water temperature in all the tanks on all days. Other life forms in the tanks like tadpoles and toads were equally not affected.

Table 2: the effect of Abate™ treatment on the population of cyclops in tanks A, B and C compared to control tank D.

	Tank A		Tank B		Tank C		Tank D	
Day	No. of Cyc/2litrs.	Motility	No. of Cyc/2litrs.	Motility	No. of Cyc/2litrs	Motility	No. of Cyc/2litrs	Motility
1	18	Fast	28	Fast	38	Fast	16	Fast
2	18	Fast	26	Fast	38	Fast	14	Fast
3	10	Fast	22	Fast	38	Fast	16	Fast
4	6	Slow	14	Fast	34	Fast	16	Fast
5	4	Sluggish	8	Slow	28	Fast	20	Fast
6	0	-	4	Sluggish	14	Slow	24	Fast
7	0	-	2	Sluggish	10	Slow	28	Fast
14	0	-	0	-	4	Sluggish	30	Fast
21	0	-	0	-	0	-	36	Fast
28	0	-	0	-	0	-	40	Fast

Table 3: Variations in the physico-chemical parameters in Tanks A, B, C and D

Parameter	Tank A	Tank B	Tank C	Tank D
Av. Water temperature (^{O}C)	28.1	28.1	27.6	28.0
pH before Abate treatment	7.2	7.3	7.2	7.2
pH after Abate treatment	8.0	8.0	8.0	-
Dissolved oxygen before Abate (mg/l)	7.6	7.5	7.6	7.5
Dissolved oxygen after Abate (mg/l)	8.4	10.0	8.4	-

DISCUSSION

Results show that the Abate™ at the standard concentration used in guinea worm eradication (WHO/CDC, 1992) took a week, over a week and over two weeks to control the species of cyclops, *Thermocyclops decipiens* found in Alagba pond in created short term ponds, tanks A, B and C respectively. WHO/CDC manual (1992) states that within 12 hours of exposure of cyclops to this chemical at the standard concentration, the cyclops become progressively less able to swim and feed normally, and within 72 hours they become paralysed and then settle at the bottom of the pond and consequently die as a result of cholinesterase enzyme depletion. Abate™ inhibits the production of cholinesterase, which is essential for synaptic transmission of nerve impulses in living organisms. The mode of action of Abate™ as a copepodcide is by selectively causing paralysis and ultimately death of cyclops through irreversible inhibition of cholinesterase enzyme.

The results of this study did not tally with those of WHO/CDC (1992) since cyclops were still found moving around on the 5th and 7th day in tanks A and B respectively, although sluggishly and even weeks after chemical application in tank C. Again the present result does not agree with the work of Sastry *et al.* (1978), where cyclops population were completely wiped out a week after treating pond with Abate™ . Similarly, Lyons (1972) reported that 24 hours after first pond treatment with Abate™ cyclops were still alive and active but at 48 hours, most of the few cyclops that were seen were dead or sluggish. Twenty-four hours after 2nd treatment, Lyons (1972) reported that 2 slow-moving cyclops were seen in a 20-litre sample and no cyclops was seen in samples taken 1 and 3 weeks later. It can therefore be deduced from this study that the Abate™ used by NIGEP in the south-west zone of Nigeria was not very effective in controlling the species of cyclops, *Thermocyclops decipiens*,

probably because of chemical changes resulting from the long storage period to which the Abate was subjected.

This experiment could not be repeated because of the rains however this work leaves room for further studies especially testing the effect of unexpired Abate on cyclops and the active ingredient left in the chemical days and years after expiration and to know when exactly it is no longer potent after expiry date. Proper application of the potent Abate™ will go a long way in ensuring the eradication of the guinea worm disease but applying non-potent Abate™ wastes time, energy, manpower, flaws eradication and delays the eradication of the disease.

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