Protective Effects of Vitamin C on Hematological and Biochemical Parameters of Intoxicated Male Albino Rats with Lead and Cadmium

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ABSTRACT

Lead and cadmium are reported as heavy metals that induce blood disorders and immunological effects. This study was performed to determine the hematological toxicity and biochemical alterations in male albino rats as affected by the oral administration of a single dose equivalent to 1/20 from LD50 of lead acetate and cadmium chloride individually for 30 days, and evaluated the protective antioxidative role of vitamin C. The current results showed a significant increase (P < 0.05) in the relative liver and kidneys weights of treated rats with lead acetate and cadmium chloride compared with control group. Result also revealed that a significant increase (P < 0.05) in white blood cells count (W.B.Cs) and Platelet count (PLT) in lead acetate and cadmium chloride treated groups as compared to control group. While, the mean red blood cell (R.B.Cs) count and hemoglobin concentration (Hb) reduced significantly (P < 0.05) in PbAc and CdCl2 treated animals compared with control group. As well as, there were no significant differences in mean corpuscular volume (MCV), mean corpuscular hemoglobin (MCH) and mean corpuscular hemoglobin concentration (MCHC) in all treated groups compared to control animals. Biochemical analysis results illustrated that there was an exceptional rise at the end of experiment in liver function parameters including serum aminotransferase (AST and ALT) and alkaline phosphates (ALP) activity. While, serum total protein and albumin significantly decreased (P < 0.05) in lead acetate and cadmium chloride treated animals compared with control group. In addition, kidney function parameters showed that a significant increase (P < 0.05) in urea and creatinine levels in treated animals by lead and cadmium compared to the control untreated animals group. However, Pre-administration with vitamin C concurrently with lead and cadmium metals prevented adverse effect of tested heavy metals on hematological and biochemical parameters compared to vitamin C treated rats group and control untreated rats group.

Key words: Pollution, Heavy metals, Hematological parameters, Biochemical alterations, antioxidant, vitamin C, rat.

Introduction

Environmental pollution, especially by chemicals is one of the most effective factors in the destruction of the biosphere components. Among all chemicals contaminates, heavy metals are considered potential hazardous contaminates in the biosphere to human health (Feleafel and Mirdad, 2013). Heavy metals pollution represents an important environmental problem due to toxic effect of metals and their accumulation throughout the food chain leading to serious ecological and health problems (Mansour, 2014). This problem is even getting more serious all over the world especially in developing countries (Sathawara et al., 2004 and Radwan and Salama, 2006). In developing countries an estimated 0.5-1.0 million peoples die prematurely each year as a result of exposure to heavy metals pollution (Kojima, 2001).

Heavy metals are metallic element their density at least five times more than that of water (Pouls, 2005 and Igwegbe et al., 2013). In general, heavy metals are not biodegradable, have long biological half-lives and have the potential for accumulation in the different body organs leading to undesirable side effects (Sathawara et al., 2004; Radwan and Salama, 2006 and Bagdatlioglu et al., 2010). There are known sixty heavy metals. Some of these metals don't know any biological role in the body and

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are highly toxic even at low levels (Robert and Clarkson, 2001; Jarup, 2003 and Parthipan and Muniyan, 2013). Lead, cadmium, nickel, arsenic, chromium and mercury are most prevalent metals that can pose threat to human at low concentration (Kechrid et al., 2006; Das et al., 2008; Sattar et al., 2013 and Al-Fatlawi and Al-Mursheidi, 2015).

Lead and cadmium are very toxic heavy metals and an important environmental pollutant which causes poisoning in various tissues of human and animals (Flora et al., 2006 and Rekha et al., 2011). They have a strong ability to accumulate in the food chain (Hounkpatin et al., 2012). In the "Top 20 Hazardous Substances Priority List" by the Agency for Toxic Substances and Disease Registry, International Agency for Research on Cancer (IARC) and the U.S. Environmental Protection Agency; Lead (Pb) is ranked the second substance and cadmium (Cd) is ranked the seventh substance in this list (WHO, 2009 and Elgawish and Ghanem, 2014).

Lead is a toxic metal that induces abroad range of physiological, biochemical and neurological dysfunctions in humans (Deveci, 2006). Lead toxicity often affects the erythrocyte membrane; significantly leading to decrease in the mobility of the erythrocytes and alterations in other haematological parameters (Gills et al., 2009). Karamala et al. (2011) reported a significant decrease in Hb, PCV, total protein, and glucose as well increased in creatinine values in rats treated with lead. Haouas et al. (2014) they found that increase in liver enzyme levels in treated rats compared to control. Moreover, lead can induce several Histopathological alterations such as hypertrophy of hepatocytes, portal space, vacuolation and lymphocytic infiltration.

Cadmium (Cd) is considered to be one of the most toxic heavy metals (Santos et al., 2004). It’s known to affect various organs like kidney, liver, bone and testes in human beings and experimental animals (Tokamura et al., 2006; Diana, 2008 and Mohamed et al., 2014). Upon acute exposure to cadmium, hepatotoxicity is indicated by changes such as swelling of hepatocytes, fatty changes, focal necrosis, hepatocytes degeneration and impaired functions of biomarkers of liver function. Hounkpatin et al. (2012) reported a significant decrease in white blood cells, red blood cells, hemoglobin concentration in rats treated with cadmium and mercury.

Ascorbic acid is an antioxidant and water-soluble vitamin that is found intra- and extra cellularly as ascorbate (Chihuailaf et al., 2002). It is a natural antioxidant that prevents the increased production of free radicals induced by oxidative damage to lipids and lipoproteins in various cellular compartments and tissues (Gupta et al., 2004). It is generally regarded as a primary first-line protective agent that repairs or nullifies free radicals by donating a single electron, followed by a proton to yield a chemically dehydroascorbic acid (Carr et al., 2000 and Halliwell, 2001). Ognjanovic et al. (2003) reported that pretreatment with vitamin E and C showed a protective role on the toxic effects of lead and cadmium on haematological values and lipid peroxide. Akhere et al. (2008) reported a decrease in the cadmium contents in the liver, kidney, testicles and mucels of cadmium exposed rats given water supplemented vitamin C for 28 days. Therefore, the present study aimed to evaluate the sub-chronic toxicity of lead acetate and cadmium chloride on hematological and biochemical parameters of adult male albino rats; and the protective effects of vitamin C as antioxidant agent to reduce the level of toxicity.

Materials and Methods

Materials:

Lead acetate \((\text{C}_2\text{H}_3\text{O}_4\text{Pb})\); M. W. 379.33 g/mol; Purity 99%. The acute oral LD\(_{50}\%) for rats 400 mg active ingredient /kg body weight. Cadmium chloride; [\text{CdCl}_2]; M. W. 183.32 g/mol; Purity 99%. The acute oral LD\(_{50}\) for rats 60 mg active ingredient /kg body weight. Ascorbic acid (Vitamin C); [\text{C}_6\text{H}_8\text{O}_6]; M. W. 176.12, Purity 99%. The acute oral LD\(_{50}\) for rats 11.9gram active ingredient /kg body weight. Chemicals and kits used in biological analysis and histopathological examination where in analytical great, and purchased from El-Gamhouri Trading Chemicals and Drugs Company, Egypt.

Methods:

Experimental Animals:
Adult male albino rats, weighting 120 - 130 g were purchased from the Biological Products & Vaccines Holding Company, Helwan Farm, were used in this study. The animals were housed in groups of 6 in stainless steel community cages with wood shavings at 25 ± 2 °C and 65 ± 5% R.H. with a 12 hr. light/dark cycle and allowed to acclimatize for a period of 15 days prior to experimental use. The animals were maintained on commercial standard pellet diet purchased from Egyptian Company of Oils and Soaps, Composed of 24% protein, 2% fat, 12.8% corn starch, 4.2% Salt and vitamins mixture, and water ad libitum.

Experiment Design:

Based on the reported oral LD50 of lead acetate and cadmium chloride for adult albino rats by Sujatha et al. (2011) we administrated 1/20 of LD50 (20 mg of lead acetate and 3.0 mg of cadmium chloride/kg body weight) and (30 mg vitamin C/kg body weight according to Rekha et al., 2011) in this study.

Forty-two rats were used and classified into six groups, each group had seven rats. Group (1): Rats provided with tap water and fed with normal diet; group (2): Rats fed with normal diet and an oral dose 30 mg vitamin C / kg b. w. day after day; for 30 days.; group (3) Rats given an oral dose equivalent to (1/20 from LD50); 20 mg lead acetate /kg b. w. day after day; for 30 days; group (4) Rats pre-treated with (vitamin C at dose 30 mg/kg b. w.) then, given an oral dose equivalent to (1/20 from LD50); 20 mg lead acetate /kg b. w. day after day; for 30 days; group (5) Rats given an oral dose equivalent to (1/20 from LD50); 3.0 mg cadmium chloride /kg b. w. day after day; for 30 days; group (6): Rats pre-treated with (vitamin C at dose 30 mg/kg b. w.) then, given an oral dose equivalent to (1/20 from LD50); 3.0 mg cadmium chloride /kg b. w. day after day; for 30 days. At the end of experimental period, blood samples were collected from the retro-orbital sinus plexus from all animals after being fasted for 12 hours and divided into two parts. The first part was used for hematological examination. The second part was used for the biochemical determination. In this part blood samples were left to clot and centrifuged at 5000 rpm at 4 °C for 10 min to separate the serum.

Hematological parameters were analyzed: red blood cells count (RBCs) and white blood cell count (WBCs) was determined according to Dacia and Lewis (1984); hemoglobin (Hb) concentration, mean corpuscular volume (MCV), mean corpuscular hemoglobin (MCH) and mean corpuscular hemoglobin concentration (MCHC) were determined according to cyanometemoglobin method described by Van-Kampen and Zijlstra (1961). Biochemical analysis were performed: serum aspartate transaminase (AST) and serum alanine transaminase (ALT) activity were carried out according to the colorimetric method of Schmidt and Schmidt (1963), serum alkaline phosphatase (ALP) activity was determined according to calorimetric method of Belfield and Goldberg (1971), total protein was determined according to Doumas (1975), albumin concentration was determined as described by Doumas (1971). Blood urea was estimated by the enzymatic method of Patten and Crouch (1977) and serum creatinine was determined according to the method described by Faulkner and King (1976). The organ weight was presented as relative organ weight was calculated according to Elgawish and Ghanem, (2014) as follows; relative organ weight = [(absolute organ weight (g)/whole body weight (g)) x 100].

Statistical Analysis:

All obtained results are expressed as mean ± standard deviation. Control untreated group and heavy metals-treated groups was performed by using a one-way analysis of variance (ANOVA) followed by Duncan's test according to the procedure of Armitage (1971) using SPSS version 20 computer program.

Results

Effect of treating with Ph, Cd and Pre-treated with vitamin C of male albino rats on relative liver and kidneys weights

The effect of the oral administration of lead acetate and cadmium chloride at dose equivalent (1/20 LD50) and the protective effect of vitamin C as pre-treatment with tested heavy metals given day
after day individually for 30 days on relative liver and kidneys weights of male albino rats are presented in Table (1). From the obtained data (Table. 1), it could be observed that there was a significant increase \((P < 0.05)\) in the relative liver and kidneys weights of treated rats with lead acetate and cadmium chloride compared with control group. While, the experimental animals pre-treated with vitamin C showed no-significant difference \((P < 0.05)\) in the relative liver and kidney weights compared with the control group and vitamin C treated group.

Table 1: Alterations in relative liver and kidneys weights of male albino rats throughout thirty days of the oral administration of tested heavy metals

<table>
<thead>
<tr>
<th>Description</th>
<th>Control group</th>
<th>Treated groups (Mean ± SD)*</th>
<th>Pb**</th>
<th>Pb+Vit. C</th>
<th>Cd</th>
<th>Cd+Vit. C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Final Body weight (g)</td>
<td>203(^a) ± 0.983</td>
<td>206(^b) ± 1.211</td>
<td>110(^d) ± 2.136</td>
<td>146(^b) ± 1.378</td>
<td>106(^a) ± 3.983</td>
<td>142(^c) ± 1.940</td>
</tr>
<tr>
<td>Liver Weight (g)</td>
<td>5.764(^a) ± 0.199</td>
<td>5.920(^b) ± 0.053</td>
<td>5.228(^b) ± 0.049</td>
<td>4.664(^a) ± 0.019</td>
<td>5.126(^b) ± 0.036</td>
<td>4.808(^c) ± 0.029</td>
</tr>
<tr>
<td>Index (%)</td>
<td>2.830</td>
<td>2.870</td>
<td>4.750</td>
<td>3.190</td>
<td>4.831</td>
<td>3.380</td>
</tr>
<tr>
<td>Kidneys Index (%)</td>
<td>1.580(^b) ± 0.004</td>
<td>1.566(^d) ± 0.012</td>
<td>2.320(^d) ± 0.003</td>
<td>1.439(^d) ± 0.024</td>
<td>2.275(^b) ± 0.064</td>
<td>1.482(^d) ± 0.007</td>
</tr>
<tr>
<td>0.778</td>
<td>0.760</td>
<td>2.109</td>
<td>0.985</td>
<td>2.146</td>
<td>1.043</td>
<td></td>
</tr>
</tbody>
</table>

*Mean ± Standard deviation for organ weight; the means within the same row having different superscripts are significantly varied.
**rats treated orally with 30 mg/kg vitamin C day after day for 30 days; **rats treated with 1/20 LD\(_{50}\) of lead acetate and cadmium chloride.

Effects of treating with Pb, Cd and Pre-treated with vitamin C of male albino rats on hematological parameters

The effect of oral administration of lead acetate and cadmium chloride at dose equivalent to 1/20 LD\(_{50}\) and the protective effect of vitamin C on some hematological parameters are shown in Table (2). Results of Table (2) revealed that a significant increase \((P < 0.05)\) in white blood cells count (W.B.Cs) and Platelet count (PLT) in lead acetate and cadmium chloride treated groups as compared to control group. While, the mean red blood cell (R.B.Cs) count and hemoglobin concentration (Hb) reduced significantly \((P < 0.05)\) in Pb Ac and CdCl\(_2\) treated animals compared with control group. As well as, there were no significant differences in mean corpuscular volume (MCV), mean corpuscular hemoglobin (MCH) and mean corpuscular hemoglobin concentration (MCHC) in all treated groups compared to control group. As illustrated in the obtained data in the same Table (2) it could be also noticed that there are no significant difference was observed between the control animals, rats treated with v. c in all haematological parameter.

Effects of treating with Pb, Cd and Pre-treated with vitamin C of male albino rats on biochemical parameters

The effects of the oral administration of either lead acetate and cadmium chloride at dose equivalent (1/20 LD\(_{50}\%\)) and the protective effect of vitamin C pre-treatment with heavy metals given day after day individually for 30 days on liver and kidney function parameters of male albino rats are presented in Table (3). From the current data (Table 3), it could be noticed that there was a significant increase \((P < 0.05)\) in tested liver functional enzymes; aspartate amino transferase (AST), alanine amino transferase (ALT) and alkaline phosphatase (ALP) activity in serum of experimental animals treated with lead acetate and cadmium chloride compared with control groups. While, serum total protein and albumin significantly decreased \((P < 0.05)\) in lead acetate and cadmium chloride treated animals compared with control group. On the other hand, the data presented in table (3) showed that
there are no significant difference was noticed among the control animals, rats treated with vitamin C and pre-treated with vitamin C in all tested liver function parameters.

Table 2: Changes in hematological parameters of male albino rats exposed to Pb, Cd and treated with vitamin C after thirty days (mean ± SD)

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Control group</th>
<th>Vitamin C treated group</th>
<th>Pb**</th>
<th>Pb+Vit. C</th>
<th>Cd**</th>
<th>Cd+Vit. C</th>
</tr>
</thead>
<tbody>
<tr>
<td>W.B.Cs (10³/mm³)</td>
<td>6.524 ± 0.287</td>
<td>6.354 ± 0.264</td>
<td>10.706 ± 0.285</td>
<td>6.936 ± 0.084</td>
<td>11.036 ± 0.216</td>
<td>6.812 ± 0.206</td>
</tr>
<tr>
<td>R.B.Cs (10⁶/mm³)</td>
<td>5.260 ± 0.264</td>
<td>5.116 ± 0.115</td>
<td>3.418 ± 0.267</td>
<td>5.104 ± 0.091</td>
<td>3.382 ± 0.232</td>
<td>5.230 ± 0.177</td>
</tr>
<tr>
<td>Hb (g/100 ml)</td>
<td>15.344 ± 0.283</td>
<td>15.194 ± 0.230</td>
<td>9.130 ± 0.164</td>
<td>14.996 ± 0.315</td>
<td>9.088 ± 0.279</td>
<td>14.898 ± 0.171</td>
</tr>
<tr>
<td>MCV (fl)</td>
<td>63.54 ± 1.436</td>
<td>64.74 ± 3.108</td>
<td>65.27 ± 1.848</td>
<td>63.71 ± 3.050</td>
<td>63.54 ± 4.052</td>
<td>64.00 ± 1.960</td>
</tr>
<tr>
<td>MCH (pg)</td>
<td>17.16 ± 0.233</td>
<td>17.30 ± 0.405</td>
<td>17.65 ± 0.460</td>
<td>16.98 ± 0.410</td>
<td>17.76 ± 0.376</td>
<td>16.88 ± 0.500</td>
</tr>
<tr>
<td>MCHC (g/dl)</td>
<td>31.95 ± 1.702</td>
<td>32.71 ± 0.891</td>
<td>32.35 ± 1.310</td>
<td>31.72 ± 1.358</td>
<td>32.13 ± 1.554</td>
<td>31.88 ± 1.235</td>
</tr>
</tbody>
</table>

▲Mean ± Standard deviation for hematological parameters; the means within the same row having different superscripts are significantly varied; †rats treated orally with 30 mg/kg vitamin C day after day for 30 days; **rats treated with 1/20 LD₅₀ of lead acetate and cadmium chloride.

Table 3: Changes in biochemical parameters of male albino rats treated with Pb, Cd and pre-treatment with vitamin C:

<table>
<thead>
<tr>
<th>Function Parameter</th>
<th>Tested function parameter value (M±SD) at the end of experiment period (30 days)</th>
<th>Normal value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Control group</td>
<td>Vit. C treated group</td>
</tr>
<tr>
<td>AST (IU/L)</td>
<td>49.98 ± 1.583</td>
<td>50.42 ± 1.283</td>
</tr>
<tr>
<td>ALT (IU/L)</td>
<td>28.60 ± 2.120</td>
<td>27.25 ± 1.372</td>
</tr>
<tr>
<td>ALP (IU/L)</td>
<td>83.58 ± 1.991</td>
<td>81.37 ± 2.852</td>
</tr>
<tr>
<td>Total protein (g/100ml)</td>
<td>7.912 ± 0.234</td>
<td>8.060 ± 0.153</td>
</tr>
<tr>
<td>Albumine (mg/dl)</td>
<td>9.256 ± 0.261</td>
<td>9.236 ± 0.371</td>
</tr>
<tr>
<td>Urea (mg/dl)</td>
<td>41.36 ± 1.328</td>
<td>40.56 ± 1.184</td>
</tr>
<tr>
<td>Creatinine (mg/dl)</td>
<td>0.994 ± 0.040</td>
<td>0.974 ± 0.042</td>
</tr>
</tbody>
</table>

▲Mean ± Standard deviation for biochemical parameters; the means within the same row having different superscripts are significantly varied; †rats treated orally with 30 mg/kg vitamin C day after day for 30 days; **rats treated with 1/20 LD₅₀ of lead acetate and cadmium chloride; ▲Normal value of each function parameter in the serum of healthy experimental male albino rats reported by Walter (1997) and Giknis and Clifford, (1999).

With regards to kidney functions as evident in the obtained data in the same table (3), it could be concluded that, there was significant increase (P ≤ 0.05) in kidney functions' parameters; serum urea and creatinine of lead acetate and cadmium chloride treated experimental animals' compared with control group. While, animals groups pre-treated with vitamin C for 15 days before heavy metals
treatment showed that no significant variation was found in serum urea and creatinine in all treated groups compared with vitamin C treated group and untreated control group.

Discussion

The increase in the pollution of our day is a major and global problem. This is due to the use of toxic chemicals or xenobiotic substances or by certain synthetic compounds such as heavy metals (Jagadeessan and Pillai, 2007, and Akinyeye and Okorie, 2012). Lead and cadmium are very toxic heavy metals and an important environmental pollutant which causes poisoning in various tissues of human and animals (Flora et al., 2006 and Rekha et al., 2011). The current study was performed to evaluate the sub-chronic toxicity of lead acetate and cadmium chloride on hematological and biochemical parameters of liver and kidneys of adult male albino rats and the protective effects of vitamin C as antioxidant agent to reduce the level of toxicity.

The results of the current study revealed that there were significant increase in the relative liver and kidney weights of treated rats with PbAc and CdCl2 compared to those of vitamin C treated group and untreated control group. While, there were no significant difference in the relative weights of the examined organs among rats pre-treatment with antioxidant vitamin C which indicated that vitamin C gave protection of these organs against metal intoxication.

In toxicological studies, organ and relative organ weights are important criteria for evaluation of organ toxicity (Timbrell, 2000 and Crissman et al., 2004). The explanation of liver and kidney enlargement could be due to the accumulation of abnormal cells. Triglyceride accumulation was the result of an imbalance between the rate of synthesis and the rate of release of triglyceride by the parenchymal cells into the systemic circulation (Plaa, 1975). These results are coincidence with those obtained by Allouche et al., (2011) they indicated that the relative liver weights were significantly increased in animals exposed to the highest PbAc concentration comparatively to the control group. Also, Ibrahim et al. (2012) found that a significant increase in the relative organs weights of liver, kidneys, heart and spleen of rats after lead acetate injection by 1/20, 1/40 and 1/60 of LD50. El-Demerdash et al. (2004) proposed that the increase in the weight of the kidney might be due to hypertrophy that induced by the nephrotoxicity of cadmium chloride (CdCl2).

Exposure to heavy metals can cause alterations and damage to the hematological profile and hematopoietic system in man and animals (WHO, 1995 and Costa et al., 2004). In this study, the W.B.C.s and PLT count were significantly increased. While, R.B.C.s and Hb count were significantly decreased in the rats administered lead acetate and cadmium chloride compared with control group. The increased count of white blood cells in rats treated with heavy metals may be due to the inflammatory response induced as defense mechanism (Ekanem et al., 2015). Also, the increased PLT counts might have been due to stimulation of erythropoietin by the elevated demands for oxygen and carbon dioxide transport as a result of increased metabolic activity or the destruction of the respiratory membranes causing faulty gaseous exchange (Zaki et al., 2008). The reduction in R.B.C.s may be attributed to more than one factor. First, the failure to supply the circulation with cells from hematopoietic tissues which might have suffered from a destructive effect of the metal on these tissues. The second factor might be the possible destructive effect of the metal to red blood cells membranes. This seems to be supported by Linman (1975) who reported that the increased destructive of erythrocytes directly increases the catabolism of haemoglobin.

Generally, when the Hb content drops below the normal values (like in the lead and cadmium treated groups in the present work) the resultant medical condition is anemia. Ashour et al. (2007) they proposed that lead might inhibit the body's ability to make hemoglobin by interfering with several enzymatic steps in the heme pathway. Specifically, lead decreases heme biosynthesis by inhibiting aminolevulinic acid dehydratase and ferrochelatase activity. Thus, lead might induce anemia both by interfering with heme biosynthesis and by diminishing R.B.C.s survival. On the other hand, the results indicated that pre-administration of vitamin C before treatment with tested metals, ameliorated its adverse effect on hematological parameters. Similar results have been reported by Al-Hamdan (2010) who found that significant increases in WBC counts in rats exposed to lead acetate and cadmium chloride due to inflammation and increase stimulate production, but found significant decrease in Hb resulted by accumulation metal inside the red cell and may be inhibition ferrochelatase enzyme which responsible for linked iron to the globin protein. Ognjaanovic et al. (2003) have also
shown that pretreatment with vitamin C and E showed a protective role on the toxic effects of cadmium on hematological value. Similar results were obtained by Fox et al. (1971) which showed the protective effect of vitamin C on anemia induced by heavy metals in rats.

The liver functional transaminases (AST and ALT) and alkaline phosphatase (ALP) enzymes activity in serum are most frequently measured for diagnosis of liver diseases particularly infective hepatitis, alcoholic cirrhosis, biliary obstruction, toxic hepatitis and liver cancer (Zaahkouk et al., 2000 and Abdel-Wahab et al., 2007). The former liver functional enzymes are not secreted into the blood; any elevation of their activities in blood is resulted from leakage of liver damage cells and from the disturbance and dysfunctions in liver functional enzymes (Abu- Zeid, 2001 and Attia and Nasr, 2009). In this study, exposed to tested heavy metals cause a significant increases in aminotransferases and alkaline phosphatase enzymes in serum of treated experimental animals. On the other hand, there were a significant decrease in serum total protein and albumin of rats treated with the tested metal alone as compared to the control rats, which was indicating poor liver functions or impaired synthesis, either primary as in liver cells damage or secondary to diminished protein intake and reduced absorption of amino acids caused by a malabsorption syndromes or malnutrition (Al-Hashem et al., 2009). The decrease in the level of total protein in metal-treated rats might be due to changes in protein synthesis and/or metabolism (Chinoy and Memon, 2001). Pre-treatment with vitamin C concurrently with any tested metal prevented adverse effect of heavy metals on liver function parameters compared to control group. Ascorbic acid plays a significant role in the toxicity inversion of lead by forming inert complexes and inhibiting its toxicity on the dopaminergic neurons (Musa et al., 2012). Similar observations were reported in many experimental investigations on animals exposed to lead acetate and cadmium chloride (Akhere et al., 2008; Youssef and Salama, 2009; Kini et al., 2011; Ibrahim et al., 2012 and John et al., 2014).

The Kidney function parameters such as urea and creatinine are useful in early deduction of nephrotoxicity induced by exogenous compounds. These parameters are used as index of renal damage in living organisms (Coles, 1986). In this study, there were a significant increase in serum urea and creatinine in animals treated with PbAc and CdCl2. While, the animal's groups pre-treatment with vitamin C concurrently with any both metal abolished its adverse effect on serum urea and creatinine levels compared to control groups. Elevation of urea and creatinine concentration in serum of treated male albino rats may be attributed to reduction in glomerular filtration in the kidney and also reflect dysfunction of the kidney tubules (El-Demerdash et al., 2004 and Al-Hashem et al., 2009). These results are in coincidence with those previously obtained by Sujatha et al. (2011) found that rats treated with lead acetate (30 and 60 mg/kg b. wt.) over a period of 12 week showed that a significant increase in serum urea and creatinine levels. Abdel-Baky (2013) who found that male rats exposed to cadmium chloride caused a significant increase in urea, creatinine and uric acid indicating kidney damage.

Conclusion

Based on the results of this investigation it could be evident that lead and cadmium present in the environment and in particular of foodstuffs is the cause of hematological and biochemical disturbances in the blood. However, pre-administration of (lead and cadmium) and antioxidant (vitamin C) has protective effect on hematological and biochemical alteration. Also, from the present results it could be concluded that vitamin C has potent antioxidant activity against lead and cadmium toxicity. The consumption of foods rich in vitamin C is a highly recommended to reduce the damage caused by the toxicity with lead and cadmium.

References


