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Comparative Evaluation of the Alleviating Effect of Standard, Low Protein and High Protein Diets on the Toxic Effect of Organophosphorus Compounds on the Growth of Rats

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ABSTRACT

Gradual elevation of protein in the diet from 5 per cent to 19 per cent to 59 per cent and kept isocaloric significantly improved the growth rate over a period of 19 days of male albino rats exposed to the toxic stress of DFP and Malathion. Elevation in growth rate was observed only under diet with 59 per cent protein.

1. INTRODUCTION

In an earlier investigation[1], it was found that elevation of protein in the diet from 19 to 59 per cent and kept isocaloric significantly improved the growth over a period of 20 days of male albino rats exposed to the toxic stress of DFP, EPN and Malathion.

In the present investigation the above study has been extended to have a comparative evaluation of the relative efficacies of the isocaloric standard (SD), low-protein (LDP) and high-protein (HPD) diets in combating toxicities of DFP (diisopropyl phosphorofluoridate) and Malathion [0, 0-dimethyl S-(1, 2-dicarbethoxy ethyl) phosphorodithioate].

The aim was to study the effect of increasing percentages of protein in the diet on the toxicity of OP compounds as envisaged by inhibition of growth rates.

Male albino rats of Wistar – Strain (body wt. 130±10g) were divided into nine groups of six animals each. The first group served as control (1) being given a standard diet (SD) containing 19 per cent protein. The second group served as control (2) being given a low-protein diet (LPD) containing 5 per cent protein. To the third group, serving as control (3), a high-protein diet (HPD) was given which contained

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59 per cent protein. All these three diets were made isocaloric, the compositions of which have been described by Purshottam & Kaveeshwar[2]. The above control groups received approx. the same volume of diluants as the experimental animals, that were used for the dilutions of OP compounds[1].

The fourth, fifth and sixth groups received, apart from SD, LPD and HPD respectively, a subcutaneous dose equivalent to 5 per cent LD_{50} value of DFP daily for 19 days.

Similarly, the seventh, eighth and ninth groups received apart from SD, LPD and HPD respectively, a subcutaneous dose equivalent to 5 per cent LD_{50} value of Malathion for the same period.

The effects of various diets either separately or in combination with OP compounds on growth rate of rats have been compared with untreated SD control (1).

The results are ennumerated in Table 1. It can be seen from groups I, II and III that all the three diets SD, LPD and HPD are growth promoting as there is an increase in body weights recording positive nitrogen balance. Elevations in growth rate as compared to SD control (1) can be seen in groups III, VI and IX. These are the

Table 1. Per cent elevation/depression in growth rates on 5, 19 and 59 per cent isocaloric protein diets subjected to subcutaneous toxic stress of OP compounds

Groups	Treatment	Mean±S.E.Wt. of animals on day 1 g	Mean±S.E.Wt. of animals on day 19 g	Per cent elevation/depression in growth rates as compared to Group I
I	Standard diet (SD) Contg. 19% protein	124.0±5.60	144.3±5.54	
II	Low-protein diet (LPD) Contg. 5 % protein	125.0±4.90	137.0±4.30	40.90 (Depression)
III	High-protein diet (HPD) Contg. 59 % protein	114.5±5.90	151.5±6.20	82.26 (Elevation)
IV	SD ± DFP 5 % LD_{50} dose daily	122.6±3.0	142.6±5.0	1.46 (Depression)
V	LPD+DFP ,,	122.0±5.0	124.3±5.2	88.70 (Depression)
VI	HPD+DFP ,,	123.6±6.1	156.0±5.0	59.60 (Elevation)
VII	SD+Malathion ,,	125.0±4.9	133.0±4.8	60.60 (Depression)
	LPD+Malathion ,,	128.0±4.8	128.0±4.9	100.00 (Depression)
IX	HPD+Malathion ,,	123.5±4.0	149.0±3.0	25.61 (Elevation)

* The quantity of food given was 17 g/rat/day (Ref. 1) with water *ad lib.*

groups with HPD alone or in combination with DFP or Malathion. The maximum elevation in growth rate being 82.2 per cent in case of HPD alone, the next being 59.6 per cent in case of HPD plus DFP and the last in order being 25.6 per cent in case of HPD and Malathion. These figures are indicative of more effectiveness of HPD in combating toxicity against DFP than Malathion. As mentioned earlier[1] DFP and Malathion follow different pattern of metabolic pathway. Whereas in case of SD and LPD either singly or in combination with DFP and Malathion there were depressions in growth rates. The maximum depression being 100% in case of LPD and Malathion combination (Gr. VIII) and the minimum being 1.4 per cent in case of SD and DFP (Gr. IV). In this respect (although HPD is best) SD seems to be better than LPD showing less depressions.

If these diets are to be assessed with respect to their suitability in combating toxicity of at least DFP, which is structural analogue of nerve gas sarin (methyl isopropyl phosphonofluoridate) it may be concluded that HPD is best. No other type of diet studied was found suitable as assessed by this parameter. However, it could be noticed that the alleviating capacity increased with the increase of protein content. A high-protein diet is nothing more than a diet low in carbohydrate content whereas a low-protein diet is a diet containing excessive amount of carbohydrate[3] with the provision that the fat level is kept constant.

2. CALCULATION OF PERCENTAGE ELEVATION/DEPRESSION IN GROWTH RATES

Example : o/o Depression in Group II as compared to Group

$$\frac{\text{difference in growths in 19 days in Groups I and II}}{\text{growth in Group I for the same period}} \times 100$$

$$\frac{(144.3-124.0)\sim(137.0-125)}{(144.3-124.0)} \times 100$$

$$\frac{20.3-12.0}{20.3} \times 100$$

$$\frac{8.3}{20.3} \times 100$$

$$= 40.90$$

Same formula is applicable to the calculation of per cent Elevation in growth rates where growth in control group is less than the group assessed.

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