Effect of Cadmium Acetate On Immuno- Hematological Parameters in White Leg-Horn Chicks

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ABSTRACT
Sublethal dose (6.8 mg/kg body weight; 0.10 LD$_{50}$ value for 96 hours) administration of 50 cadmium acetate for 16 and 32 days induced immuno-haematotoxicity in white leg-horn chicks. Haematological parameters like total erythrocyte count (TEC), haemoglobin content (Hb), packed cell volume (PCV) and mean corpuscular haemoglobin concentration (MCHC) recorded a significant decline on day 16 and 32 while mean corpuscular volume (MCV) and mean corpuscular haemoglobin (MCH) registered an elevation on the corresponding days. Though total leucocyte count (TLC) also recorded a significant increase on day 16 but the value declined by day 32. The probable causes of anaemia in the chick due to sublethal cadmium toxicity have been discussed.

Key words: Cadmium acetate, anaemia, immuno-haematotoxic, chicks.

INTRODUCTION
Cadmium pollution in the environment is increasing due to industrial and agricultural practices. Cadmium is toxic to liver, kidney, testes, bone and immune system [1,2]. Itai-itai disease is caused by long-term exposure of cadmium in Toyama Prefecture of Japan. Patient with itai-itai disease showed various symptoms including nephropathy, osteomalacia, anaemia, diarrhea, vomiting and severe pain [1]. Anaemia is a major haematotoxic effect following long-term exposure to Cd in human [3, 4] and laboratory animals [5-7]. Cadmium also produced immunotoxicity [8], dose-dependent inhibition of phytohaemaglutinine induced human lymphocyte proliferation in vitro [9] and increased monocytes. There are instances of increased monocytes count in workers exposed to cadmium [10]. At low dose of exposure, cadmium has been shown to enhance humoral responses [11], whereas high dose of the toxic metal results is decreased B-cell function [12-15]. In comparison, T-cell mediated immunity has been shown to be consistently depressed by cadmium treatment [16, 17]. Similarly, phagocytosis, natural killer activity and host resistance to infection are markedly impaired in most instances [18-20]. An attempt has been made to record the immuno-haematotoxic effects of chronic cadmium acetate treatment in white leg-horn chicks.

MATERIALS AND METHODS
Newly hatched white leg-horn (WLH) chicks were obtained from M/S Salim Hatchery, Meerut. They were kept in clean wood and steel cages in animal house and acclimatized to the laboratory conditions (temperature 36 ± 2°C, photoperiod 14L : 10D hours) for one week before initiation of the experiment. The chicks were fed formulated chicks feed (Hindustan Poultry Feed Ltd.) and body weight recorded on the alternate day. Feeding was stopped 24 hours before commencement of experiment to avoid metabolic variations due to diet. Various doses of cadmium acetate (BDH India Ltd., Mumbai) were prepared by dissolving in distilled water. LD$_{50}$ dose for 96 hours of cadmium acetate to chicks were calculated and found to be 68 mg/kg body weight through oral intubation. The acclimatized chicks were divided into two equal groups. The chicks of Group 1 were not given any treatment (control) while those of Group 2 received sublethal dose (6.8 mg/ml; 0.10 LD$_{50}$ for 96 hours) of cadmium acetate (experimental).

Blood samples of both the groups were collected directly from heart on day 16 and 32. Total erythrocyte count (TEC), haemoglobin content (Hb), total leucocyte count (TLC), packed cell volume (PCV) was done by haemoglobinometer, haematocrit tube and haemocytometer (Wintrob's tube). Values of mean corpuscular volume (MCV), mean corpuscular haemoglobin (MCH) and mean corpuscular haemoglobin concentration (MCHC) were calculated as these parameters depend on the corresponding values of Hb, TEC and PCV. The results were evaluated for statistical significance by using Students’t test.
RESULTS AND DISCUSSION

Variations in TEC, Hb, TLC, PCV, MCV, MCH and MCHC due to sublethal cadmium acetate treatment in chicks have been summarized in Table 1. Haematological parameters like total erythrocyte count (TEC), haemoglobin content (Hb), packed cell volume (PCV) and mean corpuscular haemoglobin concentration (MCHC) of the cadmium acetate treated chicks recorded a significant decline on day 16 and 32 while mean corpuscular volume (MCV) and mean corpuscular haemoglobin (MCH) registered an elevation on the corresponding day. Though total leucocyte count (TLC) of the experimental chicks also recorded a significant increase on day 16 but the value declined by day 32.

In the present study, effects of sublethal oral administration of cadmium acetate on haemopoietic and immune system in white leg-horn chicks have been recorded. The treatment induced anaemia in chicks on day 16 and 32 which was evident by decreased erythrocyte (RBC) count, haemoglobin (Hb) concentration, haematocrit (PCV) and MCHC. Occurrence of anaemia is a common finding in animals after oral as well as parenteral exposure to cadmium [1]. Though the mechanism of cadmium induced anaemia is not completely understood, it might be due to: (i) iron deficiency due to inhibition of non-absorption toxicant in the gastrointestinal tract [21], (ii) hypoplastic anaemia derived from the inhibitory effect of cadmium on the growth of erythroid progenitor cells [5,6], (iii) haemolytic anaemia due to red blood cells sequestration in spleen [22] resulting in a shorter life span and increased destruction of red blood cells in the spleen and liver [23] and (iv) hypoproduction of erythropoietin due to renal injury [7]. The present study provides evidence to support these hypotheses. Significant increase in MCV and decrease in MCHC (Table 1) support the suggestion that iron deficiency might contributed to the development of anaemia in cadmium treated chicks [24]. Since the degree of anaemia paralleled the cadmium induced renal injury suggesting to the possible reduction of erythropoietin production due to cadmium nephrotoxicity [4, 7]. These factors might contribute to the cadmium induced anaemia.

Cadmium induced immunotoxicity is concern as conflicting observations have been reported [9,12]. The discrepancies may probably be due to the route, dose and duration of exposure to the experimental animals.

Table 1: Hematological responses of white leg-horn chicks treated with cadmium acetate.

<table>
<thead>
<tr>
<th>Parameters</th>
<th>16 Days</th>
<th>32 Days</th>
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<tbody>
<tr>
<td></td>
<td>Control</td>
<td>Experimental</td>
</tr>
<tr>
<td>RBC (million/mm³)</td>
<td>3.94 ±0.21</td>
<td>2.54 ±0.25*</td>
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<tr>
<td>Hb (mg/dl)</td>
<td>12.50±0.20</td>
<td>10.50±0.21&quot;</td>
</tr>
<tr>
<td>TLC (million/mm³)</td>
<td>9,000±15.59</td>
<td>10,900±21.36&quot;</td>
</tr>
<tr>
<td>PCV (%)</td>
<td>31.00±0.43</td>
<td>28.00±0.23&quot;</td>
</tr>
<tr>
<td>MCV (fl)</td>
<td>78.68±0.24</td>
<td>110.23±0.70&quot;</td>
</tr>
<tr>
<td>MCH (pg)</td>
<td>31.72±0.28</td>
<td>46.06±0.12&quot;</td>
</tr>
<tr>
<td>MCHC (%)</td>
<td>40.30±0.33</td>
<td>38.93±0.03&quot;</td>
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Values are mean± S.E. of 5 chicks. Significant responses: *P<0.01,** P<0.001.

REFERENCES