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IMPACT OF DIMETHOATE ON TOTAL LEUCOCYTE COUNT IN BLOOD OF MICE

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The dimethoate is a commonly used organophosphorous group of insecticide. The exposure of different mammalian species including humans to this compound is well documented. The effect of low to moderate-levels of repeated exposures of adult mice only to dimethoate have been examined on total leucocyte (TLC) in order to avoid hormonal interference associated with oestrous cycle in female mice. Male swiss aslbino mice in 3-4 months of age group were administered four oral dosages of dimethoate (1. 5. 10. and 20 ppm) in different group everyday for 60 days. Treated and untreated control animals were sacrificed on 5. 10. 15. 30. 45 and 60th days of treatments. TLC in blood samples from both control and experimental groups were analyzed. TLC in blood samples from both control and experimental groups were analyzed. Dimethoate treatments significantly increased TLC, which was dependent upon dose and the duration of the treatments. A dose of 10 ppm optimally effective in inducing significant change in TLC. The increase in TLC and the dose of dimethoate were positively correlated.

Key words : Blood, dimethoate, insecticide, mice, organophosphorous and total leucocyte count (TLC).

INTRODUCTION

Dimethoate is one of the most common organophosphorous group of insecticide used in advanced agriculture to curtail pest menace. It is extremely toxic and causes injurious effects on various systems of the body of non-target organism like mice. The insecticides of this group are generally alkylating compunds (Bedford & Robinson, 1972). The alkylating properties of dimethoate, in part, might be responsible for its cytogenetic activity (Nehez *et al.*, 1994). The toxic effect of these insecticides is attributed to their ability to inactivate acetylcholine estrase and their targets include the gamma aminobutryic acid (GABA)-ergic and cholinergic systems of the brain (Talcott, 1979; Krammer *et al.*, 2002). Dimethoate is degraded in the environment to another toxic insecticide, omethoate. Dimethoate and omethoate induce a dose-dependent increase in the frequency of sister-chromatid exchanges in human lymphoblasts in *in vivo* preparation (Dolara *et al.*, 1992). Recently Akay *et al.* (1999) showed the effects of endosulfan, dimethoate and carbaryl on immune and haematological parameters of rats.

The effects of organophosphorous insecticides on haematology and blood chemistry have been studied by various workers in fish (Kumar, 1990; Mishra, 1993). Human and other mammalian species are subject to exposure of organophosphorous insecticides because of their extensive agricultural use. However, the effects of organophosphorous insecticides including dimethoate in mammalian species are poorly known. The present study examined the effects of short-term as well as long-term exposures of mice to dimethoate on total leucocytes count (TLC) of blood in mice.

MATERIALS AND METHODS

Experiments were conducted on male Swiss mice in the age group of 3-4 months procured from Golden Laboratory, Mehrauli, New Delhi. Experimental subjects were divided into groups

consisting of 15 mice each. Experimental groups were given different doses of dimethoate (30% EC, manufactured by Tata Rallies India Ltd.) dissolved in water orally every day. Four different doses of dimethoate were 1, 5, 10 and 20 ppm per day. Control groups were kept for the same duration as experimental groups on regular feed.

Blood samples from dimethoate treated and the control animals were collected by puncturing the orbital sinus on 5, 10, 15, 30, 45, and 60th days. After collecting blood, animals were sacrificed for histological studies of various organs (reported elsewhere). Blood films were stained by Leishman's stain. The student's t-test was used to determine the statistical significance of the different doses of dimethoate treatments at different time intervals on the TLC in 10^3/mm^3 *vs* their respective controls.

RESULTS AND DISCUSSION

- *Control group* : The TLC (10^3/mm^3) in control mice did not exhibit significant variations from 5 days to 60 days after attaining the adult state. The mean TLC (± S.D.) varied from 9.3 ± 1.9 to 10.2± 1.7 10^3/mm^3 (Table I).

- *Dimethoate group* : Dimethoate treatments significantly affect TLC. The increase in TLC was dose-dependent and time-dependent both. Dimethoate treatment @ 1 ppm dose produced no significant effects on TLC from 5 days to 60 days. A dose of 5 ppm was ineffective up to 30 days but increased TLC on day 45 and day 60 (Table I; Fig. 1A). Dimethoate, when given @ 10 ppm/day was ineffective up to 15 days but increased TLC on 30, 45 and 60th day (Table I; Fig. 1B). Dimethoate given @ 20 ppm/day elevated TLC at all intervals examined except for day 5 (Table I; Fig. 1C). The increase in TLC and the dose of dimethoate used were positively correlated.

The results obtained for the present study suggest that dimethoate produced significant increase in TLC. This increase was dependent up on the dose of the dimethoate used and the duration of the exposure. Even subtoxic dose of dimethoate with a long-term exposure increased TLC. The effects of dimethoate on TLC as observed in the present observation was not the by-product of normal ageing process, since no such effects were found in control animals.

Table I : Effect of different oral doses of dimethoate on TLC count 10^3/mm^3 in mice.

Dose	Blood samples collected in duration days					
	5	10	15	30	45	60
Control	9.3 ± 1.9	9.7 ± 0.9	9.5 ± 1.3	10.1 ± 1.6	9.9 ± 1.4	10.2 ± 1.7
1 ppm	9.6 ± 0.8	10.1 ± 1.6	10.3 ± 1.8	10.9 ± 2.5	11.1 ± 2.7	10.3 ± 2.1
5 ppm	9.8 ± 0.9	10.5 ± 1.9	10.2 ± 2.1	11.6 ± 2.6	16.3 ± 2.1	17.7 ± 3.4*
10 ppm	10.6 ± 2.1*	11.1 ± 2.9	11.3 ± 3.6	15.9 ± 3.2*	19.3 ± 3.1*	20.5 ± 2.9*
20 ppm	11.1 ± 2.9	15.5 ± 2.7*	17.2 ± 3.1*	20.7 ± 3.3*	21.5 ± 3.4*	24.1± 4.2*

* = $p < 0.05$: Student's t-test.

The results obtained are also in agreement with earlier findings where toxic effects of insecticides have been examined on various other systems. For example Ghosh (1990) reported an increase in total erythrocyte counts and haemoglobin content after 30 days exposure of *Heteropneustes fossilis* to sublethal doses of deltamethrin. Similar observations were made by Rao *et al.* (1984) in *Labeo rohita*. Kumar (1990) found increased TLC in *Clarias batracus* exposed to lethal 48 hrs LC_{50} of Sevin, an organophosphorous group of insecticide.

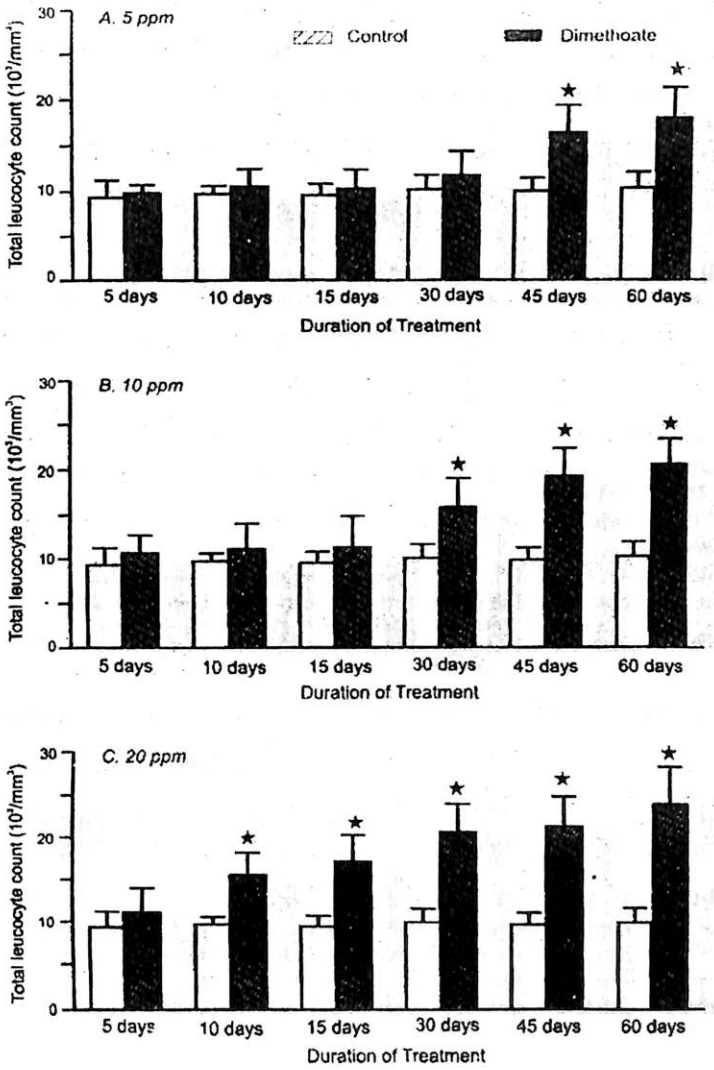

Fig. 1: Effects of different oral doses of dimethoate on total leucocytes count (10^3/mm^3) in mice.

Institoris *et al.* (1995) examined the immunotoxic effects to dimethoate in three consecutive generations and found an amplification of its toxicity. Oral treatments of chlorpyrifos also increased lymphocyte production in male Fisher 344 rats (Blackly *et al.*, 1999). Akay *et al.* (1999) reported an increase in TLC upon exposure of rats to a combination of insecticides *viz.* endosulfan, dimethoate and carbaryl. Recently, Toss-Luty *et al.* (2001) found general increase in TLC in mice after oral treatments of deltamethrin and fenvalerate.

In conclusion, the present study examined the effects of dimethoate on TLC after both short-term and long-term exposures of mice to different doses (lower to moderate) of dimethoate. This study therefore, suggests that the long-term exposure of mice to even lower levels of dimethoate produced an increase in TLC. Exposure to 10 ppm, however, was optimally effective for both short-term and long-term exposure.

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