Potassium bromate induced hematological alteration in European rabbit

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Abstract

Aim of this study was to examine the effects of potassium bromate on the levels of hematological parameters such as Hb, RBC, WBC, total WBC, Platelets, and blood indices. Adult European rabbit were grouped in to two groups. The rabbit I group were treated with vehicle (distilled water) and served as control. The rabbits in group II were exposed to KBrO3 (2, 5, 7, 14, 21 and 28 day respectively). The results of the study showed significant decline in red blood cell (RBC) count, hemoglobin (Hb), HCT, MCV, MCH, MCHC and PDW-SD value, and significant incline in white blood cell (WBC), PLT and PCT count after KBrO3 exposure. Whereas no significant changes were observed in LYM, GRS, RDW-CV, and MPV in treated rabbit. Most of the effects in these parameters were recovered post exposure. The results of the study reveals that KBrO3 exposure resulted in hematological toxicity in European rabbit and most of the changes in these parameters recovered at post exposure.

Keyword: Hematological parameters, potassium bromate, changes. European rabbit

1. Introduction

Blood parameters are generally considered physiological indicators of the whole body functioning and therefore are important in diagnosing the structural and functional status of the humans exposed to toxicants. A number of hematological indices such as hematocrit (Hct), hemoglobin (Hb), red blood cells (RBC), and are used to access the functional status of the oxygen-carrying capacity of the blood stream and have been used as an indicator of pollution. However, white blood corpuscles (WBC) Platelets; blood indices noticed defense and immune response in the animal body. Adverse effects of on hematological parameters have been rarely studied. However, there is a need for better understanding of the toxic effects toxicant on hematological parameters in the body.

Bromate is an inorganic by-product of disinfectants. It is one of the analysts used in water supply proficiency testing [1]. Bromate is a strong oxidizing agent, which oxidizes iron (II), arsenic (III) and oxalate (C2O4-2) [2] and titrates directly with antimony (III), thallium (I), and hydrazine in acid medium [3]. Bromate may be used for the titration of mercury (I) and hexacyanoferrate (II) [4]. Bromate has been used for the bromination of the aromatic rings, e.g., phenol and 8-quinothiol [5]. Potassium bromate (KBrO3) has been widely used as a maturing agent for flour and as a dough conditioner. Usage of KBrO3 as a food additive is now limited, so that exposure of humans via food is very low and bromate is generated in ozonation of drinking water [6], major by-products in the process of drinking water chlorination [7] that are carcinogenic to rodents [8], KBrO3 has been reported as a genotoxic carcinogen [9], and chromosome aberration [10]. Potassium bromate (KBrO3) is a nephrotoxic and carcinogenic substance used in food and cosmetics industry, and also found in drinking water as a by-product of disinfection by ozonation [11]. Despite the ban placed on the use of KBrO3 bread-enhancer in bakery products. It is commonly used by bakers to increase bread volume and texture. The maximum concentration of KBrO3 allowed in bread (0.02ug/g) accordingly to USFDA [12]. KBrO3 showed degenerative, necrotic, regenerative changes, nephrotoxic, DNA abbreviation, also carcinogenic [13].
hemolytic uremic syndrome \[^{[12]}\]. It has no any medicinal values but also added in flour enhancer, food additives, maturing agent to dough, fish paste, in beer, cheeses, ozonization, and cosmetic industry \[^{[11]}\]. In India KBrO\(_3\) has been banned 2012, but still used in bakers. Several researches have been carried out and also prove it’s dangerous to health after consumed. However, keeping the view the aim of the present task was assigned to examine the effects of KBrO\(_3\) on hematological parameters on European rabbit.

2. Materials and Methods

2.1 Animals: Anadult male European rabbits weighing 1.15-1.25 kg were used in the present study. The animals were housed in polypropylene cages (55cm L x45cm W x 30 cm H) under well-regulated light/dark (12 h:12 h) cycle at standard temperature (22±1°C). The animals were maintained as per guidelines of the Committee for the Purpose of Control and Supervision of Experiments on Animals regulations. A control group provided only water and food, while treatment groups provided KBrO\(_3\) dose at 2.2 mg/kg body weight accordingly \[^{[13]}\]. The treatment followed up to 28 days.

2.2 Chemical: KBrO\(_3\) was perched from Vijay Trading Corporation, Srirampur. All other chemicals used in the study were of analytical grade. KBrO\(_3\) was applied oral administration.

2.3 Experimental design: Adult European rabbit were groped in to two groups. The rabbit I group were treated with vehicle (distilled water) and served as control. The rabbits in group II were exposed to KBrO\(_3\) up to 28 day respectively. A dose prepared was used 2.2 mg/kg body weight to animal. Regularly treatment was applied up to 28 day. The acute oral study was performed according to the Office of Prevention, Pesticide and Toxic Substance (OPPTS) guidelines following the limit test procedure. The animals were overnight prior to the experiment.

2.4 Hematological analysis: Blood samples were collected by ncuturing the ear artery using heparinized microsyrings (2mm D). The animal was nurtured on control, 2\(^{nd}\), 5\(^{th}\), 7\(^{th}\), 14\(^{th}\), 21\(^{st}\) and 28\(^{th}\) day post treatment. The blood was collected with the help of microsyringe in to the sterilized vial containing anticoagulant EDTA as anticoagulant and used for determination of red blood corpuscles (RBC), white blood cell (WBC), WBC indices, platelets counts, Haemoglobin (Hb), Haemocrites (Hct), mean corpuscular volume (MCV), mean corpuscular hemoglobin (MCH), and MCH concentration (MCHC)values by automatic hematology analyzer.

2.5 Statistical Analysis: Data were analyzed by means of one-way ANOVA using the SPSS software statistical program. Data are expressed as the mean, and \(P < 0.05\) was considered statistically significant.

3. Results and Discussion

The results of the present study indicate that the RBC count, Hb, Hct, MCV, MCH, MCHC and PDV counts were decreased significantly in dose KBrO\(_3\)exposed rabbit when compared with control. WBC counts, PLT, and PCT were significantly increased in the treated group as compared to control group. Whereas on-significant changes observed in LYM, GRS, RWD-CV, and MDV values in treated group [Table 1].

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Blood parameters</th>
<th>Post exposure (day)</th>
<th></th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Control 2 5 7 14 21 28</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>WBC(cumm(^{-3}))</td>
<td>5.0 6.2 6.3 6.9 6.8 7.0 5.3</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>RBC(cumm(^{-6}))</td>
<td>6.52 5.98 6.10 6.74 6.63 6.53 6.77</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Hb(gm.dl)</td>
<td>13.3 12.2 13.3 13.0 12.9 13.7 12.0</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>HCT (%)</td>
<td>41.8 36.2 37.8 37.4 39.5 40.9 41.6</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>MCV(fi)</td>
<td>64.1 60.5 62.0 62.9 63.7 65.7 62.9</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>MCH(pg)</td>
<td>20.4 20.4 19.7 19.7 19.6 19.8 20.2</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>MCHC(g/dl)</td>
<td>31.8 33.7 31.7 31.4 31.2 30.1 32.2</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>PLT(cumm(^{-3}))</td>
<td>106 212 285 230 225 220 135</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>LYM (%)</td>
<td>92.7 94.0 92.3 93.1 92.1 87.7 78.8</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>GRS</td>
<td>7.3 7.0 7.7 6.9 7.9 7.9 7.2</td>
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</tr>
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</table>
In recent years, hematological variables have been used to determine the sublethal concentration or toxicity of environmental pollutants and drugs in humans and animals. Results of the present investigation showed that the KBrO₃ treatment inflicted a drastic reduction in the total RBC count, Hb, and Hct values. The decrease in hematological parameters (RBC, Hb and Hct) observed in the present study is in agreement with some earlier studies who also showed a decrease in blood indices. The decline of blood parameters value might be the result of disturbed activity of hematopoietic system as hematopoietic system, is one of the most sensitive systems to assess the toxicity of environmental toxins in animals. Due to toxicity, hematopoietic organ might get affected and became unable to release normal RBCs in general circulation and thus can be held responsible for drastic decline in RBC’s count.

Hb is the iron containing oxygen transport metallorprotein in the RBCs, and the Hct is the volume percentage (%) of RBCs in blood which is major determinant of viscosity. The decreases in Hb concentration in KBrO₃ exposed rabbits in the present study represent impaired supply of adequate oxygen to the tissues consequently resulting in decline of physical stir. It has been reported that KBrO₃ interferes with absorption of the dietary sharing the similar metabolic pathway as that of iron. Thus, long-term exposure to excess levels of KBrO₃ may result in iron deficient anemia and decline in production of Hb.

The formation of deficiency in Hb may result in an altered oxygen caring capacity of Hb. Moreover, the significant decline in Hb and Hct values in KBrO₃ might be attributed to the formation of methemoglobin, a form of Hb, which has a decreased ability to bind oxygen. In the present study, no significant changes were observed in LYM, GRS, RDW-CV and MDV after KBrO₃ administration.

WBCs play a major role in the defense mechanism of the animal. In the present investigation, WBC count showed a significant increase in KBrO₃ exposed rabbits when compared with that of the control group. The increase in WBC count observed in KBrO₃ treated groups in the present study may indicate an activation of the animal’s immune system in response to tissue damage caused by any toxicant.

Blood platelets play an important role in blood clotting and prevent blood loss from hemorrhaging. The present observation showed decrease in platelet number after exposure with KBrO₃. This might be due to disturbance in hematopoiesis process. A similar decline in platelets count has been reported in fishes after MnSO₄ administration. In contrast to this, Khan et al. reported an increase in platelet number in MnCl₂ exposed dogs. This might be due to short duration and intravenous route of administration. In the present study, after 28 days of cessation of KBrO₃ exposure, all these altered hematological parameters showed recovery indicating resumption of normal functioning of hematopoietic tissues.

On the basis of the present study, it can be concluded that KBrO₃ exposure showed an adverse impact on hematological parameters in rabbits. Most of the changes in these parameters returned towards normal side after the exposure withdrawal. Therefore, further studies are suggested to better understand the mechanism(s) of KBrO₃ induced hematological toxicity and possible mechanism behind the recovery.

4. References


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