CHEMICAL DEPRECIATION OF $CUSO_4$, NAPCP AND BAYLUSCIDE IN STANDING WATER IN IRAN*

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ABSTRACT In an attempt to determine the chemical losses of three common molluscicides, i.e. CuSO4, NaPCP and Bayer-73, in stagnant water, a solution of each of these molluscicides was applied to one or more B. truncatus habitats and outdoor aquariums. The concentration of each molluscicide in these water bodies was determined immediately after application and at fixed time intervals thereafter.

The concentration of copper sulfate dropped dramatically to 50% within 1½hours after application. This fast depreciation is attributed to the alkalinity of the natural waters in this area.

The depreciation of NaPCP, although slower than copper sulfate, was faster than Bayluscide. As this fast depreciation is caused by sunlight, NaPCP is not recommended for use in Khuzestan (Iran).

Since the effect of Bayluscide on snails was also superior to that of the other two molluscicides, Bayer-73 can be considered as the molluscicide of choice for snail control in Iran.

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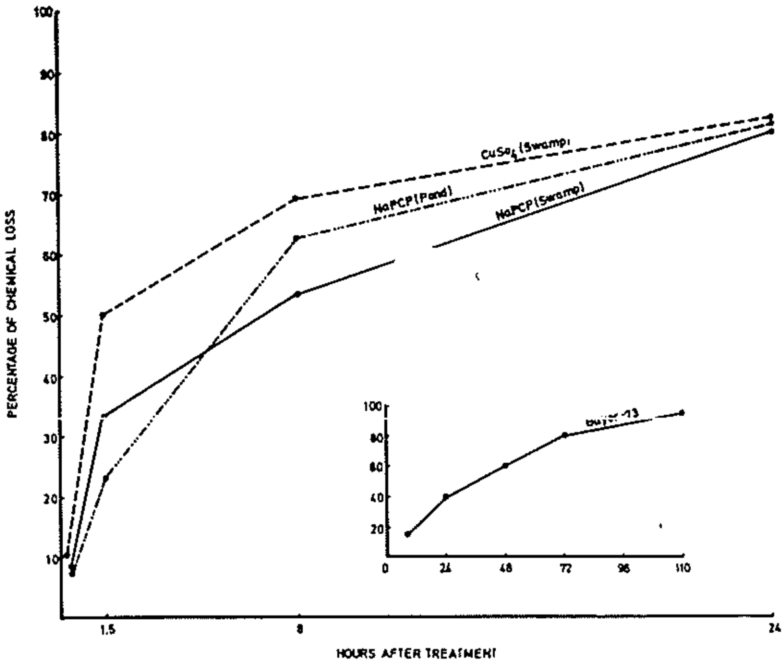
INTRODUCTION

The use of molluscicides to eliminate or control the snail intermediate-host has become a promising means of combating bilharziasis. Before using a molluscicide, it is wise to first make field trials of the available molluscicides to determine their suitability under local conditions. In Khuzestan, southern Iran, the intermediate-host of *Schistosoma haematobium, Bulinus truncatus,* occurs in a variety of habitats such as swamps, ponds and springs (standing water) and canals and drains (flowing water).

The aim of tht present study was to determine the chemical losses of three common molluscicides, i.e. CuSO4, NaPCP and Bayer-73, in stagnant water. It is known that chemical losses in a habitat may be caused by several factors, viz. quantity and quality of suspended and dissolved solids, vegetation, pH, temperature, sunlight and conditions of the stratum. A good molluscicide is one which combines stability in water with good molluscicidal effect at economic dosage.

FIG.

CHEMICAL DEPRECIATION OF COPPER SULFATE, NaPCP AND BAYER-73 IN NATURAL SNAIL HABITATS IN IRAN



MATERIAL AND METHODS

CuSO4 Field Trial

A solution of copper sulfate was made by pulverizing the solid material and dissolving it in field water. This solution was applied on a clear morning to a swamp immediately after it was prepared. The swamp, having a muddy bottom and was moderately overgrown with vegetation including *Potomegcton*, *Cerato phylum*, *Ranunculus* and submerged algae. By means of hand-pumps, an amount of solution containing 25 kilograms of copper sulfate was applied. Prior to application, the water from this swamp was chemically analyzed and found to contain 420 ppm total dissolved solids with pH of 7.7. The water was clear with the diurnal water temperature ranging from 10° to 20°C. Water samples were taken from two marked sites in the swamp at fixed time intervals after application for the estimation of the dosages actually used and chemical losses thereafter. The Haskins method (7) was followed to determine the CuSO4 concentration of the treated water. Immediately after application, the water contained 34 ppm of CuSO4 which was reduced to 17 ppm (50% loss) one and-a-half hours later; 14 ppm (59% loss) 3 hours later; 11 ppm (68% loss) 8 hours later; 6 ppm (82% losss) 24 hours later; and 0.6 ppm five days later. The chemical loss during a 24-hour period is plotted in the accompanying figure.

The results of a snail search afterward indicate that snails were only partially killed.

In the course of application, the blue-green CuSO4 solution was found to become a greenish-white suspension after contact with the swamp water.

NaPCP FIELD TRIALS

On a clear morning, 6 kilograms of 80% wettable powder formulation of NaPCP were applied with a motor, spraying into a swamp with a muddy bottom containing an estimated water volume of 496 cubic meters. In this swamp, no gross vegetation was observed and the water was clear with a diurnal water temperature of 10° to 22°C. Prior to treatment, the water contained 495 ppm of total dissolved solids with a pH of 7.8. The spraying was begun at 11 :30 a.m. and completed at 1 :30 p.m. It was endeavored to make the distribution of the molluscicide in the water as homogeneous as possible.

After treatment, water samples were taken from two marked sites at fixed time intervals and the NaPCP concentration of the treated water was determined by the Haskins method (1).

Immediately after application, the treated water contained 15 ppm NaPCP. The concentration dropped to 10 ppm (33% loss) in active ingredient 1½ hours later; 7 ppm (53% loss) 8 hours later; 3 ppm (80% loss) 24 hours later; 1 ppm (93% loss) two days later; and just a trace three days later. The chemical loss in percentage during a 24 hour period is shown in the accompanying figure.

A snail search made afterward showed that the experiment was not successful.

Another similar experiment with NaPCP was carried out in a pond with a muddy bottom. It was also a sunny day. The pond was small but densely overgrown with vegetation. The water volume was estimateed to be 31 cubic metres and 400 grams of NaPCP were applied by hand pump (13 ppm.) The water was clear with a diurnal water temperature of 10° to 21°C. The pre-treated water contained approximately 400 ppm total dissolved solids with a pH of 7.7. The operation begun at 9 p.m. and took 15 minutes.

Immediately after treatment, water samples were taken from 4 marked sites at different time intervals, the results of which are shown in Table 1.

The average NaPCP concentration of the treated water was 12.5 ppm immediately after application. This concentration dropped to 10 ppm (20% loss) 1½ hours later; 7.4 ppm (41% loss) 3 hours later; 4.6 ppm (63% loss) 8 hours later; and 2.4 ppm (81% loss) 24 hours later. The loss percentage is plotted in the accompanying figure.

With the NaPCP dosage used in this pond, the snails were only partially killed. This failure might be due to the fast depreciation of NaPCP in bright sunlight and to the fact that only 37% of the active ingredient remained eight hours after application. It is suggested that the application of NaPCP be undertaken late in the afternoon when the sun is setting.

A parallel experiment was carried out in two outdoor aquariums to test the chemical depreciation of NaPCP within 24 hours. The aquariums contained 5 liters of NaPCP solution prepared with river water of 9.0 and 4.5 ppm, respectively, and were placed outside in direct sunlight. The concentration dropped to 2.1 and 1.0 ppm, respectively, within 24 hours. Chemical losses approached those found in the field.

BAYLUSCIDE FIELD TRIALS

A 70% wettable powder formulation of Bayer-73 was suspended in water and then sprayed in a clear morning by two power-operated stirrup pumps into a shallow swamp with a muddy bottom. The habitat was sparsely overgrown with *Typha* and other water plants with an estimated water volume of 810 cubic meters in the main water body. Approximately 2020 grams of Bayer-73 were applied to the main water body (2.5 ppm) and 440 grams were used to treat several isolated pools. Prior to treatment, the water was analyzed and found to contain 848 ppm total dissolved solids with a pH of 7.6. The water was clear with a diurnal temperature of 13° to 27°C. After treatment, a water sample was taken from a marked site daily for a period of 5 days to test the loss of active ingredients in the water by the Strufe method (5).

Immediately after application, the water contained 1.75 ppm active ingredient of Bayer-73, which changed to 1.05 ppm on the 2nd day, 0.70 ppm on the 3rd day, 0.35 ppm on the 4th day, 0.21 ppm on the 5th day and 0.14 ppm on the 6th day.

The swamp remained free of snails for 18 months.

A similar study was carried out in a pond with a muddy bottom near the Bayer-73 treated swamp. The pond was estimated to contain 650 cubic meters of water. Sparse *Typha* grew at the shallow end whereas the main water body, which was over one meter deep, was without visible vegetation. The chemistry of the water was similar to that in the Bayer-73 treated swamp. By means of a power-operated pump, a total of 1300 grams of Bayer-73 were applied to this pond (2.0 ppm).

Immediately after application, 6 water samples were taken from six marked sites and on the following day another six samples were taken to test the chemical depreciation.

Immediately after application, the average concentration of active ingredient of Bayer-73 in the surface water was 3.57 ppm. The average concentration of Bayluscide one day later was estimated to be 1.25 ppm. The loss of active ingredient of Bayer-73 from an average of 3.57 ppm to a average of 1.25 ppm, approaching 65%, was found to be 25% higher than in the Bayer-73 treated swamp. Such excessive loss may be due partly to the dispersal of Bayluscide from the surface down into the deep water.

An outdoor experiment was carried out parallel to the above field trials with Bayluscide. Serial test solutions of Bayluscide were prepared in porcelain aquarium, each containing 5 liters of test solution made up with river water and placed outside in direct sunlight. The diurnal water temperature ranged from 12° to 27°C. The pH of the river water was 7.5 with a total of 364 ppm dissolved solids. The chemical loss of the active ingredient of Bayer-73 within 24 hours is shown in Table 2.

The data shown in Table 2 indicates that there is a sequential degradation or loss of active ingredient in water for Bayer-73, and this generally agrees with the results recorded by Strufe and Gonnert (6) who studied the loss of active ingredient of Bayer-73 in a solution containing 1750 ppm of river mud.

Furthermore, these results may support our view that the excessive loss of active ingredient of Bayer-73 when sprayed into a deep pond may possibly be due to the downward dispersal of the chemical.

The losses of active ingredient of Bayer-73 sprayed into a swamp and a pond are plotted in the accompanying figure. Since the time of treatment, these two habitats have been free of snails for 18 months.

DISCUSSION AND CONCLUSION

According to Meyling & Pitchford (3), copper sulfate is likely to precipitate in alkaline waters. The precipitation may remain in suspension for some time and retain certain toxic properties, which would probably be lost with settling and incorporation into the mud (pitchford *et al.*, (4); Hopf *et al.*, (2). The same results may be seen in our experiments with copper sulfate in which a dramatis drop of 50%of the concentration (from34 to 17 ppm)occurred with 1½ hours after application. As the natural waters in this area are known to be alkaline with a pH range of from 7.5 to 8.5, it is not economic to use CuSO4 as a molluscicide in Iran.

It has been known for years that NaPCP can easily be broken down under sunlight and the Khuzestan area is renowned for clear sky and heat.Thus it is advisable that the application of NaPCP be carried out bate in the afternon. According to Strufe & Gonnert (6), the chemical loss due to adsorption for Sodium-PCP within the first five hours is almost twice as high as that recorded for Bayluscide. Furthermore, Sodium-PCP is harmful to the handlers, especially under summer heat. For these reasons, the further use of NaPCP in Iran is not recommended.

Bayluscide was found to be the most stable molluscicide in our field trials, and at the present time is the molluscicide of choice for ponds, springs, canals and small swamps.

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TABLE 1

Chemical Loss of NaPCP Concentration

in a Pond (in ppm)

Water Samples Taken at Site	Hours after Application				
	Immediately	1½	3	8	24
A	15	14	6.5	3	2
B	10	11	10	5	2.4
C	15	10	7.5	6	2
D	10	5	5.5	4.5	3
Average	12.5	10.0	7.4	4.6	2.4

TABLE 2

Depreciation of Active Ingredient in Bayluscide

under Outdoor Conditions within 24 hours

Aquarium No.	Original Concentration ppm	Concentration (1 day later) ppm	Percentage Loss
1	0.07	trace	--
2	0.14	trace	--
3	0.21	0.11	48
4	0.28	0.18	36
5	0.35	0.21	40
6	0.70	0.49	30
7	1.40	0.88	37