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Effects of Daily Phosphamidon Administration on Certain Blood Biochemical Measurements in *Bubalus bubalis*

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Phosphamidon is a broad-spectrum, systemic and contact organophosphate (OP) insecticide being applied extensively to protect crops including forages against insect pests. Spray application of 250 mL of 0.02% phosphamidon in 450-500 L water/ha is used to control shoot bugs on sorghum. For control of pests of maize, spraying with 0.1% concentration is advocated (Jha 1987). The biological spectrum of phosphamidon is not just limited to insects but it has potential to induce deleterious effects in mammals. The widespread use of phosphamidon poses health hazards to domestic animals including buffaloes exposed by ingestion of insecticide sprayed crops (Singh 1981; Singh and Singh 1984; Hatch 1988). Apart from sporadic cases, epidemics of OP insecticide poisoning have been reported in buffaloes (Singh 1981). There is paucity of information on phosphamidon toxicity in the buffalo in particular with regards to its effects following long-term exposure. Previous reports have ascertained that sensitivity of the buffalo to OP insecticides varies markedly from other animal species (Vadlamudi 1974; Paul et al. 1984; Murphy 1986). It has been emphasised that toxicity data of OP insecticides generated in other animal species may not be useful for extrapolation to the buffalo. The study reported here was undertaken to investigate the toxicity of phosphamidon and its influence on erythrocyte acetylcholinesterase (AChE), blood glucose and total serum proteins in buffalo calves following long-term exposure.

MATERIALS AND METHODS

Nine male buffalo calves weighing between 70 and

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120 kg were used. The calves were considered in good health, as determined by physical examination and were maintained on green fodder and wheat straw and water was provided ad libitum. They were randomly assigned to 3 groups of 3 animals each. Groups 2 and 3 received phosphamidon (0, 0-dimethyl-0-(2-chloro-2-(diethylcarbamoyl)-1-methylvinyl) phosphate, dimecron; 85% w/w; Hindustan Ciba-Geigy Ltd, Bombay) in daily oral doses of 0.25 and 0.5 mg/kg body wt, respectively for 120 consecutive days. Each day before drenching the requisite amount of phosphamidon was mixed with 50 ml of tap water. The animals were weighed at weekly intervals and the amount of insecticide administered was corrected for the changes in body weight. The animals of group 1 were left unexposed to insecticide and served as controls. All the calves were observed closely for any clinical signs of toxicosis during the exposure and post-exposure periods of 120 and 14 days, respectively. Blood samples were collected by jugular venepuncture at weekly intervals during the course of the study. Erythrocyte AChE was determined by using a modification of method of Voss and Sachsse (1970) as suggested by Moroi et al. (1976). The levels of blood glucose and total serum proteins were determined by the methods of Frankel et al. (1970) and Wootton (1964), respectively. Various parameters were compared statistically by using Student's t-test and the P values < 0.05 were considered significant.

RESULTS AND DISCUSSION

The daily oral administration of phosphamidon at dose of 0.25 mg/kg body wt for 120 consecutive days caused no apparent toxic signs in buffalo calves. The animals receiving higher dose (0.5 mg/kg/d) exhibited mild intermittent diarrhea between 35 and 84 days during the treatment period. Since calves may be exposed to phosphamidon through ingestion of contaminated fodder under natural circumstances it was most appropriate to administer the insecticide by oral route. In buffalo species, phosphamidon in repeated oral doses seems to be less toxic than monocrotophos which produced partial lethality in male buffalo calves treated orally at dose of 0.5 mg/kg/d for 28 consecutive days (Sandhu and Malik 1988).

Table 1 presents the changes in erythrocyte AChE in control and phosphamidon treated calves during the 120-d treatment and the 14-d post-treatment period. Although enzymatic activity and other biochemical parameters were monitored at the 7-d intervals during the course of the study, only a few highly relevant data points have been included in Tables 1 and 2. The pretreatment value of each group formed the basis for comparison with levels measured after phosphamidon

Table I. Effect of long-term oral administration of phosphamidon on erythrocyte acetylcholinesterase in buffalo calves

Dose (mg/kg/day)	Time in days							
	Treatment						Post-treatment	
	0	14	28	77	91	119	7	14
Control	2272 ± 92 (100)	2176 ± 63 (96)	2211 ± 46 (97)	2124 ± 17 (93)	2158 ± 41 (95)	2158 ± 46 (95)	2176 ± 76 (96)	2141 ± 30 (94)
0.25	2280 ± 46 (100)	2124[a] ± 17 (93)	2054[b] ± 17 (90)	1480[b] ± 63 (65)	1514[b] ± 52 (66)	1662[b] ±8.7 (73)	2141 ± 30 (94)	2210 ± 46 (97)
0.5	2280 ± 46 (100)	1897[b] ± 46 (83)	1715[b] ± 49 (75)	1166[b] ± 17 (51)	1288[b] ± 46 (56)	1375[b] ± 17 (60)	2106[a] ± 18 (92)	2158 ± 46 (95)

Values given are mean±SE of the results obtained from 3 animals and expressed as nmol acetylthiocholine hydrolyzed/min/ml. Figures in parentheses indicate percentage of control (0 d) activity

[a]Statistically significant difference when compared with pretreatment value (0 d) of the same group ($P < 0.05$)

[b]Statistically significant difference when compared with pretreatment value (0 d) of the same group ($P < 0.01$)

Table 2. Effect of long-term oral administration of phosphamidon on blood glucose and total serum proteins in buffalo calves

Dose (mg/kg/ day)	Treatment (days)					
	0	21	70	91	112	119
	Blood glucose (mg/100 ml)					
Control	52 ± 5.5	56 ± 1.8	51 ± 1.6	49 ± 2.4	51 ± 2.7	51 ± 1.6
0.25	54 ± 3.1	61 ± 2.4	65 ± 3.1	63 ± 1.8	58 ± 2.4	52 ± 1.7
0.5	55 ± 2.9	69 ± 3.9[a]	76 ± 3.1[b]	72 ± 3.2[a]	62 ± 2.7	57 ± 2.7
	Total serum proteins (g/100 ml)					
Control	7.5 ± 0.06	7.3 ± 0.11	7.2 ± 0.06	7.1 ± 0.11	7.4 ± 0.06	7.4 ± 0.12
0.25	7.8 ± 0.22	7.9 ± 0.03	8.2 ± 0.03	8.1 ± 0.03	8.0 ± 0.05	7.9 ± 0.18
0.5	7.4 ± 0.09	8.3 0.21[a]	8.5 ± 0.12[b]	8.4 ± 0.17[b]	7.9 ± 0.03[b]	7.9 ± 0.18

Values given are mean±SE of the results obtained from 3 animals

[a]Statistically significant difference when compared with pretreatment value (0 d) of the same group ($P < 0.05$)

[b]Statistically significant difference when compared with pretreatment value (0 d) of the same group ($P < 0.01$)

exposure. There appeared to be a dose-dependent depression in the enzymatic activity and maximal inhibition of 35 and 49% was observed on the 77th d following 0.25 and 0.5 mg/kg/d doses of the insecticide, respectively. On terminating phosphamidon administration, the recovery of AChE was rapid and activity comparable to pretreatment values was recorded within 7-14 days.

The daily oral administration of phosphamidon exerted a less pronounced effect on blood glucose and total serum proteins (Table 2). Although both doses produced gradual increase in these biochemical indices up to the 70th d, statistically significant ($P < 0.05$) rise was observed only at the higher dose of phosphamidon. Such effects are known to follow the administration of OP insecticides in laboratory and ruminant animals (Paul et al. 1979; Raina et al. 1990). The levels of blood glucose and total serum proteins recovered to control values by days 112 and 119, respectively.

It is obvious from the data presented in Tables 1 and 2 that the intensity of phosphamidon - induced changes in parameters measured was decreased during the later phase of the treatment period. The results show that following low-dose chronic exposure buffaloes appear to develop some degree of tolerance to the biochemical effects of phosphamidon.

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