EVALUATION OF HAEMATO-BIOCHEMICAL ALTERATIONS IN CHLORPYRIFOS TOXICITY IN RATS AND THE PROTECTIVE ROLE OF VITAMIN C

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Abstract

The study aimed at assessing the protective effect of vitamin C on chlorpyrifos toxicity. Eighteen rats were divided into three groups each with six rats. Group I serving as control was administered with the vehicle tween 80 as 2% aq. solution. Chlorpyrifos was administered at a dose rate of 3.1mg/kg body weight in groups II and III and Vitamin C (120µg/kg)was supplemented to group III. The regimen was administered by oral gavage once daily for 28 days. While in the chlorpyrifos treated group the blood mean values of haemoglobin, volume of packed red cells, leukocytes and red blood cells were lowered, the vitamin C treated group revealed enhancement in these values. The altered serum parameters like AST and ALT in chlorpyrifos treated animals were also restored in vitamin C treated group. The study highlights that the adverse effects of chlorpyrifos toxicity on haemato-biochemical parameters of rats could be mitigated by treatment with vitamin C.

Key words: *Chlorpyrifos, vitamin C, haemato-biochemical parameters*

Chlorpyrifos is an effective organo phosphate (OP) pesticide being widely used for agricultural and domestic purposes. Due to its persistence in soil, it poses a serious health hazard to humans and animals alike. Exposure to pesticide predominantly occur in the farm where the insecticides are used for pest control. Generally exposure to large doses of OP pesticides result in inhibition of acetyl choline esterase, but recent studies suggest that in both acute and chronic chlorpyrifos toxicities, one of the mechanisms implicated is oxidative stress. The toxic effect of

pesticides is imparted by their interaction through the lipid rich biomembranes (Jagdale *et al*., 2009). Vitamin C is an important water soluble antioxidant that is effective in combating pesticide stress by neutralizing the reactive oxygen metabolites thereby enhancing the nonspecific immune response and disease

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resistance. Therefore the aim of the study was to evaluate the protective effect of vitamin C on haematological and serum biochemical parameters in rats dosed with chlorpyrifos.

Materials and Methods

Eighteen adult rats were purchased from Small Animal Breeding Station, Mannuthy. Rats were randomly divided into five groups each having six rats.The study was undertaken for a period of 28 days. Chlorpyrifos and Vit. C were administered daily. Blood was collected at the rate of 0.5-1mL on 14th and 29th days of experiment for the analysis of haemato-biochemical parameters. Data were analysed statistically with SPSS version 21.0.

GroupI	Normal standard diet + vehicle (Tween 80)
GroupII	Normal standard diet + chlorpyrifos (3.1 mg/kg body weight) in vehicle
GroupIII	Normal standard diet + chlorpyrifos (3.1 mg/kg body weight) in vehicle + vitamin C (120µg)

Main items of observation:

1. Haematological parameters:
   a. Haemoglobin (Hb) concentration
   b. Total leucocyte count (TLC)
   c. Differential leucocyte count (DLC)
   d. Volume of packed red blood cells (VPRC)
2. Biochemical parameters
   a. Aspartate amino transferase (AST)
   b. Alanine amino transferase (ALT)

Results and Discussion

There was a significant reduction in the haematological parameters like Hb, PCV and RBC in chlorpyrifos intoxicated animals on 14th and 28th days. The low values of Hb, PCV and RBC indicate thatchlorpyrifos administration could cause anemia. This is in accordance with the findings of Goel*et al*. (2006) and Ambali*etal*. (2007).Goel *et al*. (2006) imputed anemia to the ability of chlorpyrifos to reduce the iron concentration in serum thus affecting Hb synthesis. Besides, chlorpyrifos could directly affect Hb synthesis and shorten the life span of RBC as well. Ambali*et al*. (2011) reported that chlorpyrifos compromises the RBC life span by increasing the erythrocyte membrane fragility by way of increased lipid peroxidation. Administration of vitamin C could alleviate the toxicity induced by chlorpyrifos. The experimental results of Wardlaw (1999) underscored that vitamin C in its reduced form could enhance the absorption of iron from gut thereby increasing the serum iron concentration needed for heme synthesis. Vitamin C could also reduce the peroxidative damage to erythrocyte, thus contributing to the mitigation of anemia.

The present study also revealed significant leucopenia indicating the immunotoxic effect of chlorpyrifos exposure. Many pesticides induce immunosuppression either via induction of apoptosis or by necrosis (Corcoran *et al*., 1994). Hemila, (2003) suggested that vitamin C could enhance the immune response by inducing lymphocytic proliferation besides inhibiting apoptosis.

A significant($P< 0.001$) increase in AST and ALT levels was observed in group II on 14th and 29th day which could be due to the oxidative stress and thus contributed to the cell membrane damage. These findings were also noticed in the work conducted by Mansour *et al*. (2009) where they found an increased level of AST in rats exposed to chlorpyrifos. The protective effect of vitamin C resulted from the scavenging of reactive oxygen and nitrogen species and neutralizing them, before they could cause any damage to the organs. Ambali *et al.* (2011) reported that pretreatment with vitamin C in subchronic chlorpyrifos exposure caused a decrease in the levels of AST and ALT.

The present study revealed that chlorpyrifos at a dose of 3.1 mg/kg body weight in rats could produce significant adverse effects in different body tissues as evidenced by the haemato-biochemical changes. Supplementation of vitamin C at 120µg/ kg body weight could counter the alteration in the haematobiochemical parameters.

Table1. Haemato- biochemical parameters

Parameters	14th day			29th day		
	G_I	G_{II}	G_{III}	G_I	G_{II}	G_{III}
Hb (g/dl)	14.55^{c}± 0.26	11.22^{a}± 0.28	12.00^{ab}± 0.20	14.77^{c}± 0.30	11.75^{a}± 0.36	12.35^{a}± 0.27
VPRC (%)	42.31^{c}± 0.91	37.6^{a}± 0.80	39.48^{ab}± 0.71	42.77^{c}± 0.94	36.77^{a} ± 0.46	40.41^{bc}± 0.42
TLC (10^3/ mm^3)	13.23^{c}± 0.19	9.97^{a}± 0.37	10.96^{b}± 0.37	13.32^{c}± 0.33	7.65^{a}± 0.28	11.08^{b}± 0.40
RBC (10^6/ mm^3)	6.70^{c} ± 0.18	5.10^{a} ± 0.23	5.52^{b} ± 0.18	6.64^{c} ± 0.1	4.37^{a} ± 0.20	5.57^{b} ± 0.31
AST (IU/L)	152.03^{a} ± 2.16	220.72^{c}± 3.18	164.99^{b} ± 2.73	153.88^{a} ± 2.04	246.82^{c} ± 2.21	193.81^{b} ± 6.94
ALT (IU/L)	54.92^{a} ± 0.66	71.28^{b}± 1.92	57.12^{a} ± 2.38	54.78^{a} ± 0.84	97.18^{c} ± 2.72	66.06^{b} ± 1.63

Means bearing different superscripts in columns differ significantly (P< 0.001)

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