THE EFFECT OF LONG-TERM EXPOSURE TO PHOSPHAMIDON ON THE RUMINAL MICROORGANISMS AND CIRCULATING CARBOXYLESTERASE OF BUBALUS BUBALIS

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ABSTRACT

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The effect of long-term exposure to the organophosphate insecticide phosphamidon on the ruminal microorganisms and serum carboxylesterase of buffalo calves was investigated. Oral administration of phosphamidon in doses of 0.25 and 0.5 mg/kg per day for 120 days caused significant inactivation of carboxylesterase activity (16-32%) without eliciting any intoxicating signs apart from mild intermittent diarrhoea in the animals receiving the higher dose. The higher dose also produced a significant reduction in the total number of rumen protozoa (16-24%). However, the insecticide had no discernible effect on the total bacterial count or pH of the rumen liquor.

Keywords: buffalo, carboxylesterase, microorganisms, phosphamidon, rumen, serum, toxicity

INTRODUCTION

In mature ruminants, pregastric microbial fermentative digestion is of considerable significance for the sustenance of life. Both protozoa and bacteria play an important role in ruminal digestion, providing an energy source for the animal. Intake of forage contaminated with poisonous agents may have a deleterious influence on the protozoal and bacterial activities in the rumen, so adversely affecting the host. Organophosphate (OP) insecticides are widely employed as crop protectants and their indiscriminate use poses health hazards to ruminants exposed by ingestion of insecticide-sprayed forages (Singh, 1981; Singh and Singh, 1984; Hatch, 1988). Although toxic manifestations induced by OP insecticides have been extensively investigated in man and a variety of animal species, little is known about their long-term effects on the ruminal microbial population. Thus, the object of the present investigation was to detect the influence of a widely used OP crop protectant, phosphamidon, on the ruminal microorganisms of buffalo calves following daily oral administration in low doses over 120 days. It was also of interest to study the effect of this insecticide on circulating carboxylesterase, an enzyme involved in the detoxification of certain other pesticides (Matsumura, 1985).
MATERIALS AND METHODS

Clinically healthy male buffalo calves with body weights ranging from 70 to 120 kg were acclimatized to the departmental animal housing conditions for 2 weeks before being used. They were maintained on green fodder, wheat straw and tap water. The calves were randomly divided into 3 groups of 3 animals each. The animals in group 1 were not exposed to insecticide and served as controls, whereas those in groups 2 and 3 received phosphamidon (O,O-dimethyl-O-(2-chloro-2-(diethylcarbamoyl)-1-methylvinyl)-phosphate, dimecron; 85% (w/w); Hindustan Ciba Geigy Ltd, Bombay) in daily oral doses of 0.25 or 0.5 mg/kg body weight, respectively, for 120 consecutive days. The requisite quantity of insecticide was suspended in 50 ml of tap water just prior to drenching. All the animals were weighed weekly and the doses were corrected for the changes in body weight.

Rumen liquor was collected by inserting a sterilized needle directly into the rumen and blood samples were drawn by jugular venepuncture. The colour and odour (Misra and Tripathy, 1963), pH, total bacterial count (Gall et al., 1949), total protozoal count (Purser and Moir, 1959) and differential protozoal count (Misra et al., 1972) of the rumen liquor were recorded. The carboxylesterase (CarbE; EC 3.1.1.1) activity was measured in serum by the colorimetric method of Mendoza et al. (1971). Various parameters of rumen liquor and serum CarbE were monitored at weekly intervals during the exposure period and 2 weeks after cessation of insecticide administration. Much data that offered no additional information has been omitted in Table I. Data were subjected to statistical analysis using Student's t-test and significant differences between the means were determined at the $p<0.05$ and $p<0.01$ levels.

RESULTS

Daily oral administration of phosphamidon at doses of 0.25 or 0.5 mg/kg for 120 days did not induce any apparent intoxicating signs except mild intermittent diarrhoea between 35 and 84 days after administration commenced in animals exposed to the higher dose of the insecticide. The data presented in Table I show that long-term treatment with either 0.25 or 0.5 mg/kg per day of phosphamidon did not produce any significant ($p>0.05$) change in the total rumen bacterial count. Similarly, no appreciable change in colour, odour or pH of the rumen liquor was detectable during the study. The pH values of the rumen liquor in the animals given no insecticide or exposed to low or higher doses of phosphamidon were 6.92 ± 0.02, 6.85 ± 0.03 and 6.92 ± 0.02, respectively. However, the higher dose of phosphamidon significantly ($p<0.01$) decreased the total protozoal count, the maximal reduction of 24% being evident 13 weeks after the start of dosing. The protozoal population returned to control values within 14 days after insecticide administration ceased. Phosphamidon also caused a dose-dependent significant ($p<0.05$) reduction in serum CarbE activity (Table I). The maximum depression of 22–38% occurred at the 10th week after the start of insecticide exposure. Two weeks after discontinuance of phosphamidon application, the activity of CarbE had returned to the vicinity of the control values.