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EFFECT OF CONCURRENT EXPOSURE OF HIGHER CONCENTRATIONS OF LEAD AND ENDOSULFAN ON CERTAIN BIOCHEMICAL PARAMETERS IN WISTAR RATS

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Abstract: The effect of concurrent repeated exposure of higher concentrations of lead and endosulfan were evaluated on certain biochemical parameters in male wistar rats. Rats of group I served as untreated control where as Group II received drinking water containing lead as lead acetate @1000 ppm (Pb1000). Group III was exposed to feed containing technical grade endosulfan @ 10 ppm (E100). Group IV was exposed to Pb (1000) +E (100). Blood and target organs were collected for estimation of biochemical parameters to assess toxicity by combination of these two chemicals at higher doses. The results suggest that higher doses of endoulfan and lead alone and in combination may modify general biochemical parameters carried out in the study.

Keywords: Lead, Endosulfan, Biochemical parameters.

Introduction

Lead is a major human health hazard due to its wide distribution in the environment and in biological systems (Zhen et al., 2013). Endosulfan is a member of the cyclodiene group of organochlorine pesticides used worldwide in agriculture. It is used around the world for applications on vegetables, fruits, and non-food crops such as cotton and tobacco. This colourless solid has emerged as a highly controversial agrichemical due to its acute toxicity (Wade et al., 2002). Since multiple-chemical exposure is believed to represent a realistic picture of the human and animal chemical toxic burden, one chemical may modify the effect of the other by altering its kinetics and/or dynamics in a co-exposure situation. In view of the increased use of endosulfan for agroproduction and high levels of lead in the ground water and environment, coexistence of lead and endosulfan seems to be a reality and simultaneous exposure of human and animals to these chemicals could be potentially hazardous.

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Human and animals may be exposed to lead and endosulfan concomitantly. The interaction resulting from the concurrent exposure of lead and endosulfan cannot be predicted to be less hazardous. Hence the present study was aimed to evaluate whether repeated co-exposure to lead through drinking water and to dietary endosulfan at higher concentration level could modify the effect produced by each compound on general biochemical parameters in male wistar rats.

Materials and Methods

Colony-bred adult male albino Wistar rats (70-90g; 4-5 weeks age) were procured from Laboratory Animal Resource Section, Indian Veterinary Research Institute, Izatnagar. As per the Institute Animal Ethical Committee guidelines they were maintained under standard managemental conditions. Four groups of six rats were taken for the study. Rats of group I served as untreated control where as Group II received drinking water containing lead as lead acetate @100 ppm (Pb1000). Group III was exposed to feed containing technical grade endosulfan @ 10 ppm (E100). Group IV was exposed to Pb (1000) +E (100). All the treatments were given daily for 28 days. Rats of all the groups were observed daily for clinical signs and mortality, if any, during the entire period of the experiment and body weights were recorded weekly. Blood was collected and used for estimations of general blood biochemical parameters.

Serum was separated from anticoagulant free blood samples and refrigerated at 4^0C for biochemical estimations. Blood urea nitrogen (BUN), serum creatinine, serum alanine (SALT) and serum aspartate aminotransferases (SAST) were determined by using Span diagnostic kits, India. Estimation of haemoglobin was done by cynomethaemoglobin method using kit (Beacon, India). The organs were examined for any gross abnormality. Liver, kidney, brain, heart, lung and testes were removed, washed free of extraneous material and weighed. Results have been expressed as mean ± SEM. The data were analyzed by ANOVA with Duncan's multiple comparisons (Snedecor and Cochran, 1989).

Results and Discussion

After 28 days, there were no significant changes in the body weights of rats given higher concentrations of lead, endosulfan and lead plus endosulfan in all groups taken for the study. Similar results were noticed in the reports of Wade *et al*. (2002) and Banerjee and Hussain (1987) with lead and endosulfan, respectively. In the present study, significant increases ($P<0.05$) in absolute weights of liver and kidney were noticed in rats treated with

lead and endosulfan at higher dose alone. Testes weight was also observed to be increased in group treated with lead and endosulfan at higher dose when given alone.

Kidney weight increase in male rats with 100 ppm dose of endosulfan at 104 weeks of exposure was observed by Keller (1959c). Several reports also confirm elevated liver weight by endosulfan (Gupta and Gupta, 1977; Dikshith *et al*. 1984). Significant increase in liver weight was observed in rats exposed to 50 ppm endosulfan (Banerjee and Hussain, 1987). Significant elevation in kidney weight was observed in a study in rats exposed to 0.5% lead acetate in drinking water after 3 months (Vyskocil *et al.,* 1995). This increase in liver and kidney weight in lead and endosulfan exposed rats may be attributed to proliferation of smooth endoplasmic reticulum. Such alteration of the hepatic system may directly or indirectly influence the function of lymphatic system. Another reason for elevated weight may be the cytotoxicity developed by the compounds.

In the present study, both lead (1000 ppm) and endosulfan (100 ppm) treated rats showed increased serum levels of ALT, BUN and creatinine and decreased levels of glucose. It is in accordance with the findings of Dikshith *et al. (*1988) who reported increase in serum ALT levels in rats received endosulfan. Shalan *et al*. (2005) reported elevated serum ALT levels in rats receiving lead at 500 mg/kg in diet daily for 6 weeks. Rahman and Sultana (2006) also showed elevated transaminase enzymes in rats in their study. Teijon *et al*. (2006) also reported the changes in blood urea nitrogen, alanine aminotransferase, and alkaline phosphatase in the first month of post weaning of rats given with 400 ppm of lead in drinking water. Ashour *et al.* (2007) who reported decreased serum glucose, elevated serum urea, uric acid and creatinine in rats receiving 1000 and 2000 ppm of lead acetate. Increase in serum ALT may be the indication of injury to the liver. Increase in the levels of BUN and creatinine may be the indication of nephrotoxicity. Liver and kidney are the two main target organs for both lead and endosulfan (ATSDR, 2000). Lead acetate elicits toxic pathological changes in the testes in mice treated with lead @ 200 mg/kg body weight compared to respective control groups (Acharya *et al*., 2003). Recent report indicates that endosulfan induces testicular toxicity and damage testicular tissue by the process of necrosis (Jaiswal *et al*., 2005). Testicular toxicity may be attributed to the endocrine disrupting property of both compounds.

In conclusion, it is suggested that the effects on biochemical parameters by repeated exposure to combination of lead and endosulfan at the concentrations used in the study may be modified significantly to produce toxicity.

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Table 1: Effect of 28- day treatment with lead, endosulfan and their combination on general biochemical parameters in rats

Groups	SALT (units/ml)	SAST (units/ml)	Creatinine (mg/dl)	BUN (mg/dl)
Control	63.62±0.36[a]	77.21±0.57	1.25±0.00[a]	17.59±0.22[a]
Pb-1000	65.01±0.38[b]	76.73±0.28	1.32±0.01[b]	20.14±0.15[b]
E-100	65.11±0.39[b]	76.71±1.52	1.33±0.01[b]	20.16±0.26[b]
Pb-1000+E-100	64.46±0.52[ab]	78.08±0.85	1.33±0.02[b]	20.17±0.13[b]

Table 2: Effect of 28- day treatment with lead, endosulfan and their combination on organ weights in rats

Groups	Liver	Heart	Brain	Kidney	Lungs	Testis
Control	6.66±0.05[a]	0.75±0.01	1.46±0.01	1.25±0.01[a]	1.36±0.01	1.95±0.48[a]
Pb-1000	7.52±0.31[b]	0.75±0.01	1.50±0.02	1.32±0.02[b]	1.36±0.04	2.18±0.10[ab]
E-100	7.43±0.21[b]	0.74±0.01	1.45±0.01	1.38±0.01[bc]	1.34±0.01	2.31±0.08[c]
Pb-1000+E-100	7.61±0.34[c]	0.77±0.01	1.46±0.01	1.41±0.03[c]	1.36±0.01	2.27±0.07[b]

Table 3: Effect of 28- day treatment with lead, endosulfan and their combination on haemoglobin (g/dl) in rats

Groups	Haemoglobin (g/dl)
Control	15.81±0.32[a]
Pb-1000	12.12±0.12[b]
E-100	12.16±0.31[b]
Pb-1000+E-100	12.45±0.33[b]

Pb-1000 indicates lead 1000 ppm and E-100 indicates endosulfan 100 ppm. Different superscripts in a column differ significantly (mean ± S.E.M., n=6, $P \leq 0.05$) in Duncan multiple comparison post hoc test.