

EFFECT OF LOW LEVEL ADMINISTRATION OF MALATHION ON ADRENAL MEDULLARY RESPONSE IN RATS

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ABSTRACT

The effect of malathion at a dose rate of 23 mg/kg (1/50th of LD-50) given intraperitoneally daily for 60 days on the activity of adrenal medulla has been investigated. Levels of adrenal catecholamines *i.e* adrenaline, noradrenaline, and dopamine were determined. The rise in the level of adrenaline on 30th, 45th and 60th day were observed while noradrenaline and dopamine showed decline at 30 and 45 days. The levels of all the amines was raised above their controls on the 60th day. Changes in the contents of adrenal catecholamines indicate the hyperadrenal medullary activity. The adrenal medulla plays a part in adapting to stressful situation by releasing its catecholamine stores and later increasing the synthesis.

INTRODUCTION

PESTICIDES are being increasingly used in recent years. The acute and subacute toxic effects of many pesticides have been studied but little attention has been paid to examine the long range effects on adrenalmedulla. However, there are a few studies showing hyper adrenal medullary activity in rats after application of different physical stressors like cold¹⁻³, immobilization⁴, heat⁵, burns and foot electroshock stimulus⁶ and chemicals like diazepam⁷ and chlorisondamine⁸. Various physical exercises have also been shown to cause hyper medullary activity^{1,9}.

A systematic study exposing the animals to very low level of these insecticides and monitoring the activity of adrenalmedulla has not been reported. Hence, this study was undertaken using malathion which is being extensively used for public and animal health programs and for food production in agriculture.

MATERIALS AND METHODS

The experiment was conducted on Wister strain of albino male rats. The animals procured from the Haryana Agricultural University were kept on standard feeding schedule and management conditions. The feed and water were provided with *ad lib*. The weight of the animals ranged from 100 to 150 g with their age ranging from 12 to 14 weeks.

Malathion [0,0 dimethyl S(1-2 dicarboethoxy ethyl) phosphorodithioate], technical grade (97.72%), was used. The insecticide was dissolved in arachis oil

and administered intraperitoneally. The animals were divided into two groups, one treated and the other control group. The animals in the treatment group received malathion daily for 60 days at a dose rate of 23 mg/kg which is 1/50th of LD-50 (LD-50 as worked out in the laboratory is found to be 1150 mg/kg). Animals in the control group received no malathion but only an equivalent volume of arachis oil. Six animals from malathion-treated group and another six animals from control group were sacrificed at 30, 45, and 60 days following the start of malathion administration after anaesthetising them with pentobarbitone given at the rate of 50 mg/kg intraperitoneally. The peritoneal cavity was opened and adrenal glands were taken out for estimating catecholamines *i.e* adrenaline, noradrenaline and dopamine. The levels of catecholamines were determined by employing the procedure of Ansell and Beeson¹⁰.

Statistical analysis of the data

The experimental data were analysed by calculating means 371 and standard errors. The paired *t*-test was applied to determine the statistical significance according to Snedecor and Cochran¹¹.

RESULTS

The effect of malathion on adrenal catecholamines has been presented in table 1. There was a rise in the level of adrenaline on all the days *i.e* 30th, 45th and 60th days. On the 30th day, it was significantly higher

Table 1 Effect of malathion (23 mg/kg, i.p. daily for 60 days) on adrenal catecholamine concentrations (Adrenaline, Noradrenaline, Dopamine) in rats

Catecholamines ($\mu\text{g/g}$ of adrenal)	Time after administration (days)			
	0	30	45	60
<i>Adrenaline:</i>				
Control	755.22 \pm 85.45	800.81 \pm 86.29	807.68 \pm 86.25	788.52 \pm 86.72
Treated	798.02 \pm 85.74 (105.6)	1048.38 \pm 98.76 ^a (130.9)	1023.24 \pm 44.41 (126.7)	1005.34 \pm 47.81 (127.5)
<i>Noradrenaline:</i>				
Control	274.51 \pm 9.08	288.54 \pm 6.65	295.45 \pm 6.68	284.36 \pm 7.07
Treated	288.45 \pm 9.71 (105.1)	223.15 \pm 18.13 ^a (77.3)	248.45 \pm 14.13 (84.1)	336.19 \pm 24.52 (118.2)
<i>Dopamine:</i>				
Control	266.08 \pm 28.56	270.24 \pm 28.36	260.30 \pm 28.60	272.58 \pm 28.45
Treated	269.19 \pm 28.53 (101.2)	244.04 \pm 20.77 (90.3)	250.43 \pm 18.92 (96.2)	299.47 \pm 28.67 (109.2)

Animals in the control groups were administered arachis oil

Values are means \pm S.E. of six animals

Values in the parenthesis denote per cent of corresponding control

^a $P < 0.01$

(1048.38 $\mu\text{g/g}$) than the corresponding control value (800.81 $\mu\text{g/g}$). However, the level of noradrenaline and dopamine decreased at 30th and 45th day. On the 30th day, the levels of noradrenaline and dopamine were 77.3 and 90.3% of their corresponding control animals. Table 1 indicates that the levels of both noradrenaline and dopamine started rising after the maximum decrease and were even more than the control values on the 60th day of administration of malathion. However, the levels of all the amines were higher than the corresponding control values at 60th day.

DISCUSSION

There was a rise in the level of adrenaline at all intervals *i.e.* 30, 45 and 60 days of administration of malathion at 23 mg/kg *i.p.* daily and on 30th day, it was significantly higher. On the other hand, the level of noradrenaline and dopamine decreased at 30 and 45 days. The levels of all the amines were raised above their controls at 60 days which indicate either increased synthesis of these catecholamines *i.e.* adrenaline, noradrenaline and dopamine or their reduced release. Greater probability, however, is that the synthesis of catecholamines is increased, since during stress due to this insecticide there is increased release of corticosteroids¹², which have been demonstrated to stimulate the enzymes tyrosine hydroxylase¹³, dopamine beta-hydroxylase^{13,14} and phenylethanol-*n*-methyl transferase^{15,16}. The changes in the

contents of adrenal catecholamines observed in the present study indicate the hyper adrenal medullary activity. Adrenal medulla plays a part in adapting to stressful situations by releasing initially its catecholamine stores and later increasing the synthesis. However, experiments conducted by Selye^{17,18} indicate more emphasis on the cortical activity during exposure to a stressor and his findings do not report the involvement of medulla in such exposures.

Gascon and Leloir⁷ showed increase in catecholamine content of adrenals by subacute treatment with diazepam. After one week of treatment with morphine Anderson and Slotkin¹⁹ observed the increase of catecholamines in adrenal glands. All these drugs act as CNS sedatives or tranquillizers and may have stimulatory actions on one or more of enzymes involved in catecholamines biosynthetic pathway. However, studies with other insecticides to show increased catecholamine synthesis after prolonged administration are lacking. Malathion produced hyper adrenal medullary activity when given in a low dose of 23 mg/kg for a period of 60 days probably acts as a stressor.

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ANNOUNCEMENTS

THIRD ALL INDIA SYMPOSIUM ON INVERTEBRATE REPRODUCTION

The Third All India Symposium on Invertebrate Reproduction will be held under the auspicious of Indian Society of Invertebrate Reproduction (ISIR), Tiruchirapalli on 28 and 29 May 1984.

Details can be had from: The Organising Secretary, Dr S. Thangavelu, Post Graduate Professor of Zoology, Jamal Mohamed College, Tiruchirapalli 620 020.

INTERNATIONAL SYMPOSIUM ON RADIOACTIVITY

The International Symposium on Radioactivity will be held at Pune to commemorate the 50th Anniversary of the discovery of Artificial Radioactivity on 8-12 January 1985. Areas covered are (1) Production and characterisation of new (exotic) nuclides and radio-pharmaceuticals, (2) Application of isotopes in new areas of research, pure and applied, (3) New tech-

niques of detection and counting and health protection and (4) Special areas is hot atom chemistry.

For details please write to Prof. H. J. Arnika, Convener, International Symposium on Radioactivity (ISR), Chemistry Department, University of Poona, Pune 411 007, India.
