

# Biochemical Indices in Workers engaged in Production and Formulation of Organophosphate Insecticides

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## Abstract

The study was conducted in a unit of organized sector, engaged in production and formulation of organophosphate insecticides (triaziphos and acephate). Study population comprising of 161 workers was divided into three groups namely, control group (n = 40), maintenance group (n = 50) and exposed group (n = 71). Their blood samples were collected and analyzed for the serum activities of GOT, GPT, alkaline phosphatase and lactate dehydrogenase. The blood samples were also analyzed for plasma cholinesterase (pseudo cholinesterase) and erythrocyte (RBCs) cholinesterase activities. The levels of these enzyme activities were within normal limits, except the levels of RBCs cholinesterase, which were significantly inhibited ( $p < 0.05$ ) in exposed group subjects, indicating appreciable exposure to the pesticides from their working environment.

## INTRODUCTION

By their very nature, most of the pesticides create some risk of harm to humans, animals or the environment. Millions of hectares of farm and forest land all over the world have been sprayed and dusted with pesticides to contain insect pests and weeds. There are about 400 manufacturing units involved in the production of pesticides and their formulations in India. Their production and formulation in industrial settings may involve exposure risks to the workers. The existing database on the health survey of workers involved in the production and formulation of pesticides in the country is scanty and, therefore, the present study was designed to examine the magnitude of health risk among pesticide formulators in an industrial unit associated with the production of technical grade organophosphate (OP) insecticides including triaziphos and acephate and their formulation products and to recommend appropriate intervention programs to ensure safety to the workers.

## MATERIALS AND METHOD

### STUDY POPULATION

A total of 161 workers were included as subjects in this study. These were divided into three groups; i) Control Group (n=40) comprised of employees of administration department e.g. managers, executives, clerks, typists, stenographers, peon, orderlies etc ii) Maintenance Group (n=50) comprised of mechanics, electricians, engineers, fitters and helpers etc and iii) Exposed Group (n=71)

comprised of workers, supervisors involved in the production and formulation of organophosphate insecticides. There was specific work schedule (8 hr shift duty) for exposed and maintenance group workers whereas the control group subjects had 8 hr general duty without any shift. There was not much negligence in the use of protective devices (apron, gloves, helmet, industrial boots, masks etc). Normal hygienic measures like washing of hands before meals and taking bath after the work shift were being practiced.

## DEMOGRAPHIC DATA

Each subject was interviewed for their demographics, smoking habits, alcohol intake, medical history, past and present illness, work conditions and exposure to other chemicals. Their detailed occupational history (past and present) was recorded on pre-coded proforma.

## LABORATORY INVESTIGATIONS

Blood samples of the subjects from cubital vein were obtained with the help of vacutainer (BD Vacutainer, Plymouth, PL6 7BP, UK). Serum was obtained by centrifuging blood sample at 5,000 rpm for 5 min and stored at  $-20^{\circ}\text{C}$  till the time of analysis. The activities of serum glutamate oxaloacetate transaminase (SGOT, EC 2.6.1.1), serum glutamate pyruvate transaminase (SGPT, EC 2.6.1.2), alkaline phosphatase (AIP, EC 3.1.3.1) and lactate dehydrogenase (LDH, EC 1.1.2.27) were estimated using the AutoPak Kit manufactured by M/s Bayer Diagnostics, India

(1). The absorbance of these parameters was recorded on RA-50 Chemistry Analyzer. Plasma Cholinesterase (ChE, EC 3.1.1.8) activity was estimated according to method of Ellman et al (2) and that of RBCs cholinesterase (ChE, EC 3.1.1.7) was estimated following the procedure of Worek et al (3). The absorbance of plasma and RBCs ChE activities were measured on Varian Cary-100 Spectrophotometer.

**STATISTICAL ANALYSIS**

Data presented as Mean ± SD. All statistical calculation was performed using SPSS 15.0 for window. Analysis of variance (ANOVA) was used for comparison among groups followed by group wise comparisons by Dunnett's T3 test. Linear regression was used for studying various relationships among continuous variables. Two tailed tests were used for all comparisons with level of significances as 5% (p < 0.05).

**RESULTS AND DISCUSSION**

Data on distribution of subjects in relation to their duration of job have been mentioned in Table 1: There were 40 subjects in control group (aged: 35.02 ± 9.98 years), 50 subjects in maintenance group (aged: 31.38 ± 9.08 years), and 71 subjects in exposed group (aged: 28.45 ± 6.81 years),

**Figure 1**

Table 1: Distribution of subjects according to the duration of their Job

Group	n	Age (Years) (Mean ± SD)	Duration of Exposure (Years)			
			< 1	1 – 2	2 – 5	> 5
Control	40	35.02 ± 9.98	4	15	10	11
Maintenance	50	31.38 ± 9.08	18	5	15	12
Exposed	71	28.45 ± 6.81	29	10	16	16

The levels of various biochemical indices estimated from the blood samples of study population are given in Table 2. The serum levels of GOT, GPT, alkaline phosphatase and lactate dehydrogenase were within normal limits in the maintenance and exposed groups subjects.

**Figure 2**

Table 2: Levels of various biochemical indices in the study population

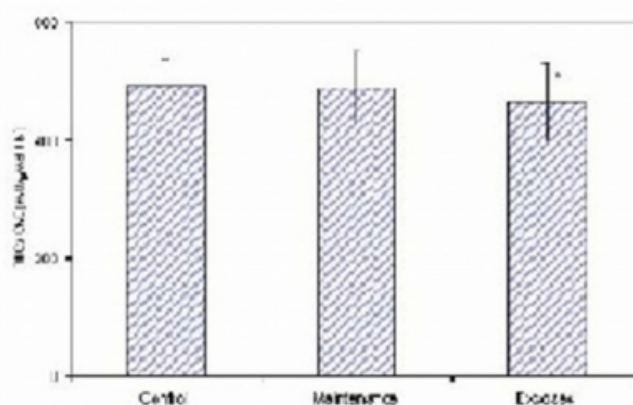
Indices	Control Group (n=40)	Maintenance Group (n=50)	Exposed Group (n=71)
Hb (gm/dL)	13.78 ± 1.55	13.63 ± 1.36	14.20 ± 1.35
ALK Pase (U/l)	136.57 ± 4.29	141.56 ± 3.38	136.59 ± 2.68
LDH (U/l)	327.72 ± 9.52	312.83 ± 8.67	320.62 ± 7.70
RBCs ChE (mU/μmol Hb)	492.35 ± 7.56	488.67 ± 9.09	464.6 ± 7.97*
*Plasma ChE (U/l)	3421.3 ± 1.25	3326.64 ± 1.27	3144.47 ± 1.28
*SGPT (U/l)	22.72 ± 1.39	22.26 ± 1.52	23.48 ± 1.50
*SGOT (U/l)	26.11 ± 1.25	26.1 ± 1.24	27.57 ± 1.27

Data expressed as mean ± SE; \* represents GM ± GSD. \* p < 0.05

However, the activities of RBCs cholinesterase were significantly inhibited (p < 0.05) in exposed group subjects, indicating appreciable exposure to the pesticides from their working environment (Fig 1). The depression in RBCs ChE activity is an effect biomarker of pesticide load and in accordance to our previous published studies (4,5,6) amongst pesticide formulators and with other studies conducted on sprayers of pesticides in field conditions (7). The exposure of OP compounds manifests as a cholinergic crisis and diagnosis is based on the clinical signs and symptoms as well as the measurement of inhibition of erythrocyte (RBC) and/or plasma cholinesterase (ChE) activities.

**Figure 3**

Figure 1: Levels of RBCs ChE activity in the study population



Data expressed as mean ± SE; \* p < 0.05

The correlation between plasma ChE and RBCs ChE in three groups have also been evaluated (Table 3). A significant positive correlation was observed between plasma ChE and RBCs ChE in maintenance group (r = 0.459; p < 0.001) and

in exposed group ( $r = 0.402$ ;  $p < 0.001$ ).

**Figure 4**

Table 3: Correlation between RBCs and Plasma ChE in study population

Parameter		Plasma ChE		
		Control (n=40)	Maintenance (n=50)	Exposed (n=71)
RBCs ChE	Correlation Coefficient	0.282	0.459	0.402
	p value	0.078	0.001	0.001

The findings on depression of RBCs ChE activity in exposed group in our study may indicate that the operational activities pertaining to production and / or formulation of these chemicals in industrial settings should be done with utmost care e.g. minimizing the risk by using protective devices to avoid absorption of these chemicals into the body and by instituting educational preventative modules on hygienic measures at periodic interval in order to ensure the safety to the workers.

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