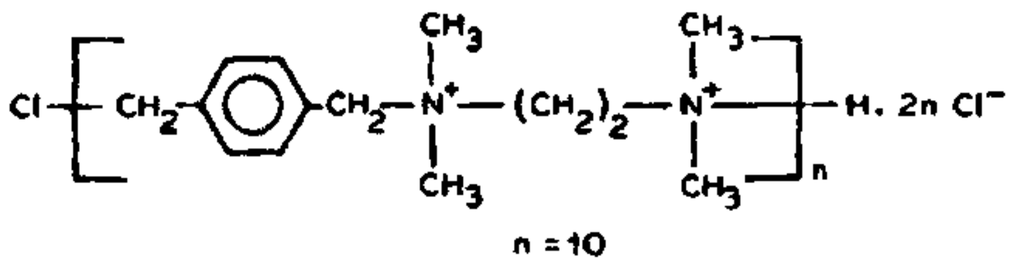
ionone polymers are structurally related to spermine, spermidine and their methylated derivatives[1]. Polymers containing cationic centres form very interesting polysalts, which have a variety of uses[2]. Since a polycation of high positive charge could lead to organic materials of high conductivity, this type of polymer is of considerable interest. The synthetic polycation polylysine inhibits the infectivity of tobacco mosaic virus as well as some animal viruses and bacteriophages, and the growth of numerous bacteria[3]. Polycations constitute an important group of biologically active molecules that have shown considerable promise in prophyl axis and chemotherapy of viral infections[4]. It is well known that polycations interact with nucleic acids and α-amylases[5]. This communication reports antibacterial activity of a synthetic polycation.

The polycation shown below was synthesized according to the procedure described earlier[6,7]. It was screened for activity against eight bacterial species, viz. *Escherichia coli*, *Pseudomonas alkaligenes*, *Bacillus subtilis*, *Proteus vulgaris*, *Serratia marcescens*, *Vibrio cholerae*, *Shigella sonnei* and *Salmonella typhi*. Antibacterial activity was assessed by the cup plate method[8]. The base layer medium was melted on a water bath and cooled to 55°C. Aliquots of 20 ml of liquid medium were distributed to each petri dish and allowed to solidify. The seed layer medium was melted and cooled to 45–50°C with gentle shaking. Overnight culture (2%) was added asceptically to the seed layer medium, which was then mixed thoroughly and quickly poured into petri dishes containing the base layer. After solidification and cooling, cups were made by punching into the set agar with a sterile cork borer and scooping out the punched part. The diameter of each cup was 10 mm. To these cups, 0.1 ml (9 μg) of a solution of the polycation in distilled water was added using a sterile. The plates were kept in the cold for an hour to facilitate diffusion. They were then incubated at 37°C for 48 h. Aqueous phenol (5%) was used as positive control. The results are summarized in table 1.

On the basis of these observations the polycation is highly active against *E. coli* and *P. alkaligenes*, moderately active against *S. typhi*, and less active against *P. vulgaris* and *S. marcescens*. It was inactive against the other microorganisms tested.



n = 10

Table 1 *Antibacterial activity of polycation*

Organism	Zone of inhibition (mm)
E. coli	25–32
P. alkaligenes	25–32
S. typhi	20–25
P. vulgaris	15–20
S. marcescens	15–20
V. cholerae	—
S. sonnei	—
B. subtilis	—

—, No inhibition.

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1. Mulimani, V. H., *Curr. Sci.*, 1985, **54**, 10.
2. Hadek, V., Noguchi, H. and Rembaum, A., *Macromolecules*, 1971, **4**, 494.
3. Mathur, K. B., Gangopadhyay, Chowdhury, B. L. and Babbar, O. P., *Indian J. Exp. Biol.*, 1982, **20**, 227.
4. Stahmann, M. A., Gzaf, L. H., Patterson, E. L., Walker, J. C. and Watson, D. W., *J. Biol. Chem.*, 1951, **189**, 45.
5. Mulimani, V. H. and Gopal, M., *Indian J. Med. Res.*, (in press)
6. Rembaum, A., Baumgartner, W. and Eisenberg, A., *J. Polym. Sci.*, 1968, **B6**, 159.
7. Noguchi, H. and Rembaum, A., *J. Polym. Sci.*, 1969, **7**, 383.
8. Collins, C. H. and Lyne, P. M., *Microbiological Methods*, Butterworth, London, Boston, IV edn, 1976, p. 235.

PHOSPHAMIDON-INDUCED CHANGES IN HEPATIC ENZYMES OF MOUSE

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PHOSPHAMIDON (*O,O*-dimethyl-*O*-1-methyl-2-choloro-2-diethylcarbamoylvinyl phosphate) is an organophosphate systemic acaricide. It is extensively used against sucking, chewing and mining insects. The

liver is the organ most significantly involved in the metabolism and storage of different pesticides. The phosphatases of the liver play an important role in the biochemical transformation of these substances. The present study was undertaken to evaluate the effects of phosphamidon on the activity of hepatic enzymes acid and alkaline phosphatase and glucose 6-phosphatase in mice.

Swiss albino male mice obtained from an inbred colony were treated with LD_{50} and half-LD_{50} dose of phosphamidon, i.e. 11.2 mg/kg body wt and 5.6 mg/kg body wt respectively, by gavage. Autopsies were done at 3, 6, 12 and 24 h, and 3, 7, 14, 21 and 28 days post-treatment. The liver was removed quickly and processed for biochemical estimations. Alkaline and acid phosphatases were estimated colorimetrically by the method suggested by Fiske and Subbarow[1] and glucose 6-phosphatase activity was determined by Swanson's method[2].

The results are shown in tables 1 and 2. The higher dose of phosphamidon caused significant increase in acid phosphatase activity. The lower dose did not cause significant change in acid phosphatase activity. The increase in hepatic acid phosphatase activity in treated animals may be due to destruction of lysosomal membranes in the cells, resulting in release of the enzyme[3]. Similar changes in hepatic acid phosphatase activity induced by other organophosphate pesticides have been reported by many workers[4–7].

A significant decrease in alkaline phosphatase activity was observed at the higher dose of phospha-

Table 1 *Effect of phosphamidon (11.2 mg/kg body wt) on hepatic acid and alkaline phosphatase and glucose 6-phosphatase activities in Swiss albino mice*

Time after treatment	Enzyme activity (mg Pi released/g/h)					
	Acid phosphatase		Alkaline phosphatase		Glucose 6-phosphatase	
	Control	Treated	Control	Treated	Control	Treated
3 h	2.07 ± 0.01	5.00 ± 0.40^{y}	3.12 ± 0.04	3.20 ± 0.01	13.53 ± 0.21	8.20 ± 0.35^{z}
6 h	2.07 ± 0.01	4.11 ± 0.37^{y}	3.12 ± 0.04	2.96 ± 0.07^{y}	13.53 ± 0.21	9.35 ± 0.22^{z}
12 h	2.07 ± 0.01	3.34 ± 0.31^{y}	3.12 ± 0.04	2.62 ± 0.01^{z}	13.53 ± 0.21	10.22 ± 0.17^{z}
24 h	2.07 ± 0.01	3.06 ± 0.21^{y}	3.12 ± 0.04	2.80 ± 0.10^{z}	13.53 ± 0.21	10.70 ± 0.08^{z}
3 days	1.97 ± 0.07	5.18 ± 0.17^{z}	3.22 ± 0.05	2.98 ± 0.02^{y}	13.96 ± 0.10	12.46 ± 0.26^{x}
7 days	2.08 ± 0.06	5.97 ± 0.31^{z}	3.20 ± 0.02	2.80 ± 0.03^{y}	13.26 ± 0.14	9.35 ± 0.17^{z}
14 days	2.08 ± 0.08	5.39 ± 0.09^{z}	3.08 ± 0.01	2.84 ± 0.05^{y}	13.97 ± 0.07	11.18 ± 0.17^{z}
21 days	2.13 ± 0.02	5.46 ± 0.09^{z}	3.20 ± 0.02	2.91 ± 0.03^{y}	12.45 ± 0.21	8.55 ± 0.16^{z}
28 days	1.99 ± 0.01	5.40 ± 0.18^{z}	3.11 ± 0.04	2.98 ± 0.01^{x}	13.31 ± 0.16	7.48 ± 0.18^{z}

Each value is the mean of 5 animals ± SE.
Significance of difference: $^{x}P < 0.05$, $^{y}P < 0.01$, $^{z}P < 0.001$.

Table 2 *Effect of phosphamidon (5.6 mg/kg body wt) on hepatic acid and alkaline phosphatase and glucose 6-phosphatase in Swiss albino mice*

Time	Enzyme activity (mg Pi released/g/h)					
	Acid phosphatase		Alkaline phosphatase		Glucose 6-phosphatase	
	Control	Treated	Control	Treated	Control	Treated
3 h	3.04 ± 0.03	3.69 ± 0.30	3.76 ± 0.19	3.69 ± 0.23	10.13 ± 0.15	9.32 ± 0.33
6 h	3.04 ± 0.03	3.58 ± 0.25	3.76 ± 0.19	4.20 ± 0.11	10.13 ± 0.15	9.51 ± 0.31
12 h	3.04 ± 0.03	3.10 ± 0.55	3.76 ± 0.19	4.00 ± 0.07	10.13 ± 0.15	9.11 ± 0.36
24 h	3.04 ± 0.03	3.56 ± 0.31	4.02 ± 0.47	6.79 ± 0.44^{x}	10.13 ± 0.15	8.34 ± 0.13^{z}
3 days	3.32 ± 0.48	2.23 ± 0.36	4.21 ± 0.38	5.20 ± 0.99^{x}	11.91 ± 0.15	7.20 ± 0.52^{z}
7 days	3.17 ± 0.25	2.63 ± 0.14	4.35 ± 0.48	4.75 ± 0.55	10.93 ± 0.67	6.89 ± 0.21^{z}
14 days	3.29 ± 0.49	2.14 ± 0.12	3.97 ± 0.36	4.40 ± 0.49	11.06 ± 0.36	10.23 ± 1.56^{x}
21 days	3.29 ± 0.47	2.43 ± 0.25	4.18 ± 0.10	4.40 ± 0.37	11.72 ± 0.80	10.40 ± 0.22
28 days	3.32 ± 0.54	2.72 ± 0.12	3.92 ± 0.03	3.99 ± 0.62	10.59 ± 0.69	9.70 ± 0.37^{x}

Each value is the mean of 5 animals ± SE.
Significance of difference: $^{x}P < 0.05$, $^{z}P < 0.001$.

midon, whereas the lower dose did not produce any significant change except at 24 h and 3 days after treatment. The decrease in alkaline phosphatase activity may be due to massive cell damage as suggested by Dinman[8] and also observed by the present authors[9]. Other organophosphate insecticides also act on this enzyme in a similar way[6,7]. Increase in the activity of alkaline phosphatase (24 h and 3 days) may be to counteract the effect of the toxic action of the insecticide, as also observed and suggested by other workers[4,5,10,11].

A significant decrease in glucose 6-phosphatase activity was observed after the treatment at both the doses. The decrease in activity of this enzyme in treated animals is an indication of cellular damage, which obstructs cellular metabolic activity under the toxic influence of phosphamidon[12]. Other organophosphate pesticides which cause pathological changes in hepatic tissue also interfere with the glucose 6-phosphatase activity[4,5].

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1. Fiske, C. H. and Subbarow, Y., *J. Biol. Chem.*, 1925, **66**, 375.
2. Swanson, M. A., *Methods Enzymol.*, 1955, **2**, 541.
3. Deckers-Passau, L., Maisin, J. and Deduve, C., *Acta Unio. Int. Cancrum.*, 1957, **13**, 822.
4. Saxena, A. K. and Sarin, K., *Pestology*, 1978, **2**, 26.
5. Saxena, A. K. and Sarin, K., *Toxicology*, 1980, **18**, 133.
6. Bulusu, S. and Chakravarty, I., *IRCS Med. Sci.*, 1982, **10**, 780.
7. Chakravarty, I. and Sreedhar, R., *Environ. Res.*, 1982, **27**, 179.
8. Dinman, B. D., *Arch. Environ. Health*, 1965, **11**, 265.
9. Bhatnagar, P. and Jain, N., *Bull. Environ. Contam. Toxicol.*, 1986, **37**, 767.
10. Jenkins, L. J. Jr., Trabulers, M. J. and Murphy, S. D., *Toxicol. Appl. Pharmacol.*, 1972, **23**, 501.
11. Murphy, S. D. and Malley, S., *Toxicol. Appl. Pharmacol.*, 1969, **15**, 117.
12. Papadimitriou, J. M., Bradshaw, R. D., Petterson, D. S. and Gardiner, M. R., *J. Pathol.*, 1974, **112**, 43.