Protective effect of Radish, Cabbage and Jews mallow on lead toxicity in rats.

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ABSTRACT :

The present study aimed to investigate effect of Radish, Cabbage and Jews mallow on lead toxicity in rats. This work was carried out on 48 adult male rats of Sprague Dawely strain. The mean weight of male rats ranged **from** 110 ±5 g. The rats were randomly classified as follows: I- Control group (negative group), which consisted of six rats fed on standard diet and supplied with tap water. II- lead acetate rats group, which included 42 rats fed on standard diet with lead acetate and reclassified into 7 groups (6 rats each) as follows:- 1- Group consumed standard diet with lead acetate(control positive group). 2 - Group fed on lead acetate diet with 5% dried radish. 3- Group fed on lead acetate diet with 10% dried radish. 4 - Group fed on lead acetate diet with 5% dried cabbage. 5 - Group fed on lead acetate diet with 10% dried cabbage. 6 - Group fed on lead acetate diet with 5% dried Jews mallow.7 - Group fed on lead acetate diet with 10% dried Jews mallow .The duration of the study was six weeks. Results of this study showed that the highest increase in body weight gain showed in group which treated with 10% Radish (3G). While the lowest value in body weight gain was found in the group of rats fed on (5%) cabbage (G5). The highest decrease in serum cholesterol, LDL-c and VLDL-c recorded for the group treated with 10% Jews mallow. The highest decrease in the mean all treated groups with tested diets improved the mean value AST, ALT and The lowest decrease in serum ALT enzyme recorded for the group which treated with 5% cabbage followed by 10% Jews mallow, respectively. While the highest decrease recorded for the group treated with 5% radish. All treated groups with 5% and 10% Radish, Cabbage and Jews mallow decreased the mean value of serum lead significantly, as compared to the positive control group. The highest decrease in serum lead recorded for the group which treated with 10% Jews mallow, followed by the group treated with 10% Cabbage, respectively.

INTRODUCTION

John H. Duffus (2002) found that heavy metal pollution can arise from many sources but most commonly arises from the purification of metals, e.g., the smelting of copper and the preparation of nuclear fuels. Electroplating is the primary source of chromium and cadmium. Through precipitation of their compounds or by ion exchange into soils and muds, heavy metal pollutants can localize and lay dormant. Unlike organic pollutants, heavy metals do not decay and thus pose a different kind of challenge for remediation. Currently, plants or microorganisms are tentatively used to remove some heavy metals such as mercury. Plants which exhibit hyper accumulation can be used to remove heavy metals from soils by concentrating them in their bio matter. ***Verma et al., (2006)*** suggested that disposal of municipal and industrial wastes, application of fertilizers, atmospheric deposition and discharge of wastewater on land, has resulted in increase in the concentration of heavy metals in the soil. ***Parisa et al., (2011)*** reported that metal-polluted industrial effluents discharged into sewage treatment plants could lead to high metal concentrations in the activated sludge microbial populations in metal-polluted environments contain microorganisms that have adapted to the toxic concentrations of heavy metals and become “metal resistant". ***Wakefield (2002)*** showed that behavioral alterations such as reduced attention span, learning deficit, impaired cognition, hyperactivity, impulsiveness, and aggressiveness have been found in children exposed to lead. ***Jabeen et al., (2010)*** suggested that workers employed in metal-polluted industries are more exposed to lead than general public. Numerous studies have shown that 15-30% of lead exposure in humans occurs though inhalation and 70-85% with food and drinks from gastrointestinal tract. ***Sushil and Madhur (1993)*** found that lead enters the brain and selectively deposited in the hippocampus and cortex, as well as in nonneuronal elements that are important in the maintenance of the blood brain barrier function. Lead exposure causes distractibility inability to maintain physical balance and it affects some complex functions including learning. ***Chaturvedi (2008)*** found that (Raphanus sativus L) provides protection by strengthening the antioxidant like glutathione and catalase**.** ***Kwon (2009)*** found that methylisogermabullone (MIGB) purified from radish has stimulatory effect on the spontaneous contractility of gastrointestinal smooth muscles in a study of rat gastrointestinal strips. And, these contractile responses of GI tracts to MIGB are likely mediated, at least, by activation of acetylcholinergic M2 and M3 receptors. ***Galati and Brien (2004)*** indicated that brassica species are reported to possess cancer preventive properties that have been attributed to the glucosinolates and their derived products "flavonoids" and other phenolies also contribute to this capacity. ***kylenorton (2011)*** found that Brussels sprouts, contains high amounts of vitamin C which play a major role, acting as cofactors for many enzyme systems including those of liver detoxification, in cleansing the body toxins, due to features of vitamin C metabolism and the functional status of the liver in alcoholism and alcoholic delirium in the stage

of detoxification therapy. ***Mohammed et al., (2012)*** suggested that cabbage can also be included in dieting programs, as it is a low calorie food. ***schippers, (2000)*** suggested that corchorus olitorius is a popular vegetable in either dry or semi-and regions and in the humid areas of Africa. The genus corchorus consists of 50 - 60 species, of which about 30 are found in Africa. The plant is mainly known for its fiber product, jute and for its leafy vegetables. ***Innami et al. (2005)*** reported that on ability of C. olitorius leaf extract to reduce elevation of postprandial blood glucose levels in rats as well as humans. ***Amanabo et al., (2011)*** reported that Corchorus olitorius is extremely consumed as a health vegetable, because it contains abundant beta - carotene and other carotenoids, vitamins B1, B2, C and E, and minerals. ***Chia-Sung et al., (2012)*** found that recent studies have shown that compounds such as carotenoids, flavonoids, and vitamin C isolated from the leaves of COL exhibit significant antioxidative activity.

MATERIAL AND METHODS

1- Material: Lead acetate is a white powder odorless, having a Mw. of [379.33]. Casein, minerals, vitamins, cellulose and choline chloride were obtained from Elgomhoria Company, Cairo, Egypt.

Experimental vegetables:

Radish, Cabbage and Jews mallow were obtained from the local market in El-Minify, Governorate, Egypt. These vegetables washed in clean water then cut into small pieces. Drying vegetables was prepared by solar energy in central research; Dokki, Egypt (central laboratory), then dried vegetable were crushed into fine powder.

Experimental animals:

This work was carried out on 48 adult male rats of Sprague Dawley strain. The mean weight of male rat ranged 110 ± 5g. The animals were purchased from the Agricultural Research Center, Giza, Egypt, housed individually in cages under the normal laboratory conditions and fed the basal diet for a week as adaptation period.

2-Methods:

"1"- Chemical analysis of the experimental vegetables:

a- Moisture, ash, crude protein, and fat were determined in radish, cabbage and Jews mallow samples according to the method of the ***A.O.A.C. (1995)***.

b- Determination of minerals of the experimental vegetables

Minerals contents were determined after wet washing by using atomic absorption spectrophotometer in experimental vegetables [perkins-Elmer, Model 2380] according to ***Pupsa et al; (1994).***

"2"- Biological method:

Experimental rats design. The animals were kept under observation for one week (7days) before the start provided adlibtum. The rats were randomly classified as follows:-T- Control group (negative group), which consisted of 6 rats fed on standard diet and supplied with tap water. TT- lead acetate rats group, which included 42 rats fed on standard diet with lead acetate in 100 mg/kg of diet rats by adding it in the diet and reclassified into 7 groups (6 rats each) as follows: 1 - Group consumed standard diet with lead acetate(control positive group). 2 - Group fed on lead acetate diet with 5% dried radish. 3 - Group fed on lead acetate diet with 10% dried radish. 4 - Group fed on lead acetate diet with 5% dried cabbage. 5 - Group fed on lead acetate diet with 10% dried cabbage. 6 - Group fed on lead acetate diet with 5% dried jews mallow. 7 - Group fed on lead acetate diet with 10% dried Jews mallow.

Biological evaluation: The duration of the study was six weeks. Feed intake was recorded daily and body weight of rats was measured once weekly. The total body weight gain and feed intake during the experimental period (6weeks) were also calculated. BWG% was calculated at the end of experiment as follows:

$$\text{BWG \%} = \frac{\text{(Final Weight - Initial Weight)}}{\text{Initial Weight}} \times 100$$

At the end of the experiment period, the rats were anaesthetized by diethyl ether and sacrificed. Blood samples of each rat were withdrawn in test tubes. The whole blood in the heparenized tube was used for estimation of some biochemical analysis. Blood samples were collected in clean dry centrifuge tubes from hepatic portal vein and left to clot and centrifuge at 3000 r.p.m for 15min to obtain serum. After that, serum was kept at – 20 ºC until analysis in well stoppered plastic vials. Liver, kidney, spleen and heart were removed, blotted on filter paper weighted separable to calculate the absolute and relative organ weight. Relative organ weight (liver, kidney, spleen and heart) were calculated according to the following formula:

Relative organ weight = Organs weight (gm) / final weight (gm) ×100

Table (1): Basal diet was prepared according to *NRC (1995)* as the following (g/kg diet):

Ingredients g/kg diet	Group1 control negative	Group 2 control positive	Group 3	Group 4	Group 5	Group 6	Group 7	Group 8
Casein	200	200	200	200	200	200	200	200
Corn starch	497	496.9	446.9	396.9	446.9	396.9	446.9	396.9
Sucrose	100	100	100	100	100	100	100	100
Vitamin mixture	20	20	20	20	20	20	20	20
Mineral mixture	100	100	100	100	100	100	100	100
Corn oil	50	50	50	50	50	50	50	50
Dl methionine	3	3	3	3	3	3	3	3
Cellulose	30	30	30	30	30	30	30	30
Lead	……	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Radish	……	…….	50	100	…….	……..	……..	……
Cabbage	…….	…….	……	……	50	100	……	……
Jews mallow	…….	……..	…….	……	……..	…….	50	100

***- Biochemical analysis of serum:**

1- Serum lead, calcium and zinc were estimated according to ***Pupsa et al., (1994).***

2- Liver and renal function was determined as follows:-

A) - Serum alanine amino transferees and aspartate amino transferee's enzymes activity (ALT & AST) were performed according to the method of ***Reiman and Frankel (1957).***

B) - Kinetic determination of alkaline phosphatases (ALP) in serum or plasma samples was performed according to ***(Devi et al. 2000 and Draper & Handley, (1990).***

C) - Serum uric acid was determined enzimetrically according to ***Barham and Trinder (1972).***

D) - Serum creatinine enzimetrically according to ***Young (2001).***

E) - Serum urea were estimated according to ***Fosse and Francois (1914).***

****- Biochemical analysis of whole blood:**

1- Serum Triglycerides: Enzymatic determination of triglyceride was conducted according to the method of ***Fossati and Principe (1982)***

2- Serum total cholesterol: Enzymatic corimetric determination of total cholesterol was conducted according to ***Tomas (1992).***

3- Serum HDL- c: Serum HDL- c was determined by using precipitation colorimetric method kits developed by Randox combany, UK according to ***Loper- Virellaet al., (1977)***

4- Serum LDL- cholesterol: Serum LDL- cholesterol was calculated by the difference between total cholesterol, HDL- cholesterol and triglycerides according to ***Fried wald et al., (1972)*** as follow:

$$\text{LDL} = \text{Total cholesterol} - \left[\text{HDL} + \frac{\text{Triglycerides}}{5}\right]$$

5- Serum VLDL cholesterol: The VLDL cholesterol was calculated according to the equation given *by* ***Lee and Nieman (1996).*** **VLDL = Triglycerides/5**

Statistical Analysis:-Results are expressed as mean ± SD, the difference among groups evaluated by two ways analysis of variance (ANONA, F.test).The analysis carried out using statistical package for the Social Science ***SPSS (1998)*** computer programs variation 10 .

RESULTS

Data in table [2] showed the percent of moisture, protein, fat, ash, fiber, carbohydrate, wastage and calories of radish cabbage and Jew's mallow (Mg per 100g sample). Moisture content of cabbage [92.62 %] is higher than the moisture content of radish [91.8 %] and Jew's mallow [82.60%], respectively. Protein content of Jew's mallow [4.83 %] is higher than the protein content of radish [2.05%] and cabbage [1.47%], respectively. Fat content of Jew's mallow [0.90%] is higher than the fat content of radish [0.31%] and the fat content of cabbage [0.21%]. Ash content of Jew's mallow [2.76%] is higher than the content of radish [1.4%] and cabbage [0.68%]**,** respectively. Fiber content of Jew's mallow [1.71%] is higher than the fiber content of cabbage [0, 90] and content of radish [0.84 %]. Carbohydrate content of Jew's mallow [7.20%] is higher than cabbage [4.13%] and radish [3.6 %], respectively. Wastage content of Jew's mallow [62.5%] is higher than the wastage content of cabbage [27.3]. Calories content of Jew's mallow [56.22%] is higher than the calories content of radish [25.39%] and cabbage [24.29%]**,** respectively.

Table [2]: The chemical composition of radish, cabbage and Jew's mallow (Mg per 100g).

Samples	Radish	Cabbage	Jews mallow
Moisture	91.8	92.62	82.60
Protein	2.05	1.47	4.83
Fats	0.31	0.21	0.90
Ash	1.4	0.68	2.76
Fiber	0.84	0.90	1.71
Carbohydrate	3.6	4.13	7.20
Wastage	……	27.3	62.5
Calories	25.39	24.29	56.22

Data in table [3] showed the minerals content [calcium, zinc, sodium, iron, copper, manganese potassium, magnesium and phosphorus] of radish, cabbage and Jew's mallow (Mg per 100g sample). The sodium content of Jew's mallow is higher [52mg] than the sodium content of cabbage [15mg] and the sodium content of radish [9.34mg]. The potassium content of Jew's mallow is higher [490mg] than the potassium content of cabbage [294] and the potassium content of radish [276.3mg]. The calcium content of radish is higher [160.97mg] than the calcium content of Jew's mallow [120mg] and the calcium content of cabbage [40mg]. The manganese content of Jew's mallow is higher [104mg] than the magnesium content of radish [17.67mg] and the magnesium content of cabbage [12mg]. The magnesium content of radish is higher [0.97mg] than the manganese content of Jew's mallow [0.731mg] and the manganese content of cabbage [0.11mg]. The iron content of Jew's mallow is higher [2.8mg] than the iron content of radish

[1.2mg] and the iron content of cabbage [0.6]. The phosphorus content of Jew's mallow is higher [67mg] than the phosphorus content of radish [35.66mg] and the phosphorus content of cabbage [28mg]. The copper content of Jew's mallow is higher [0.188mg] than the copper content of radish [0.13mg] and the copper content of cabbage [0.10mg]. The zinc content of Jew's mallow is higher [0.4mg] than the zinc content of radish [0.34mg] and the zinc content of cabbage [0.3mg]

Table [3]: Mineral content [sodium, potassium, calcium, manganese, magnesium, iron, phosphorus, copper and zinc] in radish, cabbage and Jew's mallow (Mg per 100g sample).

Simples / Mineral	Radish	Cabbage	Jews mallow
Sodium(Na)	9.34	15	52
Potassium(K)	276.3	294	490
Calcium(Ca)	160.97	40	120
Manganese,(Mg)	17.67	12	104
Magnesium(Mn)	0.97	0.11	0.731
Iron(Fe)	1.2	0.6	2.8
Phosphorus (P)	35.66	28	67
Copper(Cu)	0.13	0.10	0.188
Zinc (Zn)	0.34	0.3	0.4

Effect of Radish, Cabbage and Jews mallow on feed intake and body weight gain% of rats suffering from lead toxicity

Data in table (4) show the effect of some levels (5 and 10%) from radish, cabbage and Jews mallow on feed intake (g/day/) and body weight gain% of rats suffering from lead toxicity**.**

Feed intake (g/day): The mean value of feed intake of the negative control group (healthy group) recorded 19.632 g/day/each rats, while the mean value of feed intake of the positive group (rats suffering from lead toxicity) recorded 18.330g/day.

Table (4) Effect of Radish, Cabbage and Jews mallow on feed intake and body weight gain% of rats suffering from toxicity.

Parameters / Groups	Feed Intake (g/day/each rat)	Body weight gain %
Control (-ve)	19.632	31.443 [a] ± 1.893
Control (+ve)	18.330	7.825 [f] ± 1.722
5% Radish	19.00	15.636 [d] ± 1.951
10% Radish	19.543	20.863 [b] ± 2.013
5% Cabbage	18.632	11.423 [e] ± 1.474

10% Cabbage	19.341	16.050 [d] ± 2.028
5% jews mallow	19.200	18.621 [c] ± 1.502
10% jews mallow	19.600	17.110 [c d] ± 0.544

Values are expressed as mean ± SD. Significant at $p<0.05$ using one way ANOVA test.
Values which have different letters differ significantly, while those with have similar or partially are non significant

All treated groups which suffer from led toxicity (rats suffering from lead toxicity) with 5 and 10% Radish, Cabbage and Jews mallow revealed increased mean value of feed intake than that of the positive control group. The highest mean value of feed intake recorded for the group which treated with 10% Jews mallow, followed by the group which treated with 10% Radish.

Body weight gain %: The data presented in table (4) show the effect of some levels from radish, cabbage and Jews mallow on body weight gain % of rats suffering from lead toxicity. The mean value of body weight gain % of the positive group decreased significantly $p< 0.05$, as compared to the negative control group. All treated groups which suffer from lead toxicity and fed with 5 and 10% Radish, Cabbage and Jews mallow showed increased mean values of body weight gain% significantly ($p <0.05$), as compared to the positive control group. On the other hand, the mean value of body weight gain% increased mostly with increasing the levels of tested materials. The highest increase in body weight gain % recorded for the group which treated with 10% Radish, followed by 5% jews mallow.

Effect of Radish, Cabbage and Jews mallow on organs weight / body weight % of rats suffering from lead toxicity

Data in table (5) show the effect of different levels (5 and 10) from radish, cabbage and Jews mallow on organs weights/body weights % of rats suffering from lead toxicity**.** The mean values ± Sd of liver, kidney, spleen and heart of healthy rats (control negative group) were 2.074 ± 0.146, 0.516 ± 0.021, 0.235 ± 0.041 and 0.258 ± 0.013, respectively. While these values recorded 4.006 ± 0.344, 0.999 ± 0.045, 0.491 ± 0.035 and 0.540 ± 0.036 in the positive control group (rats suffering from lead toxicity), respectively.

Liver weight / body weight%: Data in table (5) illustrated that, treating rats which suffer from toxicity with (5% and 10%) Radish, cabbage and Jews mallow led to significant decrease in liver weight / body weight%, as compared to the positive control group. On the other hand, non-significant changes in the mean value of liver weight / body weight % were observed between the groups which treated with 5% and 10% (Radish, Cabbage and Jews Mallow). All treated groups showed non-significant differences in liver weight / body weight %, as compared to the positive control group.

Kidney weight / body weight%: The data in the same table(5) revealed that, all levels of radish, cabbage and Jews mallow (5% and 10%) diets caused significant decrease($p<0.5$) in kidney weight / body weight %, as compared to the positive control group.

Table (5) Effect of Radish, Cabbage and Jews mallow on organs weights/body weights % of rats suffering from lead toxicity.

Parameters / Groups	Organs weight/body weight %			
	Liver	Kidney	Spleen	Heart
Control (-ve)	2.074 [b] ± 0.146	0.516 [c] ± 0.021	0.235 [c] ± 0.041	0.258 [c] ± 0.013
Control (+ve)	4.006 [a] ± 0.344	0.999 [a] ± 0.045	0.491 [a] ± 0.035	0.540 [a] ± 0.036
5% Radish	2.251 [b] ± 0.223	0.548 [b c] ± 0.042	0.285 [c] ± 0.051	0.258 [c] ± 0.024
10% Radish	2.193 [b] ± 0.315	0.558 [b c] ± 0.050	0.245 [c] ± 0.037	0.271 [c] ± 0.020
5% Cabbage	2.281 [b] ± 0.212	0.560 [b c] ± 0.056	0.312 [c] ± 0.059	0.274 [b c] ± 0.023
10% Cabbage	2.073 [b] ± 0.056	0.517 [c] ± 0.037	0.273 [c] ± 0.064	0.277 [b c] ± 0.030

5% jews mallow	2.240 [b] ± 0.312	0.587 [b c] ± 0.077	0.275 [c] ± 0.029	0.314 [b] ± 0.052
10% jews mallow	2.392 [b] ± 0.228	0.614 [b] ± 0.070	0.395 [b] ± 0.135	0.280 [b c] ± 0.034

Values are expressed as mean ± SD. Significant at $p<0.05$ using one way ANOVA test.
Values which have different letters differ significantly, while those with have similar or partially are non significant

The mean value ± SD of kidney weight / body weight % showed non significant differences in group fed on diet containing 5% and 10% (cabbage or radish) and 5% jews mallow, compared with the control negative group. On the other hand the highest decrease in kidney weight / body weight % found in the group treated with 10% cabbage, while the lowest decrease in kidney weight / body weight % recorded for the group which treated with 10% Jews mallow.

Spleen weight / body weight%: Treating rats which suffer from lead toxicity with (5% and 10%) radish, cabbage and Jews mallow diets improved the mean value of spleen weight/body weight%, as compared to the positive control group (non-treated rats). All treated group showed non-significant changes in spleen weight / body weight %, except group of rats which treated with 10% Jews mallow, as compared to the negative control group (Table 5).

Heart weight / body weight%: All treated groups with different levels of radish, cabbage and Jews mallow showed significant decrease ($p<0.05$) as compared to the positive control group. All treated rats which suffer from toxicity with all levels from radish, cabbage and Jews mallow recorded non-significant changes in heart weight/body weight%, except group of rats which treated with 5% Jews mallow, as compared to the negative control group.

Effect of Radish, Cabbage and Jews mallow diets on lipid profile of rats suffering from lead toxicity

Data in table (6) show the effect of some levels (5% and 10%) radish, cabbage and Jews mallow on serum cholesterol and triglycerides of rats suffering from lead toxicity.

Total serum cholesterol and triglycerides increased significantly ($p<0.05$) in the positive control group (rats suffering from lead toxicity), as compared to the negative control group (133.333 ± 7.637 mg/dl and 82.000 ± 9.165mg/dl) vs. (94.000 ± 6.000 mg/dl and 40.000 ± 2.000 mg/dl), respectively. On the other hand, serum cholesterol and triglycerides increase by about 41.843% and 105% in the positive control group, than that of the negative control group.

Serum cholesterol (mg/dl): All treated groups with some levels of radish, cabbage and Jews mallow showed significant decrease in serum cholesterol, as compared to the positive control group. The data presented in table (6) and the Fig. (7) Showed significant decrease ($P< 0.05$) in the mean value of serum cholesterol in the group which treated with 10% radish, as compared with the group treated with 5% radish. On the other hand, non-significant changes were observed between the groups treated with low and high levels of cabbage or jews mallow. The highest decrease in serum cholesterol recorded for the group treated with 10% jews mallow, followed by the groups which suffering from toxicity with lead and treated with 5% jews mallow and 10% radish.

Treating rats which suffering from lead toxicity with 10% jews mallow decreased serum cholesterol by about 27.249%, than that of the positive control group.

Table (6): Effect of Radish, Cabbage and Jews mallow on serum cholesterol and triglycerides of rats suffering from lead toxicity

Parameters / Groups	Cholesterol	Triglycerides
	mg/dl	
Control (-ve)	94.000 [e] ± 6.000	40.000 [d] ± 2.000
Control (+ve)	133.333 a ± 7.637	82.000 a ± 9.165
5% Radish	118.333 [b] ± 7.637	76.667 [a] ± 3.214
10% Radish	106.000 [c d] ± 6.245	68.167 [b] ± 5.965
5% Cabbage	114.500 [b c] ± 4.500	77.000 [a] ± 1.00
10% Cabbage	111.000 [b c] ± 3.000	55.000 [c] ± 2.000
5% jews mallow	104.666 [c d]	77.000 [a]

	± 3.055	± 3.605
10% jews mallow	97.000 $^{d e}$ ± 4.358	56.000 ^{c} ± 2.000

Values are expressed as mean ± SD. Significant at $p<0.05$ using one way ANOVA test.
Values which have different letters differ significantly, while those with have similar or partially are non significant

Serum triglycerides (mg/dl): The mean values of serum triglycerides in all treated groups which suffering from lead toxicity with the high levels of radish, cabbage and Jews mallow decreased significantly ($p< 0.05$) in serum triglycerides, while the low levels showed non-significant changes in this parameter, as compared to the positive control group (Table 6 and Fig.8). The highest decrease in the mean value of serum triglycerides in all treated groups recorded for the group treated with 10% Jews mallow, followed by the groups which treated with 10% cabbage and 10% radish, respectively. Treating rats which suffering from lead toxicity with 10% Jews mallow or 10% Cabbage decreased serum triglycerides by about 31.707% and 32.927% compared with that of control (+)groups respectively.

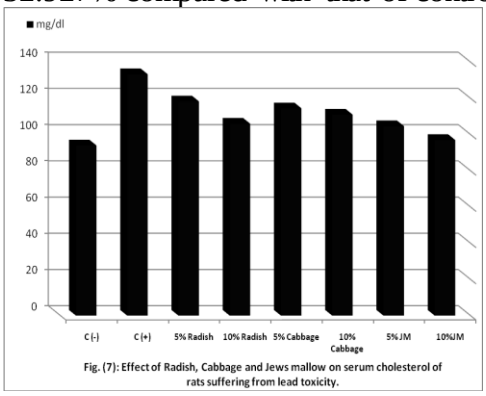

Fig. (7): Effect of Radish, Cabbage and Jews mallow on serum cholesterol of rats suffering from lead toxicity.

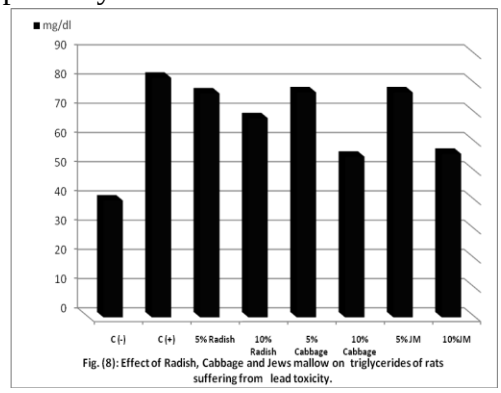

Fig. (8): Effect of Radish, Cabbage and Jews mallow on triglycerides of rats suffering from lead toxicity.

Data in table (7) and figures [9, 10 and 11] show the effect of some levels (5% and 10%) radish, cabbage and Jews mallow on serum high density lipoprotein – cholesterol (HDL-c), low density lipoprotein – cholesterol (LDL-c) and very low density lipoprotein – cholesterol (VLDL-c) of rats suffering from lead toxicity.

Data in table (7) showed that, rats which suffering from lead toxicity revealed significant decrease in serum HDL-c, while LDL-c and VLDL-c increased, as compared to the negative control group (healthy rats).

Serum HDL-c (mg/dl): Data in this Table and Fig. (9) revealed that, serum HDL-c in the group which suffers from lead toxicity decreased by about 47.860%, than that of the negative control group. All treated groups with some levels from radish, cabbage and Jews mallow (5% and 10%) showed significant increase in the mean value of serum HDL-c, as compared to the positive control group except for 5% cabbage group.

Table (7): Effect of Radish, Cabbage and Jews mallow on serum Lipoproteins of rats suffering from lead toxicity

Parameters / Groups	HDL-c	LDL-c	VLDL-c
	mg/dl		
Control (-ve)	49.866 ^{a} ± 3.685	36.133 ^{e} ± 2.396	8.000 ^{d} ± 0.400
Control (+ve)	26.000 ^{e} ± 1.200	90.933 ^{a} ± 6.300	16.400 ^{a} ± 1.833
5% Radish	42.083 $^{b c}$ ± 5.137	60.916 ^{c} ± 4.046	15.333 ^{a} ± 0.642
10% Radish	43.983 $^{a b c}$ ± 3.186	50.050 ^{d} ± 1.975	13.633 ^{b} ± 1.193
5% Cabbage	31.000 $^{d e}$ ± 2.600	68.100 ^{b} ± 1.700	15.400 ^{a} ± 0.200
10% Cabbage	32.150 ^{d} ± 1.350	67.850 ^{b} ± 3.950	11.000 ^{c} ± 0.400
5% jews mallow	38.100 ^{c} ± 3.100	51.166 ^{d} ± 4.474	15.400 ^{a} ± 0.721
10% jews mallow	48.133 $^{a b}$ ± 4.614	36.000 ^{e} ± 1.732	11.200 ^{c} ± 0.400

Values are expressed as mean ± SD. Significant at $p<0.05$ using one way ANOVA test.
Values which have different letters differ significantly, while those with have similar or partially are non significant

The highest increase in the mean value of serum HDL-c recorded for the groups which treated with 10% Jews mallow and 10% radish, these groups showed non-significant differences in this parameter, as compared to the negative control group. On the other hand, the lowest increase in this parameter recorded for the group which treated with 5% cabbage, followed by 10% cabbage and 5% Jews mallow.

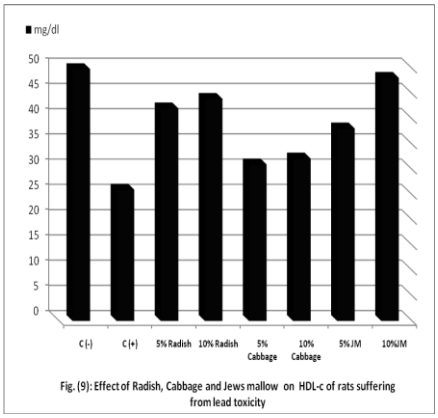

Fig. (9): Effect of Radish, Cabbage and Jews mallow on HDL-c of rats suffering from lead toxicity

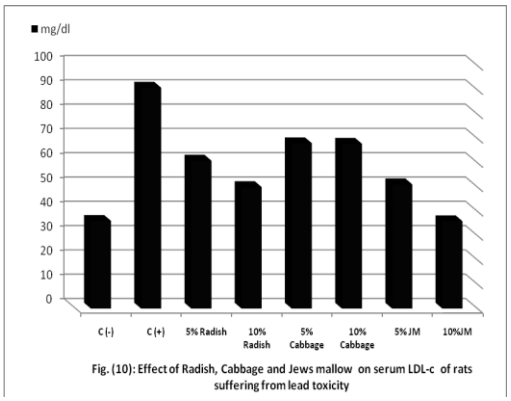

Fig. (10): Effect of Radish, Cabbage and Jews mallow on serum LDL-c of rats suffering from lead toxicity

Serum LDL-c (mg/dl): Data in this table (7) and Fig. (10) revealed that, serum LDL-c in the group which suffers from lead toxicity increased by about 151.661% than that of the negative control group. Treating groups which suffering from lead toxicity with radish, cabbage and Jews mallow (5% and 10%) improved the mean value of serum LDL-c, as compared to the positive control group. The mean values of serum LDL-c showed non-significant differences between the rats groups which suffer from lead toxicity and treated with 5% Radish, 5% cabbage and 5% jews mallow. The highest decrease in serum LDL-c recorded for the group treated with 10% jews mallow, these treatment recorded non-significant changes in this parameter. Treating rats which suffer from lead toxicity with 10% Jews mallow decreased the mean value of serum LDL-c by about 60.410%, than that of the positive control group.

Serum VLDL-c (mg/dl): The mean value of serum VLDL-c in all treated groups which suffering from lead toxicity with the high levels of radish, cabbage and Jews mallow decreased significantly $p< 0.05$ in serum VLDL-c, while the low levels showed non-significant changes in this parameter, as compared to the positive control group (Table 7 and Fig. 11). The highest decrease in the mean value of serum VLDL-c in all treated groups recorded for the group treated with 10% Jews mallow, followed by the groups which treated with 10% cabbage and 10% radish, respectively. Treating rats which suffering from lead toxicity with 10% jews mallow or 10% cabbage decreased serum VLDL-c by about 31.707% and 32.927%, respectively compard to that of control (+) group.

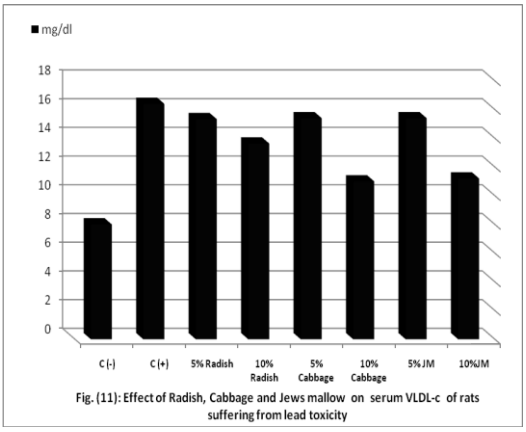

Fig. (11): Effect of Radish, Cabbage and Jews mallow on serum VLDL-c of rats suffering from lead toxicity

Effect of Radish, Cabbage and Jews mallow on kidney functions of rats suffering from lead toxicity

Data in table (8) and figures (12, 13 and 14) show the effect of radish, cabbage and jews mallow on kidney function including (uric acid, urea nitrogen and creatinine) of rats suffering from lead toxicity.

Results in table (8) revealed that, the mean value of serum uric acid, urea nitrogen and creatinine increased significantly in the positive control group (rats suffering from lead toxicity), as compared to the negative control group (healthy rats). The mean values ± SD of serum uric acid, urea nitrogen and creatinine were (3.533 ± 0.305mg/dl, 20.850 ± 3.650 mg/dl and 0.430 ± 0.06 mg/dl) for the positive control group, while healthy rats recorded (1.900 ± 0.01mg/dl, 28.266 ± 1.921mg/dl and 1.046 ± 0.200 mg/dl), respectively. The mean value of serum uric acid, urea nitrogen and creatinine increased by about 85.947%, 35.568% and 143.255%, respectively in the positive control group, than that of the negative control group.

Serum uric acid (mg/dl): Data presented in table (8 and Fig (12) showed that, the mean value of serum uric acid decrease significantly in all treated groups, except the group which treated with 5% radish,

as compared to the positive control group. Results in this table showed non-significant differences in the mean value of serum uric acid between all treated groups.

Serum urea nitrogen (mg/dl): The mean value of serum urea nitrogen of the groups which suffering from lead toxicity and treated with 5% and 10% Jews mallow decreased significantly ($p< 0.05$) in, while other treated groups showed non-significant changes in this parameter, as compared to the positive control group (Table 8 and Fig. 13). Treating rats which suffering from lead toxicity with 5% and 10% Jews mallow decreased the mean value of serum urea nitrogen by about 24.234% and 15.269%, respectively, than that of the positive control group.

Table (8): Effect of Radish, Cabbage and Jews mallow on Kidney function of rats suffering from lead toxicity

Parameters / Groups	Uric acid	Urea nitrogen	Creatinine
	mg/dl		
Control (-ve)	1.900 ^{c} ± 0.01	20.850 ^{e} ± 3.650	0.430 ^{d} ± 0.06
Control (+ve)	3.533 ^{a} ± 0.305	28.266 $^{a b}$ ± 1.921	1.046 ^{a} ± 0.200
5% Radish	3.050 $^{a b}$ ± 0.350	25.100 $^{b c}$ ± 1.300	0.686 $^{b c}$ ± 0.098
10% Radish	2.700 ^{b} ± 0.300	24.900 $^{b c d}$ ± 0.300	0.540 $^{c d}$ ± 0.060
5% Cabbage	2.966 ^{b} ± 0.416	30.650 ^{a} ± 2.050	0.740 ^{b} ± 0.060
10% Cabbage	2.600 ^{b} ± 0.300	31.750 ^{a} ± 1.150	1.016 ^{a} ± 0.087
5% jews mallow	2.733 ^{b} ± 0.208	21.416 $^{d e}$ ± 2.157	0.400 ^{d} ± 0.080
10% jews mallow	2.800 ^{b} ± 0.200	23.950 $^{c d e}$ ± 0.750	0.540 $^{c d}$ ± 0.020

Values are expressed as mean ± SD. Significant at $p<0.05$ using one way ANOVA test.
Values which have different letters differ significantly, while those with have similar or partially are non significant

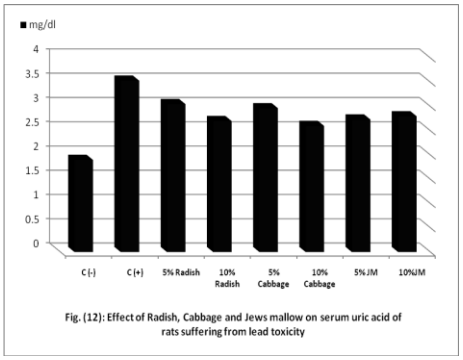

Fig. (12): Effect of Radish, Cabbage and Jews mallow on serum uric acid of rats suffering from lead toxicity

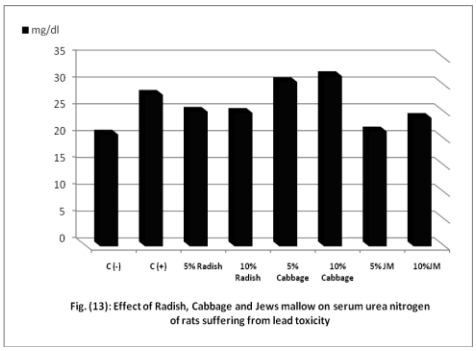

Fig. (13): Effect of Radish, Cabbage and Jews mallow on serum urea nitrogen of rats suffering from lead toxicity

Serum creatinine (mg/dl): Data in table (8) and Fig. (14) Show the effect of some levels of radish, cabbage and Jews mallow in serum uric acid of rats suffering from lead toxicity. The data in this Table revealed that, all treated groups recorded significant decreases in the mean value of serum creatinine, except group of rats which treated with 10% cabbage, as compared to the positive control group.Treating rats which suffering from lead toxicity with 5% Jews mallow recorded the best results in this parameter, followed by groups which treated with 10% Jews mallow and 10% radish. These treatments decreased the mean value of serum creatinine by about 61.759%, 48.375% and 48.375%, respectively compared to that of control (+) group.

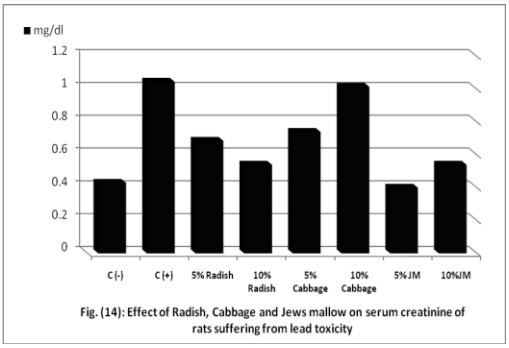

Fig. (14): Effect of Radish, Cabbage and Jews mallow on serum creatinine of rats suffering from lead toxicity

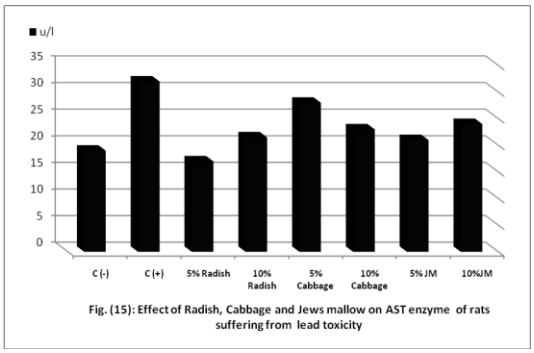

Fig. (15): Effect of Radish, Cabbage and Jews mallow on AST enzyme of rats suffering from lead toxicity

Effect of Radish, Cabbage and Jews mallow on liver enzymes of rats suffering from lead toxicity

Data in table (9) and figures (15, 16 and 17) show the Effect of radish, cabbage and jews mallow on liver enzymes (AST, ALT and ALP) of rats suffering from lead toxicity.

The mean value of Aspartate amino transferees (AST) u/l, Alanine amino transferees (ALT) u/l , and alkaline phosphatases (ALP) u/l of rats suffering from lead toxicity increased significantly ($p<0.05$), as compared to the negative control group (healthy rats). The mean value of AST, ALT and ALP enzymes were (32.000 ± 1.000 u/l, 15.333 ± 1.527 u/l and 22.000 ± 3.800 u/l for the positive control group) vs. (19.000 ± 0.200 u/l, 5.000 ± 1.00 u/l and 11.866 ± 2.013 u/l for the negative control group), respectively.

Aspartate amino transferees (AST) u/l: The mean value of serum AST enzyme increased by about 68.421% in the positive control group, than that of the negative control group. Data in table (9) and Fig. (15) showed that, treating rats which suffering from lead toxicity with some levels (5% and 10%) radish, cabbage and Jews mallow caused significant decreases ($p<0.05$) in serum AST enzyme, except the group which treated with 5% cabbage, as compared to the positive control group. Treating rats which suffering from lead toxicity with 5% radish, 5% Jews mallow,10% radish & 10% cabbage recorded the best results in serum AST enzyme, these treatments recorded non-significant changes in AST enzyme, as compared to the negative control group. Feeding rats which were suffering from lead toxicity on diets containing 10% radish or 5% jews mallow, decreased the mean value of serum AST by about 32.812% and 34.375%, respectively, than that of the positive control group. The lowest decrease in serum AST enzyme recorded for the group which treated with 5% cabbage and 10% Jews mallow, respectively.

Table (9): Effect of Radish, Cabbage and Jews mallow on Liver enzymes of rats suffering from lead toxicity

Parameters / Groups	AST	ALT	ALP
	m/l		
Control (-ve)	19.000 ^{cd} ± 0.200	5.000 ^{de} ± 1.00	11.866 ^{bc} ± 2.013
Control (+ve)	32.000 ^{a} ± 1.000	15.333 ^{a} ± 1.527	22.000 ^{a} ± 3.800
5% Radish	17.000 ^{d} ± 4.358	3.500 ^{e} ± 0.500	9.865 ^{c} ± 1.535
10% Radish	21.500 ^{cd} ± 2.500	7.000 ^{cd} ± 1.00	11.566 ^{bc} ± 1.401
5% Cabbage	28.000 ^{ab} ± 3.000	9.500 ^{b} ± 2.500	14.550 ^{b} ± 3.000
10% Cabbage	23.000 ^{bc} ± 3.000	7.000 ^{cd} ± 1.000	13.016 ^{bc} ± 2.850
5% jews mallow	21.000 ^{cd} ± 0.300	4.500 ^{e} ± 0.500	12.667 ^{bc} ± 1.527
10% jews mallow	24.000 ^{bc} ± 2.645	7.500 ^{bc} ± 0.500	10.100 ^{c} ± 0.300

Values are expressed as mean ± SD. Significant at $p<0.05$ using one way ANOVA test.
Values which have different letters differ significantly, while those with have similar or partially are non significant

Alanine amino transferase (ALT) u/l: The mean value of serum ALT enzyme increased by about 206.66% in the positive control group, than that of the negative control group. Data in table (9) and Fig. (16) showed that, treating rats which suffering from lead toxicity with some levels (5% and 10%) radish, cabbage and Jews mallow caused significant decrease ($p<0.05$) in serum ALT enzyme, as compared to the positive

control group. Treating rats which suffering from lead toxicity with 5% and 10% radish, 10% cabbage and 5% Jews mallow recorded the best results in serum ALT enzyme, these treatments recorded non-significant changes in ALT enzyme, as compared to the negative control group. Feeding rats which were suffering from lead toxicity on diets containing 5% radish or 5% Jews mallow, decreased the mean value of serum ALT by about 77.173% and 70.652%, respectively, than that of the positive control group. The lowest decrease in serum ALT enzyme recorded for the group which treated with 5% cabbage followed by 10% Jews mallow

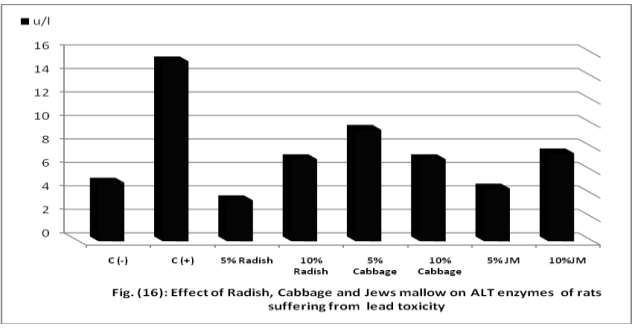

Fig. (16): Effect of Radish, Cabbage and Jews mallow on ALT enzymes of rats suffering from lead toxicity

Alkaline phosphatases (ALP) u/l: The mean value of serum ALP enzyme increased by about 85.403% in the positive control group, than that of the negative control group. Data in table (9) and Fig. (17) showed that, treating rats which suffering from lead toxicity with some levels (5% and 10%) radish, cabbage and Jews mallow caused significant decrease ($p<0.05$) in serum ALP enzyme, as compared to the positive control group. All treated groups which suffering from lead toxicity with low and high levels (5% and 10%) radish, cabbage and Jews mallow induced non-significant changes in serum ALP, as compared to the negative control group.

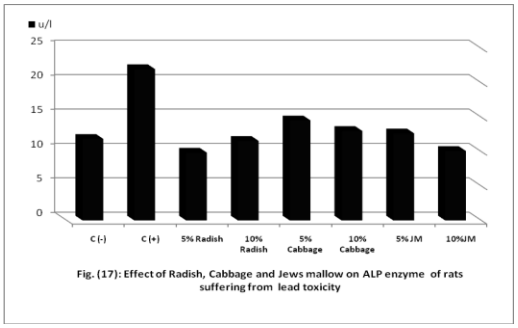

Fig. (17): Effect of Radish, Cabbage and Jews mallow on ALP enzyme of rats suffering from lead toxicity

Effect of Radish, Cabbage and Jews mallow on some minerals of serum rats suffering from lead toxicity. The effect of some levels of Radish, Cabbage and Jews mallow on serum calcium, lead and zinc of rats suffering from lead toxicity presented in table (10) and illustrated in Fig. (18, 19 and 20).

Table (10): Effect of Radish, Cabbage and Jews mallow on serum calcium, lead and zinc of rats suffering from lead toxicity.

Parameters / Groups	Calcium mmol/l	Lead mg/dl	Zinc mg/dl
Control (-ve)	2.350 $^{a b}$ ± 0.350	16.333 $^{b c d}$ ± 1.527	71.600 ^{d} ± 5.400
Control (+ve)	1.500 ^{c} ± 0.500	23.710 ^{a} ± 2.480	103.650 ^{a} ± 4.250
5% Radish	2.500 ^{a} ± 0.500	19.473 ^{b} ± 1.293	69.983 ^{d} ± 7.025
10% Radish	1.900 $^{a b c}$ ± 0.400	19.590 ^{b} ± 1.130	47.250 ^{e} ± 6.722
5% Cabbage	1.150 ^{c} ± 0.150	16.556 $^{b c}$ ± 1.210	94.500 $^{a b}$ ± 6.863
10% Cabbage	1.800 $^{b c}$ ± 0.400	14.500 $^{c d}$ ± 2.010	80.316 $^{c d}$ ± 7.413
5% jews mallow	1.850 $^{a b c}$ ± 0.150	19.000 ^{b} ± 1.00	49.883 ^{e} ± 5.124
10% jews mallow	1.500 ^{c} ± 0.100	13.135 ^{d} ± 2.665	85.333 $^{b c}$ ± 6.658

Values are expressed as mean ± SD. Significant at $p<0.05$ using one way ANOVA test.
Values which have different letters differ significantly, while those with have similar or partially are non significant

The results in table (10) and Fig. (18) Revealed that, the mean value of serum calcium decreased significantly ($p<0.05$) in the positive control group (rats suffering from lead toxicity), as compared to the negative control group (1.500 ± 0.500 vs. 2.350 ± 0.350) mole/l, respectively. Serum calcium of all treated groups with 5% and 10% (Radish, Cabbage and Jews mallow) didnot change significantly, as compared to the positive control group, except group of rats which treated with 5% Radish. Most groups which treated with Radish, Cabbage and Jews mallow recorded increased the mean value of serum calcium (numerically), as compared to the positive control group.

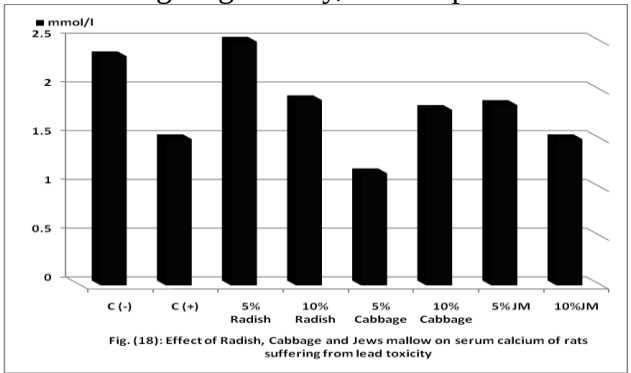

Fig. (18): Effect of Radish, Cabbage and Jews mallow on serum calcium of rats suffering from lead toxicity

The data in the same table and Fig. (19) Illustrate the effect of some levels (5% and 10%) Radish, Cabbage and Jews mallow on serum lead of rats suffering from lead toxicity. Serum lead increased significantly in the positive control group (group of rats suffering from lead toxicity), as compared to the negative control group (23.710 ± 2.480 vs. 16.333 ± 1.527 mg/dl) respectively. All treated groups with 5% and 10% Radish, Cabbage and Jews mallow decreased the mean value of serum lead significantly, as compared to the positive control group. The highest decrease in serum lead recorded for the group which treated with 10% jews mallow, followed by the group treated with 10% Cabbage, respectively.

The mean value of serum zinc increased significantly in rats suffering from lead toxicity (control positive group), as compared to the negative control group (Table 10 and Fig. 20). Treating rats which were suffering from lead toxicity with 5% and 10% Radish, Cabbage and Jews mallow led to significant decrease ($p<0.05$) in serum zinc, as compared to the positive control group. On the other hand serum zinc decreased gradually

with increasing the levels of tested materials. The highest decrease in serum zinc recorded for the group treated with 10% Radish, followed by the group which treated with 5% Jews mallow. These treatments showed significant decrease in this parameter, as compared to the negative control group. The best result in serum zinc recorded for the group treated with 10% Radish but evevn10% Cabbage, showed non-significant difference in serum zinc, as compared to the negative control group.

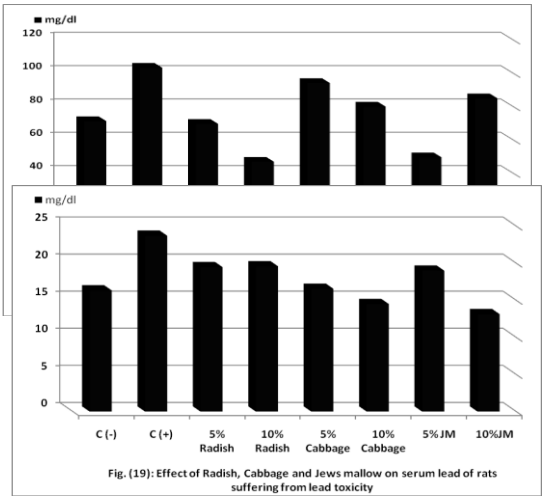

Fig. (19): Effect of Radish, Cabbage and Jews mallow on serum lead of rats suffering from lead toxicity

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الملخص العربى

التأثيرالواقى للفجل و الكرنب والملوخية على التسمم بالرصاص فى فئران التجارب

أ0د/ عبدالرحمن محمد عطيه - أستاذ التغذيه وعلوم الأطعمه - وعميد كليه الأقتصاد المنزلى - الأسبق - جامعه حلوان

أ0د/ عيد على زكى- أستاذ التغذيه وعلوم الأطعمه - وكيل الكليه لشئون التعليم والطلاب- كليه التربيه النوعيه- جامعه بنها

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غاده فريد عبدالخالق البسيونى

تتميز المعادن الثقيلة بشدة سميتها و تراكمها فى جسم كل من الأنسان والحيوان و خصوصا الأطفال و من أهمهاالكادميوم و الرصاص والزئبق.و من أهم مصادر التلوث بهذة المعادن المخلفات الصناعية خصوصا التعدين واستخدام بعض أنواع المبيدات والأسمدة الزراعية. لذالك تهدف هذه الدراسة إلى التعرف على تأثير الفجل والكرنب والملوخيه للأقلال من الأثار الضاره الناتجه من التعرض للتسمم بمعدن الرصاص .

وقد أجريت الدراسه على 48 من فئران الالبينو أوزانهم 110±5 جرام لمده 6 أسابيع حيث تم تقسمهم إلى 8 مجموعات

1- المجموعة الضابطة (المجموعة السالبة) تم تغذيتها على الوجبه القياسيه
2- المجموعة الأيجابيه) تم تغذيتها على الوجبه القياسيه بالإضافة ألى أسيتات الرصاص
3- مجموعه تناولت الوجبه القياسيه مع 5% فجل مع أسيتات الرصاص
4- مجموعه تناولت الوجبه القياسيه مع 10% فجل مع أسيتات الرصاص
5- مجموعه تناولت الوجبه القياسيه مع 5% كرنب مع أسيتات الرصاص
6- مجموعه تناولت الوجبه القياسيه مع 10% كرنب مع أسيتات الرصاص
7- مجموعه تناولت الوجبه القياسيه مع 5% ملوخيه مع أسيتات الرصاص
8- مجموعه تناولت الوجبه القياسيه مع 10% ملوخيه مع أسيتات الرصاص

وأظهرت النتائج: -

أولآ الطعام المتناول والزيادة فى الوزن:

- أفضل مجموعه استهلكت الغذاء هي المجموعة المعالجة 10% ملوخية تليها 10% فجل
- وكانت أكبر زيادة في وزن الفئران هى المجموعه المعالجه 10% فجل تليها 5% ملوخيه
- وكان أفضل نتيجة لوحظت في وزن الكلى هى المجموعه المعالجه 10% كرنب تليها المجموعه 5% فجل
- وقد لوحظ تحسن فى وزن الطحال بالنسبه لجميع المجموعات التى تناولت فجل والكرنب والملوخيه بالمقارنه بالمجموعه الأيجابيه بإستثناء المجموعه 10% ملوخيه
- سجلت البيانات تغيرات بسيطه فى وزن القلب فى جميع المجموعات بإستثناء المجموعه التى تناولت 5% ملوخيه بالمقارنه بالمجموعه السالبه

ثانياً دهون الدم:

- أظهرت النتائج أكبر أنخفاض ملحوظ فى قيمه الكوليسترول فى الدم فى المجموعه 10% ملوخيه تليها 5% ملوخيه تليها 10% فجل
- سجلت أعلى انخفاض في قيمه الدهون الثلاثيه فى السيرم فى المجموعات وهى المجموعه المعالجه 10% ملوخيه تليها 10% كرنب و10% فجل
- أعلى قيمه سجلها الكوليسترول العالى الكثافه فى المجموعه التى تناولت 10% ملوخيه وتليها10% فجل مع أقل زياده سجلتها المجموعه 5% كرنب
- بالنسبة للكوليسترول المنخفض الكثافه أعلى أنخفاض سجلته المجموعه 10% ملوخيه تليها 10% فجل
- وقد لوحظ بالنسبة للكوليسترول شديد أنخفاض الكثافه أفضل نتيجه سجلتها المجموعات هى المجموعه 10% ملوخيه تليها المجموعه 10% كرنب و10% فجل

ثالثاً نتائج وظائف الكلى:

- أظهرت التحاليل الأحصائيه أنخفاض حمض اليوريك فى جميع المجموعات المعالجه بإستثناء المجموعه المعالجه 5% فجل
- بالنسبة لليوريا نيتروجين السيرم أفضل نتيجه سجلتها المجموعه المعالجه 5% ملوخيه تليها 10% ملوخيه
- سجل كرياتين السيرم فى جميع المجموعات أنخفاضاً كبيراً بإستثناء المجموعه المعالجه 10% كرنب و أفضل نتيجه حققتها المجموعه 5% ملوخيه

رابعاً نتائج وظائف الكبد:

- بالنسبة AST السيرم أفضل النتائج سجلتها المجموعه 5% كرنب ثم المجموعه 10% كرنب تليها 5% ملوخيه
- والمجموعات التي حققت أعلى أنخفاض هو ALT سيرم سجلته المجموعه المعالجه 5% فجل تليها 5% ملوخيه
- حققت جميع المجموعات المعالجه أنخفاضات جيده بالنسبه ALP سيرم
- بالنسبة لمصل الكالسيوم جميع المجموعات سجلت أنخفاض فى قيمه الكالسيوم بإستثناء المجموعه المعالجه 5% فجل بالمقارنه بالمجموعه الإيجابيه
- جميع المجموعات سجلت أنخفاض فى نسبه الرصاص فى الدم بشكل ملحوظ بالمقارنه بالمجموعه الإيجابيه وأفضل مجموعه سجلت أعلى أنخفاض فى نسبه الرصاص فى الدم هى المجموعه المعالجه 10% ملوخيه تليها 10% كرنب
- بالنسبة للزنك أفضل أنخفاض سجلته المجموعه 10% فجل تليها 5% ملوخيه