USE OF AMMONIA AS FISH TOXICANT FOR MANAGEMENT OF FRESHWATER PONDS

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ABSTRACT

Control of unwanted fish is essential in the management of freshwater ponds. Fish toxicants such as insecticides used by the fishfarming industry in the Philippines at present do not satisfy the criteria of availability, safety and environmental protection.

Use of ammonia produced by a mixture of one part (by weight) of ammonium sulfate and five parts of calcium oxide applied in freshwater ponds at 35 g/m^2 with 0.1 m water depth was found effective in controlling *Tilapia nilotica*, *Clarias batrachus*, *Ophicephalus striatus* and *Trichogaster trichopterus* of various sizes. Juvenile fish appeared to be more tolerant to the toxicant than fry and fingerlings.

Compared to insecticides, use of ammonia as described in the study is safe to fish consumers and the environment, has a fertilizing effect on the pond water and is readily available to local fishfarmers.

Introduction

The control of predators and pests is an essential part of fishpond management. Yield reductions attributed to fish predators in freshwater ponds such as mudfish. (*Ophicephalus striatus*) and catfish (*Clarias batrachus*) in fish nursery and grow-out ponds are common in the Philippines and other Asian countries.

Various fish toxicants are used for freshwater pond management. Use of commercial compounds, such as rotenone and teaseed cake, is widely applied for wild fish control in the United States and China. In the Philippines, more potent but hazardous chemicals such as insecticides (e.g.. chlorinated hydrocarbons and organophosphates) and sodium cyanide have been used as fish toxicants in ponds.

There is need for a readily available, safe, economical and effective fish toxicant for application in Philippine fishpond management. The use of burnt lime (calcium oxide) and ammonium sulfate at rates of 50-100 g/m^2 and 10-20 g/m^2, respectively, with a water depth of 0.1 m for control of wild fish in brackishwater ponds has been recommended (Norfolk *et al.*, 1981; Gapud *et al.*, 1983). Ammonia in the un-ionized form becomes toxic to fish in alkaline water with pH 8-8.4 (Munro, 1978). Free ammonia levels of 0.2-2.0 mg/l damage the gill epithelium and are lethal to fish (EIFAC, 1970).

The use of ammonia from the mixture of ammonium sulfate and calcium oxide for freshwater ponds was evaluated in this study which was done at the Aquatic Biosystems fishfarm in Bay, Laguna in October, 1985.

Materials and Methods

Two laboratory experiments and two field trials were conducted. In the first laboratory experiment, six 60 x 15-cm circular plastic basins were used to test the effect of calcium oxide, ammonium sulfate and the mixture of ammonium sulfate-calcium oxide at a proportion of 1:5 by weight on the test fish (1-2 g *Tilapia nilotica* fingerlings). Three and a half grams of each test chemical were dissolved in each basin containing 10 liters of well water. Two basins (replicates) per chemical were used. Five fingerlings were placed in each basin. Fish mortality in each basin was observed for two hours. Water pH, before and after addition of the chemicals, and ammonia were measured in each basin using a pH colorimeter and ammonia test kit (Nessler reagent), respectively.

In the second laboratory experiment, the effect of three proportions of ammonium sulfate and calcium oxide (1:5, 1:10 and 1:15) were tested on *T. nilotica* fingerlings. Eight 75 x 45-cm plastic bags containing 10 liters of well water each were used. Five fingerlings were placed in each bag. In each of six bags, 3.5 g of each test chemical were dissolved with two bags (replicates) per chemical. The two other bags with fingerlings and water but with no chemical served as controls. Fish mortality in each bag was observed for four hours. The time lapse for complete kill of the fish within the observation period was recorded.

In the first field trial, two 200-m^2 earthen ponds with a water depth of 0.1 m were treated with the 1:5 ammonium sulfate-calcium oxide mixture to eradicate wild fish. The mixture was first dissolved in a basin of pond water and then distributed throughout the pond in portions. To calculate the amount of the mixture to be applied per pond, the following formula was used: Weight of Mixture (kg) = Area of Pond (m^2) x Depth of Water (m) x 0.35. The number, kind and size of fishes killed in each pond were recorded. The time lapse from the time the toxicant was applied to the time each fish species was observed to have been killed was measured.

In the other trial, two 14-m^2 portions of the fishfarm's supply canal with a water depth of 0.18 m were blocked-off and treated with the toxicant using the 1:5 mixture. The same data as in the pond trial were gathered.

Results and Discussion

The results of the experiment using plastic basins (Table 1) showed that the 1:5 ammonium sulfate-calcium oxide mixture was lethal to *T. nilotica* fingerlings. No fish mortality was observed in the calcium oxide only and ammonium sulfate only treatments. The water pH in treatments with calcium oxide only and

Table 1. Effect of three chemicals on survival of *T. nilotica* fingerlings in plastic basins

Chemical	*No. Fingerlings*	*% Survival*	$NH_3 \leq NH_4^+$ *(ppm)*
Calcium oxide	10	100	2-3
Ammonium sulfate	10	100	8-9
Ammonium sulfate + Calcium oxide	10	0	8-9

ammonium sulfate-calcium oxide increased from 7.5 to 8.7. Levels of ionized and free ammonia were highest in the ammonium sulfate only and ammonium sulfate-calcium oxide treatments (Table 1). These results substantiate the recommendation of Norfolk *et al.* (1981) that use of burnt lime to increase the water pH in combination with ammonium sulfate as the source of un-ionized ammonia is effective for control of tilapia in brackishwater ponds.

In the experiment using plastic bags, the results indicated that ammonium sulfate-calcium oxide proportions of 1:5 and 1:10 were effective in killing *T. nilotica* fingerlings after 47 and 125 minutes from application, respectively (Table 2). No fish mortality was observed in the controls and treatment with 1:15 proportion after 4 hours. Considering cost of the chemicals, there is only a slight difference (₱0.05) between the 1:5 and 1:10 mixtures. A higher concentration of ammonium sulfate is favored for field application to compensate for ammonia lost through volatilization, absorption by plankton and other factors (Norfolk *et al.*, 1981).

Results of the pond trial showed that the ammonium sulfate-calcium oxide (1:5) mixture was effective in eradicating four species of freshwater fish in 20 to 75 minutes from application (Table 3). Fish of various sizes (fry to juvenile) were killed. Temperature of the pond water was 27°C at 1000 hr when the toxicant was applied. Plankton blooms were observed in the treated ponds 2-3 days after

Table 2. Effect of three proportions of ammonium sulfate and calcium oxide on survival of *T. nilotica* fingerlings in plastic bags

Proportion	*No. Fingerlings*	*% Survival*	*Time Lapse for Total Kill (min.)*
0	10	100	–
1:5	10	0	47
1:10	10	0	125
1:15	10	100	–

Table 3. Effect of ammonium sulfate-calcium oxide (1:5) on freshwater fish in earthen ponds

Pond	*Species Killed*	*No.*	*Individual Wt. (g)*	*Time Lapse (min.)*
1	*Tilapia nilotica* fingerlings	2	5-10	20
	Trichogaster trichopterus fingerlings	3	1-2	20
	Ophicephalus striatus fry	5	0.25-0.5	20
2	*Tilapia nilotica* fingerlings	3	3-5	30
	Ophicephalus striatus fry	13	0.25-0.5	30
	Clarias batrachus fingerlings	9	2-5	30
	juvenile	1	100	75

application. Calcium oxide or quicklime is normally applied in fishponds as a soil conditioner and for disease control (Huet, 1972). Ammonium sulfate, on the other hand, contains 21% nitrogen and is used as fertilizer.

In the other field trial, three species (fry to adult) were killed (Table 4). In both trials, it was noted that fish of smaller sizes were killed faster than larger ones. Juveniles appeared to be more tolerant to the toxicant than fry and fingerlings.

On the whole, the results of the study demonstrate the efficacy and feasibility of using ammonia from a 1:5 mixture of ammonium sulfate and calcium oxide applied at 35 g/m^2 with a 0.1 m water depth for eradicating unwanted fish in freshwater ponds and canals. Findings of our study further show that the recommended application rate of 500 kg of lime and 100 kg of ammonium sulfate per hectare in brackishwater ponds with 0.1 m water depth for eradication of wild fish (Gapud *et al.*, 1983) is much higher than what is required for freshwater ponds.

Use of ammonia as fish toxicant in the management of freshwater ponds has many advantages over the use of conventional toxicants applied by industry in the Philippines. Lime and ammonium sulfate are locally and readily available. Fish killed by ammonia are safe for human consumption. Ponds treated with ammonia can be restocked with cultured fish on the same day. The chemicals used (ammonium sulfate and calcium oxide) have a beneficial effect on the pond water and do not pose any environmental threat compared to insecticides.

Table. 4 Effect of ammonium sulfate-calcium oxide (1:5) on freshwater fish in supply canal

Area	*Species Killed*	*No.*	*Total Wt. (g)*	*Time Lapse*
1	*T. trichopterus*			
	fingerlings	19	80	5
	adults	2	200	15
	O. striatus			
	fry	1 school	–	5
	fingerlings	3	25	15
	juvenile	1	100	65
2	*T. trichopterus*			
	fingerlings	4	25	5
		4	25	25
	T. nilotica			
	juveniles	2	50	85
	adult	1	100	25

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