

Effect of Ginger (*Zingiber Officinale*) on Some Hematological Parameters of Female (*Rattus Norvegicus*) Rats Treated with Lead Acetate

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Abstract

The present study aimed to investigate the ability of aqueous solution of whole ginger against toxic effects of lead acetate on some hematological parameters of female rats. Twenty four adult female rats were divided into four equal groups. Group 1 as the control and were gave distilled water. Group 2 treated (I.P) with (10 mg/ kg b.w.) lead acetate. Group 3 treated orally with (100mg/ kg b.w.) of aqueous solution of whole ginger. Group 4 received (I.P) and orally (10 mg/ kg b.w.) lead acetate and (100mg/ kg b.w.) of ginger/day. The duration of treatment was 2 weeks. The results showed that lead acetate caused a significant reduction ($p < 0.05$) in (RBC, Hgb, MCV, MCH, HCT), but a significant increase in WBC. These findings lead to conclusion that ginger lowered the adverse effects of Pb oxidative stress. Also, the results indicated that ginger reduced the effect of lead acetate.

Introduction

Lead (Pb) is a dangerous heavy metal and harmful even in small amounts. Humans get exposed to Pb through their environment and diet (Gidlow, 2004). The manifestations of Pb poisoning in humans are nonspecific. They may include weight loss, anemia, (Khalil-Manesh *et al.*, 1994) nephropathy, infertility, liver, testis and heart damages' (Patocka *et al.*, 2003; Gurer-Orhan *et al.*, 2004). In addition to killing cells via cytotoxicity, lead causes toxic effects by oxidative stress either directly or by indirectly-produced lipid peroxidation. Lead alters lipid metabolism, enhances lipid peroxidation and decreases cell membrane fluidity of developing rats (Gurer and Ercal, 2000; Villeeda-Hernandez *et al.*, 2001).

Zingiber officinale R., family: Zingiberaceae. (Ginger), and its constituents are stated to have antiemetic, antithrombotic, antihepatotoxic, anti-inflammatory, stimulant, cholagogue, androgenic and antioxidant (Lisa, 2002; Khaki *et al.*, 2009). Ginger is a strong anti-oxidant substance and may either mitigate or prevent generation of free radicals. It is considered a safe herbal medicine with only few and insignificant adverse/side effects (Ali *et al.*, 2008). Oxidants and antioxidants have attracted widespread interest in nutrition research, biology and medicine. It has become clear that constant generation of prooxidants, including oxygen free radicals, is an essential attribute of aerobic life (Sies *et al.*, 1991). A disturbance in the pro-oxidant/antioxidant system has been defined as oxidative stress. Reactive oxygen species (ROS) are very reactive molecules ranked as free radicals owing to the presence of one unpaired electron such as a superoxide ion (O_2^-), nitrogen oxide (NO) and hydroxyl radical (OH). Even though naturally present in the organism, they are

mainly confined to cell compartments and counterbalanced by natural antioxidant molecules, such as glutathione, glutathione peroxidase, superoxide dismutase, vitamin E and vitamin C, acting as free radical scavengers (Aruoma *et al.*, 1994). Ginger extracts have been extensively studied for a broad range of biological activities, especially antioxidant activities (Miller *et al.*, 1993). Ahmed *et al.* (2000) found that ginger significantly lowered lipid peroxidation by maintaining the activities of the antioxidant enzymes such as super oxide dismutase, catalase and glutathione peroxides in rats. This research focuses on whether oral administration of ginger prevents lead acetate induced perturbations in some blood parameters.

Materials and Methods

Tested plant:

Ginger, which is the underground stem or rhizome of the plant *Z. officinale* Roscoe, was purchased in a powder form from local market in Al-Shatrah city / Thi-Qar province / Iraq.

Experimental animals:

Twenty four adult non- pregnant female rats weighing 100-120 gm were obtained from animal house of biology department / college of science/ university of Thi-Qar / Iraq. They were randomly divided into four groups with six rats in each group. The rats were fed a standard diet and free access to water before the start of the experiment. They were housed in stainless steel cages in a temperature- controlled room (25±2°C) with a 12 h light/ 12 h dark exposure (light sun at 07.00 a.m.). The animals were divided into the bellow:

Group one received drinking water for 2 weeks .

Group two treated (I.P) with(0.5)ml of 10mg/kg lead acetate, once a day for 2 weeks.

Group three received orally 100mg/kg ginger, once a day for 2 weeks.

Group four received lead acetate similar to that of group 2, in addition, they received ginger similar to that of group 3, for 2 weeks.

Animals sacrifice and collection of sample

At the end of the experimental period, blood samples were collected via heart puncture in heparinized tubes. Samples in heparinized tubes were assessed for some hematological parameters RBC (Red Blood Cell), Hgb (Hemoglobin), MCV (Mean Corpuscular Volume), MCH (Mean Corpuscular Hemoglobin), Hematocrit (Hct) and White Blood Cells (WBC) . Blood analysis was performed using (automatic hematology analyzer \ Dingon Ltd.D- Cell).

Statistical analysis:

All data was analyzed by applying SPSS test. It was presented as Mean ± Stander Error.

Results

In this study group 2 showed a significant (P<0.05) decrease in RBC, Mean Corpuscular Volume (MCV), Hematocrit (Hct) level compared to other groups, also

group 2 showed a significant ($P<0.05$) decrease in the hemoglobin (Hgb) compared to the control. However groups 2 and 4 showed a significant ($P<0.05$) decrease in Mean Corpuscular Hemoglobin (MCH) compared to 3 and 1 groups. Group 4 also showed a significant ($P<0.05$) decrease in (MCV) compared to 3 and 1 groups. However group 4 showed a significant ($P<0.05$) decrease in (Hct) level compared to control. Also group 1 showed a significant ($p<0.05$) decrease in (MCV) compared to 3 group. On the contrary, group 3 showed a significant ($P<0.05$) decrease in White Blood Cells (WBC) compared to 2 and 4 groups (Table 1).

Table (1): Effect of lead acetate, ginger and ginger+ lead acetate on hematological parameters.

Groups	RBC _s × 10 ^{6/mm³}	Hgb (g/dl)	MCV	MCH	Hct (%)	WBC _s × 10 ^{3/mm³}
1 - control	6.68±0.10 A	14.04±0.30 A	55.46±1.07 B	19.30±0.49 A	40.48±1.16 A	11.42±1.69 AB
2- lead acetate	6.13±0.06 B	11.30±0.45 B	49.13±0.51 D	17.40±0.18 B	31.90±1.19 C	18.29±2.45 A
3- ginger	6.58±0.10 A	13.27±0.45 AB	57.57±0.84 A	20.18±38 A	37.82±0.45 AB	6.95±0.66 B
4- ginger + lead acetate	6.55±0.09 A	12.20±0.31 AB	50.77±0.79 C	17.60±0.29 B	35.25±1.11 B	17.82±2.87 AB
LSD	0.27	2.26	0.96	0.9	2.86	9.63

(Table -1-) Data are presented as mean±SE.

The different letters refers to a significant differences at $P<0.05$.

Discussion

In this study, lead acetate treatment caused hematological effects as evident from a significant decrease in RBC, Hgb , MCV , MCH , Hct, whereas increase in WBC. Similar some effects on hematological system have been reported for some heavy metals (such as arsenic, cadmium, copper, mercury, tin) (Roney *et al.*, 2011). Lead-induced oxidative stress in blood and other soft tissues has been postulate to be one of the possible mechanisms of lead-induced toxic effects (Pande *et al.*, 2001). Lead exposure induces severe oxidative damage in erythrocytes by inhibiting heme synthesis and changing erythrocyte morphology and survival (Leggett, 1993). Oxidative stress also leads to lipid peroxidation in erythrocyte membranes, autoxidation of hemoglobin and limited repair processes, leading to decreased survival (Rice-Evans and Baysal, 1987). This study showed that erythrocytes hemolysis in lead -treated animals is higher than controls consistent with the previous studies (Kharoubi *et al.*, 2008 and Attia *et al.*, 2013). Increase in total white blood cells is also reported in this study. The increase in total white blood cells and lymphocyte observed in this work may be suggested to be due to stimulated

lymphopoiesis and/or enhanced release of lymphocytes from lymph myeloid tissue (B. K. Das and S. C. Mukherjee, 2003). Ginger has the potential to ameliorate lead-induced hematotoxicity due to oxidative stress in rats. Ginger may exert its protective actions possibly through its antioxidant mechanisms and may have future therapeutic relevance (Attia *et al.*, 2013). The myriad beneficial effects of ginger are supposed to be due to the presence of bioactive phytochemicals like gingerols, shogaols, paradols, gingerdiols, and zingerone (Baliga *et al.*, 2013). Zingerone scavenges superoxide anion. 6-gingerol and zingerone are reported to be good scavengers of peroxy radicals. 6-shogaol also inhibited the production of NO. 6-Gingerol is the major bioactive constituent responsible for the anti-inflammatory, antitumour and antioxidant activities of ginger (Nagendra *et al.*, 2013).

When erythrocytes reach the end of their life due to aging or defects, Hb molecule is broken up and the iron gets recycled. When the porphyrin ring is broken up, the fragments are normally secreted in liver bile. This process also produces one carbon monoxide (CO) molecule for every heme molecule degraded (Hardison, 1996). When the iron atom is in the ferrous form, the protein is active and can bind oxygen reversibly. The oxidation to the ferric form (methemoglobin) leads to an inactive protein. Methemoglobin is unable to carry oxygen. High oxidative stress in red blood cells of lead exposed animals can account for the increase in metHb% produced through oxyhemoglobin autoxidation reactions (Waltkins *et al.*, 1985) and its improvement after treatment with ginger can observe in the present study. This study indicate that treatment of rats with present dose of lead acetate bring about oxidative stress-induced hematotoxic condition due to alterations in the balance between antioxidant/pro-oxidant system and the results raise the possibility of ginger being considered as one of the component of the regular diet of the people in the areas through its antioxidant mechanism, where they may have chances of exposure to lead occupationally or environmentally.

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تأثير الزنجبيل في بعض المعايير الدموية لأنثى الجرذان المعاملة بخلات الرصاص

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الخلاصة

يستخدم الرصاص بشكل واسع في الصناعات ويشكل مشكلة صحية للإنسان والحيوان. في هذه الدراسة تم استقصاء قابلية المحلول المائي للزنجبيل على تقليل الآثار السمية لخلايا الرصاص على بعض المعايير الدموية في الجرذان الأناث فقد تم استخدام (24) جرذ أبيض و قسمت الى أربع مجاميع متساوية. المجموعة الأولى هي مجموعة السيطرة المعالجة بماء الشرب فقط، أما المجموعة الثانية فقد عولجت بخلايا الرصاص (10 ملغم كغم) عن طريق الحقن بالغشاء البريتوني، وعولجت المجموعة الثالثة بالمحلول المائي للزنجبيل (100 ملغم كغم) عن طريق الأخطاء الفموي، وتم معالجة المجموعة الرابعة بما هو مشابه للمجموعة الثانية والثالثة يوميا ولمدة اسبوعين. أظهرت النتائج ان خلايا الرصاص سببت انخفاض معنوي في بعض معايير الدم (عدد كريات الدم الحمراء، الهيموكلوبين، معدل حجم الخلية، معدل هيموكلوبين الخلية، مكدهاس الدم) وسببت ازدياد معنوي في عدد الكريات البيضاء. كذلك النتائج أظهرت ان الزنجبيل يقلل من التأثيرات المضادة المؤكسده للرصاص.