

# Potential Ameliorative Effects of Oat (*Avena Sativa L.*) and its Efficacy Against Lead Toxicity in Experimental Rats

Soha Mohamed Yousef<sup>1</sup> and Asmaa Ahmed M.  
Hussein<sup>2</sup>

Nutrition and Food Science, Home Economics Department,  
Faculty of Specific Education, Fayoum University<sup>1</sup>  
Nutrition and Food Science Department, Faculty of Home  
Economics, Helwan University<sup>2</sup>



## مجلة البحوث في مجالات التربية النوعية

معرف البحث الرقمي DOI: 10.21608/JEDU.2023.244085.1958

المجلد التاسع العدد 49 . نوفمبر 2023

الترقيم الدولي

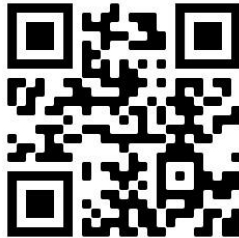
P-ISSN: 1687-3424

E- ISSN: 2735-3346

موقع المجلة عبر بنك المعرفة المصري <https://jedu.journals.ekb.eg/>

موقع المجلة <http://jrfse.minia.edu.eg/Hom>

العنوان: كلية التربية النوعية . جامعة المنيا . جمهورية مصر العربية





## Potential Ameliorative Effects of Oat (*Avena Sativa L.*) and its Efficacy Against Lead Toxicity in Experimental Rats

Soha Mohamed Yousef<sup>1</sup> and Asmaa Ahmed M. Hussein<sup>2</sup>

Nutrition and Food Science, Home Economics Department, Faculty of Specific Education, Fayoum University<sup>1</sup> & Nutrition and Food Science

Department, Faculty of Home Economics, Helwan University<sup>2</sup>

### Abstract

The study aimed to assess the dietary significance and the ameliorative effects of oat (*Avena Sativa L.*) against lead toxicity in experimental rats during their growth period. Twenty-eight albino rats divided to two groups. The first group G1 (7 rats) feed a basal diet as a negative control. Rats of the second group (21 rat) were exposed to lead toxicity using lead acetate at a 200 mg/kg diet, and then the rats were divided into 3 subgroups. G2 considered a positive control group, G3 and G4 feed a diet with different levels of oat powder 10 % and 20 %, respectively. Duration of the experiment was 6 weeks. The results indicated that rats fed on oats at 10% and 20% of their intake showed a significant decrease in serum lead levels (0.016 mg/dl) and (0.005mg/dl) respectively, comparing to G2. In addition, there were noticeable improvements in iron and hemoglobin levels in rats fed on oats of their diet, the best result was in G4 (341.33mg/dl) and (14.03mg/dl) respectively. Regarding liver enzymes ALT, AST and ALP were significant decreased in G3 and G4 comparing to G2. Improvements in kidney functions were also shown in all examined groups comparing to G2. Furthermore, the antioxidant enzymes SOD and CAT showed a significant improvement in all tested groups comparing to G2. It can be concluded that a significant improvement was evident in the changes induced by exposure to lead acetate in the groups of rats that consumed oats in the diet. Results scientifically proved that oats have significant therapeutic effects against intoxication caused by lead acetate. Oats have potential health benefits as a functional supplement that has a role in liver and kidney protection and enhancing the antioxidant system against lead toxicity. The current study's recommendation is that increasing of oats in the diet may be beneficial against lead toxicity.

**Key words:** heavy metals intoxication, liver enzymes, antioxidant activity, renal functions.

## Introduction

The existence of polluting materials in the environment, air, water, soil, and food, that could be toxic and causing harms to living organisms, this is called environment pollution. Large number of contaminants including heavy metals in animals diets are often caused by human actions, results from agricultural productions or industries or intentional or unintentional misuses (**Duruibe et al., 2007**).

Scientifically proven that several heavy metals, such as Lead, causes increasing production of reactive oxygen species. And therefor, inducing lipids peroxidation, decreasing saturated fatty acids and increasing the unsaturated fatty acid contents in the membranes. Moreover, it has been proven to strengthens producing of reactive oxygen species in a many of cells as following of oxidative stress (**Aboul-Enein et al., 2010**).

Lead is a major cause of environmental poisoning. First, it affects the central nervous system, liver and kidney systems, resulting many disturbances (**Samuel et al., 2017**). Lead may be affect anyone of any age, but its effects on children are serious, as their active patterns make them more vulnerable for exposure to lead (**Nabil et al., 2012**).

*Avena sativa* (oats) considered the perfect source of dietary fibers in grains. Oats containing high amounts of proteins, dietary fibers, fats, minerals, vitamins, iron and zinc than other whole grains. Oats are considered distinguished among grains as it has more therapeutic effect than other cereals like wheat and rice. Oats are rich in soluble and insoluble dietary fibers.  $\beta$ -glucan is the soluble dietary fiber in oats. The soluble  $\beta$ -glucan creates viscous, shear-thinning solutions until in small concentration (**Raouf et al., 2022**).

Oat is an excellent source in many oxidative compounds like phenolic contents (avenanthramides), flavonoids, vitamin E, sterols and phytic acids that protects its lipid from oxidation

process. Antioxidant effect of oat in eliminating free radicals and protecting their source plant from oxidation process is transferring to the human body when oats or other diet rich of antioxidant consumed (**Chen *et al.*, 2018**).

The study aimed to assess the dietary significance and the ameliorative effects of oat against lead toxicity in experimental rats during their growth period.

## Materials and methods

### Materials

Cellulose, lead acetate, vitamins mixture and minerals were bought from El-Gomhoria Company for Trading Drugs, Chemicals and Medical Requirements. Oat was bought from Agricultural Research Centre, Giza, Egypt. Twenty eight albino rats ( $60\pm 5$  gm) were bought from Helwan Farm for Experimental Animals, Cairo, Egypt.

### Methods

#### Mineral and vitamin composition

The Mineral and vitamin composition of oats was measured according to the method of **Brand *et al.* (1995)**.

#### Preparing of basal diet

The experiment's diet was prepared using the method of **Reeves *et al.* (1993)**. The basal diet consisting of 20.0 % proteins, 10.0 % sucrose, 4.70% corn oil, 2.0% choline chloride, 3.50 % salts mixture, 1.0% vitamins mixture and 5.0% fibers. The remaining amounts were corn starch up to 100.00 %.

#### Experimental animal design

Animals divided to two groups. The first group, **G1** (7 rats), feed on the basic diet, considered a negative control group. Rats of the second group (21 rat) were exposed to lead poisoning using lead acetate at a 200 mg/kg diet according to **Newairy and Abdou (2009)**, and then the rats were divided into 3 subgroups, assigned to groups 2- 4 as following:

**Subgroup (G2):** Rats feed a basal diet contained lead acetate, as a positive control.

**Subgroup (G3):** Rats feed a basal diet contained lead acetate + level 1 of oat powder (10%).

**Subgroup (G4):** Rats feed a basal diet contained lead acetate + level 2 of oat powder (20%).

After the end of trial period (six weeks), rats were prevented from eating throughout the night and were anesthetized with ether. Blood samples were drawn and placed in centrifuge tubes. Obtained serum was stored in  $-20^{\circ}\text{C}$  until tests were performed.

### Biochemical analyses

Serum iron was measured following **Dreux (1977)**. Lead was measured using enzymatic calorimetric method according to **Parsons (2001)**. Hemoglobin was evaluated using enzymatic calorimetric method according to **Young (1990)**. Liver enzymes including Alanine aminotransferase, Aspartate aminotransferase and Alkaline phosphatase were assessment in serum following **Sherwin (1984)**, **Young (1990)** and **Roy (1970)** respectively. Levels of albumin, urea nitrogen and uric acid were measured according to **Young (2001)** and **Fossati et al.(1980)** respectively. Serum total protein and creatinine were determined according to **Gornall et al. (1949)** and **Henry (1974)** respectively. Serum glutathione (GSH) and superoxide dismutase (SOD) activity were measured according to **Beutler et al. (1963)** and **Nishikimi et al. (1972)** respectively. Serum catalase (CAT) activity was determined following by **Aebi (1984)**.

### Statistical analysis

Results of the study were as (mean  $\pm$  SE). The statistical analyses were performed using SPSS, PC software (Verion 18.0 SPSS Inc., Chicago, USA), Dunk 'test multiple range post-hoc test was used. The results were analyzed by one-way analysis of variance (ANOVA). Values consider a significant difference at  $P < 0.05$  (**Snedecor and Cochran, 1980**).

## Results and Discussion

### Determination of minerals and vitamin composition of oats

The minerals and vitamins composition of oats are showed in Table (1). The results outlined that oat powder contained a moderate amount of B- complex vitamins content (Thiamine B1, Riboflavin B2, Cobalamin B12) and vitamin E (tocopherol). The results indicate that oat powder containing high amounts of phosphorus, potassium, magnesium, calcium and iron. However it containing small amounts of copper, sodium, zinc and manganese. These results were consistent with (Hu *et al.*, 2014), whereas the contents of minerals in Chinese naked oat flakes, were Ca, Na, Zn and Fe as 27.20-109.80 mg/100g, 2.81- 45.77 mg/100g, 1.28-5.05 mg/100g and 12.20-55.30 mg/100g, respectively.

**Table (1): Minerals and vitamins composition of oat (per 100 gm)**

Minerals and Vitamins composition	Oat (mg /100g)
Mn	4.42
Cu	1.33
Fe	13.76
Zn	3.44
Ca	54.70
Mg	120.67
K	350
P	472.57
Na	5.35
Vitamin E	0.125
Thiamin B1	0.435
Riboflavin B2	0.6
Cobalamin B12	0.09

## Effect of oat on serum lead, iron and blood hemoglobin (HB) concentrations in experimental rats

Data in Table (2) shows the effects of oat on lead levels in serum of normal and lead-intoxicated rats. Levels of lead in serum showed significantly increasing due to exposure of rats to lead poisoning in G2 ( $0.08 \pm 0.05$  mg/dl) comparing to G1 ( $0.007 \pm 0.002$  mg/dl). On the contrary, when rats' diet contained oats powder at 10% and 20% of their intake, significantly reduction in levels of lead were observed comparing to G2 ( $0.016 \pm 0.006$  mg/dl) and ( $0.005 \pm 0.002$  mg/dl) respectively, which were close to the normal control group.

In the same table, serum concentration of iron was significant reduced due to exposure of rats to lead poisoning in G2 ( $304.01 \pm 6.24$  mg/dl) comparing to G1 ( $347.66 \pm 3.42$  mg/dl). However, the levels of iron were significant increasing when rats' diet contained oat powder at any level, when compared to G2 (lead-intoxicated animals). In general, 20% of oat in the diet improves the iron concentration in serum ( $341.33 \pm 6.5$  mg/dl) which is close to G1.

In our study, Table (2) illustrates the effect of oat ingestion on blood hemoglobin (HB) in normal and lead-intoxicated rats. Levels of hemoglobin in blood were significant reduced due to exposure of rats to lead poisoning in G2 ( $10.23 \pm 0.30$  mg/dl) comparing to G1 ( $14.43 \pm 1.45$  mg/dl). On the contrary, when rats' diet contained oat powder at the two tested levels, results revealed significantly increasing in the blood hemoglobin levels comparing to the G2 ( $12.45 \pm 1.05$  mg/dl) and ( $14.03 \pm 1.36$  mg/dl) respectively. In general, oat improves hemoglobin levels in the lead intoxicated rats.

Thus, in our study, the lead concentrations in serum for the intoxicated lead group showed a significant increase comparing to negative control normal group. Moreover, the levels of iron for the intoxicated lead group revealed a significantly decreasing comparing to the negative control group. In general lead toxicity leads to a reduction in iron concentration in the serum. However, the ingestion of oats in the diet reduced lead toxicity.



Over a long time, reproductive properties of lead were questionable. However, effect of low levels have not been studied enough. It is not certain if lead is a carcinogenic agent or if its relationship to kidney adenocarcinoma is resulting from cystic nephropathy. The main risk factor of lead poisoning in children in the United States includes nutrition, especially the lack of minerals such as iron, calcium and zinc (Goyer, 1993). In a study by (Esfandiar and Mahmoud, 2012) they illustrated that levels of lead significant reduced in the groups of rats treated with artichoke comparing with lead-intoxicated rats were not treated.

Results in our study showed that blood levels of hemoglobin in lead toxicity groups were significantly decreased comparing to the negative group, which is consistent with (Khan *et al.*, 2008), clarified that ingestion of lead acetate causes reducing of Hb and PCV levels. As confirmed by (Nabil *et al.*, 2012), it was shown that Pb<sup>2+</sup> administration leads to a reduction in hemoglobin content, number of red blood cells in the blood of intoxicated rats. Also decreased the plasma level of T3 & T4 and the number of white blood cells in the blood. In another study by (Abd El-Ghany *et al.*, 2015) it was shown that comparing the rats injected with cisplatin in the positive control with the normal control group, there was a significantly reduction in hemoglobin, red blood cells and platelets in the blood, and a significantly increasing in white blood cells was noticeable. The nephrotoxic groups which their diets contained casein and different legumes revealed a non-significantly reduction in hemoglobin levels, while significantly increasing in white blood cells.

### **Evaluation of the effect of oat on serum concentrations of liver enzymes in experimental rats**

Results in Table (3) clarified the effect of oat on the serum activity of alanine aminotransferase (ALT). Data demonstrated that ALT level was significant increase in rats exposed to lead poisoning in G2 ( $39.667 \pm 2.5$  U/L) comparing to G1 ( $29.333 \pm 3.5$  U/L). The data showed, when rats' diet contained oat powder 10% and 20% of their intake a significantly reducing in the levels of

ALT were observed comparing to G2. Furthermore, G3 showed the best results in reducing the level of ALT ( $32.667 \pm 2.51$  U/L).

**Table (2): Effect of oat at different levels on serum lead, iron and blood hemoglobin (HB) concentrations in experimental rats**

Parameter Group	Serum Lead (mg/dl)	Serum Iron (mg/dl)	Blood Hemoglobin (mg/dl)
<b>G1</b> (- ve control)	$0.007 \pm 0.002^b$	$347.66 \pm 3.42^a$	$14.43 \pm 1.45^a$
<b>G2</b> (+ve control)	$0.08 \pm 0.05^a$	$304.01 \pm 6.24^b$	$10.23 \pm 0.30^c$
<b>G3</b> (10% oat powder)	$0.016 \pm 0.006^{ab}$	$319.20 \pm 5.00^b$	$12.45 \pm 1.05^b$
<b>G4</b> (20% oat powder)	$0.005 \pm 0.002^b$	$341.33 \pm 6.5^a$	$14.03 \pm 1.36^a$

Values are presented as (mean  $\pm$  SE). Data with different letters in the same column were significantly differences at  $P \leq 0.05$

Results in Table (3) demonstrated the effects of oat on the serum levels of aspartate aminotransferase (AST). The results revealed that AST level was significant increasing in rats exposed to lead poisoning in G2 ( $20.33 \pm 4.5$  U/L) comparing to G1 ( $16.00 \pm 3.60$  U/L). However the results clarified that when rats' diet contained oat powder 10% and 20% of their intake, there was a significantly reducing in the levels of AST comparing to G2. In addition, G4 showed the best results in reducing the level of AST as ( $15.66 \pm 1.52$  U/L).

Concerning the levels of alkaline phosphatase (ALP) in Table (3). The results clarified that rats exposed to lead toxicity in G2 showed significantly increasing in their serum ALP level ( $261.33 \pm 22.67$  U/L) comparing to G1 ( $236.33 \pm 8.71$  U/L). Furthermore, when rats' diet contained oat powder at two tested levels 10% and 20%, results showed significant decreasing in the levels of ALP comparing to G2 ( $223.00 \pm 4.57$  U/L) and ( $217.67 \pm 9.44$  U/L) respectively.

It is noted that there was a significantly increasing in the levels of liver enzymes in the positive group as rats exposure to lead acetate, while the improvement of these enzymes was clear in the groups of rats that consumed 10% and 20% of oat powder in their diet. The findings were agreement with (Kim *et al.*,2021), the study that dealt with the functionality of oats and individual immunity. Oats contain large amounts of saponarin, which plays a role in eliminating toxins from the liver.  $\beta$ -glucan and avenanthramides also ameliorate the functions of the immune system and remove harmful materials from the body. Saponin-based avanacosidase and functional substances of flavone glycoside play an important role in improving the functions of the immune system and resisting inflammation in the body.

Other results revealed, when the rats' diet contained a 5% oat powder mixture showed lower level of glucose. In the tested groups, the lowest level of Aspartate transaminase (GOT) and Alanine transaminase (GPT) were showed in the group feed on 5% oat powder, while the higher level was showed in the group feed on 2.5% white oat powder by a significantly difference. The lower values of triglycerides and cholesterol were showed for the group feed on a 5% mixture of oat powder (Emad *et al.*, 2020).

The study results are consistent with (Hong *et al.*, 2013), demonstrated that eating oats caused in reducing of body weight, body mass index and body fats. Oats also improved liver functions, including AST and ALT, which considered good indicators for assessment of hepatic functions. Oats can alleviate obesity, prevent body fats deposition, and improve hepatic functions to protect from hepatic steatosis in obesity people. Consuming oats as a supplementation every day can serve as an adjunct treatment for metabolic disorders.

**Table (3): Effects of oat at different levels on serum concentrations of liver enzymes in experimental rats**

Parameter Group	ALT (U/L)	AST (U/L)	ALP (U/L)
<b>G1</b> (- ve control)	29.333± 3.5 <sup>c</sup>	16.00± 3.60 <sup>bc</sup>	236.33± 8.71 <sup>b</sup>
<b>G2</b> (+ve control)	39.667±2.5 <sup>a</sup>	20.33±4.5 <sup>a</sup>	261.33±22.67 <sup>a</sup>
<b>G3</b> (10% oat powder)	32.667±2.51 <sup>bc</sup>	17.00±3.6 <sup>b</sup>	223.00 ±4.57 <sup>bc</sup>
<b>G4</b> (20% oat powder)	34.667± 1.52 <sup>b</sup>	15.66±1.52 <sup>c</sup>	217.67±9.44 <sup>c</sup>

Values are presented as (mean ± SE). Data with different letters in the same column were significantly differences at  $P \leq 0.05$ . ALT: Alanine Aminotransferase, AST: Aspartate Aminotransferase, ALP: Alkaline phosphatase.

### Effect of oat on kidney functions in experimental rats

Data in Table (4) clarified the effect of oat on kidney functions. The levels of uric acid were significant increase in G2 due to exposure of rats to lead poisoning ( $2.90 \pm 0.10$  mg/dl) comparing to G1 ( $2.16 \pm 0.25$  mg/dl). The results showed that groups of rats' diet contained oat powder 10% and 20% revealed a significant decrease in the levels of uric acid comparing to G2.

The data indicated that level of total protein was increased significantly in G2 due to exposure of rats to lead poisoning ( $6.03 \pm 0.15$  mg/dl) comparing to G1, which as ( $5.60 \pm 0.20$  mg/dl). While, groups of rats' diet contained oat powder showed decreasing in the levels of total protein comparing to G1. Moreover, there are no noticeable differences between G3 and G4 ( $5.66 \pm 0.15$  mg/dl) and ( $5.26 \pm 0.30$  mg/dl) respectively comparing to G1.

For albumin levels, data indicated that in G2, significant increase of serum albumin ( $3.53 \pm 0.47$  g/dl) were showed comparing to G1 as ( $3.10 \pm 0.10$  g/dl). However, in groups of rats' diet contained oat powder showed significantly decrease in the albumin levels in two levels comparing to G1.

Moreover, the results clarified that rats in G2, were exposed to lead poisoning had significant increasing of urea nitrogen levels as ( $50.46 \pm 1.53$  mg/dl) comparing to G1 ( $46.86 \pm 0.92$  mg /dl). Groups of rats feed on oat powder revealed a significantly decreasing in levels of urea nitrogen. Moreover, G4 showed the best results the level of serum urea nitrogen as ( $43.66 \pm 3.33$  mg/dl).

Results in the same table showed that G2 with lead toxicity had increasing in the creatinine levels ( $0.86 \pm 0.11$  mg /dl) comparing to G1 ( $0.60 \pm 0.077$  mg/ dl). Groups of rats exposed to lead toxicity and feed on oat at two levels showed decreasing in the levels of creatinine comparing to G2. The best result of creatinine level was in G4 ( $0.57 \pm 0.06$  mg /dl).

Kidney dysfunction appeared through changes that occurred in levels of serum uric acid, total protein, albumin, urea nitrogen and creatinine in the group of rats exposed to lead acetate in the positive group, while these changes improved when the diet contained oats in different levels. These results are agreement with (**Wang et al., 2022**), the study that explore the oat  $\beta$  glucan mechanism, therapeutic potential and its effect on kidney functions in rats with diabetic kidney disorder. The findings revealed that oats  $\beta$  glucan decreased the levels of blood glucose and improve in functions of kidney ( $P < 0.05$ ).

Results are consistent with (**Abdel Rahman, 2010**), demonstrated that the rats feed on oat bran and barley bran revealed significant decreasing in the levels of uric acid, urea nitrogen and creatinine comparing to the positive control group. Which agreement with hypothesis that dietary fibers make improvement in kidney functions.

**Raya et al., (2022)**, examined the potential anti-diabetic effects of oat extract fermented with the *L. plantarum* strain, UFOE and LFOE at a dose of 7 ml. The results showed that the levels of serum creatinine, urea and BUN were significantly decreased in groups of UFOE and LFOE comparing to STZ group. The fermented oats had effects in hepato-protective and nephron-protective in the diabetic rats. Similar findings were of

improvements in the levels of total protein, creatinine and blood urea nitrogen have been reported in diabetic rats resulting the interventions of fermented rice (**Rajasekaran and Kalaivani, 2015**). **Hanan and Ahdab, (2020)** revealed that rats treated with gentamicin recorded significantly reduction in the levels of urea nitrogen and creatinine when they were provided with meals containing oat and barley as snacks.

**Table (4): Effect of oat at different levels on kidney functions in experimental rats**

Parameter Group	Uric Acid (mg/dl)	Total protein (mg/dl)	Albumin (g/dl)	Urea Nitrogen (mg/dl)	Creatinine (mg/dl)
<b>G1</b> (- ve control)	2.16 ± 0.25 <sup>c</sup>	5.60 ± 0.20 <sup>bc</sup>	3.10 ± 0.10 <sup>ab</sup>	46.86 ± 0.92 <sup>b</sup>	0.60 ± 0.077 <sup>b</sup>
<b>G2</b> (+ve control)	2.90 ± 0.10 <sup>a</sup>	6.03 ± 0.15 <sup>a</sup>	3.53 ± 0.47 <sup>a</sup>	50.46 ± 1.53 <sup>a</sup>	0.86 ± 0.11 <sup>a</sup>
<b>G3</b> (10% oat powder)	2.46 ± 0.55 <sup>b</sup>	5.66 ± 0.15 <sup>ab</sup>	3.13 ± 0.20 <sup>ab</sup>	45.33 ± 1.32 <sup>b</sup>	0.71 ± 0.03 <sup>ab</sup>
<b>G4</b> (20% oat powder)	2.23 ± 0.32 <sup>b</sup>	5.26 ± 0.30 <sup>c</sup>	2.90 ± 0.10 <sup>b</sup>	43.66 ± 3.33 <sup>c</sup>	0.57 ± 0.06 <sup>b</sup>

Values are presented as (mean ± SE). Data with different letters in the same column were significantly differences at  $P \leq 0.05$ .

### Effect of oat on serum concentrations of antioxidant activity in experimental rats

Results in Table (5) revealed that there were significantly decreasing of serum SOD and CAT in G2 with a mean value ( $32.89 \pm 2.69$  U/mg protein) and ( $9.43 \pm 1.25$  nmol/min/mg protein), comparing to G1 ( $78.60 \pm 3.90$  U/mg protein) and ( $11.37 \pm 1.57$  U/mg) respectively. While, levels of SOD and CAT significantly increasing in G3 and G4 comparing to G2. Furthermore, best result of SOD levels was in G4, as ( $51.26 \pm 7.64$  U/mg protein). Also, best result of CAT levels was in G4, as ( $14.53 \pm 0.86$  nmol/min/mg protein). It was also noticeable, that there were significant decreasing of GSH levels in G2 comparing to G1, as ( $2.64 \pm 0.81$   $\mu$ mol/dL) and ( $4.56 \pm 0.94$   $\mu$ mol/dL),

respectively. Levels of GSH in G4 was best result as  $(5.016 \pm 0.87 \mu\text{mol/dL})$ .

**Lamidi et al., (2021)** showed that the lower activity of antioxidant enzymes were apparent in the lead treated group of rats, however pretreatment with flavonoid fractions of diosmin and hesperidin alleviated the disorders that followed. Also, **(Eshginia and Marjani, 2013)** demonstrated that lead causes changes in the erythrocyte antioxidant enzyme activities in the young female rats. Treatment with vitamin C during infancy has a protective effect against lead poisoning. Most GSH in the liver converted to GSSG by the enzyme glutathione reductase to protect the living cells from damage resulting from toxic materials, leading to a low level of GSH **(Asl et al., 2013)**

Fermented oats with honey in large doses showed synergistic effects. Levels of glutathione, catalase, superoxide dismutase and malonaldehyde showed significant enhancement after consuming fermented oat with honey at 7.0 mL as 68.60%, 71.50%, 55.69%, and 15.98%, respectively, comparing with the DR group. The treatments resulting a considered increasing in the levels of the antioxidant enzymes GSH, CAT, and SOD, and a significantly decreasing in MDA levels **(Hend et al., 2022)**.

The results consistent with **(Ilias et al., 2017)**, revealed that the oats extract (2000.0 mg/kg) improved the glucose tolerance, reduced FBG and oxidative stress biomarkers as SOD, CAT, GPx, GSH and MDA in liver and renal of rats. All three treatments revealed improvement effects in ameliorate the antioxidant markers. Also, **(Raya et al., 2022)** demonstrated that there were significant alterations in antioxidant enzymes levels in diabetic rats as GSH, CAT, SOD and MDA. However, fermented oat extracts for six weeks resulting significantly improvements in the levels of antioxidant enzymes. Levels of GSH, CAT, and SOD increasing, where the level of MDA decreasing as comparing to the positive control group. Phenolic contents in fermented oat has been revealed playing a important role in amelioration of the oxidative stress as its high antioxidant capacity **(Sunderam et al., 2020)**.



Beta-glucan is an essential active compound in oat and is considered one of the most important dietary fibers found in it. Oat also contain high levels of other bioactive compounds such as phenolic acids, sterols, avenacosides, and avenanthramides. It has been proven that oat are beneficial to the health of the human body through its role in enhancing the functions of the immune system and also helps in preventing atherosclerosis and cancer (Paudel *et al.*, 2021).

**Table (5): Effects of oat at different levels on serum concentrations of antioxidant enzymes in experimental Rats.**

Parameter Group	SOD (U/mg protein)	CAT (nmol/min/mg protein)	GSH ( $\mu$ mol/dL)
<b>G1</b> (- ve control)	78.60 $\pm$ 3.90 <sup>a</sup>	11.37 $\pm$ 1.57 <sup>bc</sup>	4.56 $\pm$ 0.94 <sup>b</sup>
<b>G2</b> (+ve control)	32.89 $\pm$ 2.69 <sup>c</sup>	9.43 $\pm$ 1.25 <sup>c</sup>	2.64 $\pm$ 0.81 <sup>c</sup>
<b>G3</b> ( 10% oat powder)	34.62 $\pm$ 4.00 <sup>b,c</sup>	12.98 $\pm$ 1.69 <sup>ab</sup>	4.66 $\pm$ 0.64 <sup>b</sup>
<b>G4</b> (20% oat powder)	51.26 $\pm$ 7.64 <sup>b</sup>	14.53 $\pm$ 0.86 <sup>a</sup>	5.016 $\pm$ 0.87 <sup>a</sup>

Values are presented as (mean  $\pm$  SE). Data with different letters in the same column were significantly differences at  $P \leq 0.05$ .

## Conclusion

There were significant improvements in the changes caused by exposure to lead acetate in the groups of rats that consumed oats in their diet. Results scientifically proved that oat have significant therapeutic effects against intoxication caused by lead acetate. The two groups with different levels of oat 10% and 20%, achieved satisfactory results, however group 4 had the best effect against lead toxicity. Oats have potential health benefits considering a functional supplementation that has a role in liver and kidney protection, and enhances the antioxidant system against lead toxicity.



## References

- Abd El-Ghany, M., Sedky, A. and El-Metwally, D. (2015).** Effect of Consumption Different Legumes in Diets Fortified With Black Cumin and Guava Seeds on Nephrotoxicity in Rats. *Current Science International*, 4 (1), 45-55.
- Abdel-Rahman, M.K. (2010).** Influence of dietary fat on renal function, lipid profile, sex hormones, and electrolyte balance in rats. *European Journal of Lipid Science and Technology*, 112(10),1166-1172.
- Aboul-Enein, A., Abou Elella, F. and Abdullah, E. (2010).** Monitoring of some organochlorines and organophosphorus residues in imported and locally raised chicken and bovine muscles in Egypt. *J Appl Sci Res.*, 6(6), 600-608.
- Aebi, H. (1984).** Catalase in vitro. In: *Methods of Enzymology*, 105, 121-126.
- Asl, N.A., Banaei, S., Alihemmati, A., Baradaran, B. and Azimian, E. (2013).** The anti-inflammatory effect of erythropoietin and melatonin on renal ischemia reperfusion injury in male rats. *Adv. Pharm. Bull.* 4,49-54.
- Beutler, E., Duron, O. and Kelly, B.M. (1963).** Improved Method for the Determination of Blood Glutathione. *Journal of Laboratory and Clinical Medicine*, 61, 882-888.
- Brand, W., Cuvelier, M. and Berset, C. (1995).** Use of a free-radical method to evaluate antioxidant activity. *LWT Food Sci. Techno.*, 28, 25-30.
- Chen, C., Wang, L., Wang, R., Luo, X., Li, Y. and Li, J. (2018).** Phenolic contents, cellular antioxidant activity and antiproliferative capacity of different varieties of oats. *Food Chem.* 239, 260-7.
- Dreux, C. (1977).** Selected method. Analysis of human serum: assay of iron II. Method using bathophenanthroline Se-Iron II (bathophenanthroline). *Ann Biol Clin (Paris)*, 35(3), 275-7.
- Duruibe, J., Ogwuegbu, M. and Egwurugwu, J. (2007).** Heavy metal pollution and human biotoxic effects. *Int J Phys Sci*, 2(5), 112-118.

- Emad, M., Seham, A., Amal N. and Hanaa A. (2020).** Anti-Diabetic Effect Of Oats Flour On Streptozotocin- Induced Diabetic Rats. Journal of Home Economics, 30 (4),727-742.
- Esfandiar, H. and Mahmoud, R. K. (2012).** Protective effect of artichoke (*Cynara scolymus*) leaf extract against lead toxicity in rat, 51, 1104-1109.
- Eshginia, S. and Marjani, A. (2013).** The Effect of Vitamin C on the Erythrocyte Antioxidant Enzymes in Intoxicated-Lead Rat Offsprings. J Clin of Diagn Res. 7(6),1078-1081.
- Fossati, P., Prencipe, L. and Berti, G. (1980).** Enzymatic colorimetric method of determination of urea in serum. Clin. Chem., 6 (18), 499-502.
- Gornall, A.G., Bardawill, C.J. and David, M.M. (1949).** Determination of serum proteins by means of the biuret reaction. J Biol Chem.,177(2),751-66.
- Goyer, (1993).** Lead toxicity: current concerns. Journal of Environ Health Perspect, 100, 177-187.
- Hanan, R. and Ahdab, A. (2020).** Effect of Snacks Manufacture with Barley and Oat Flour on Kidney and Liver Functions in Rats Treated with Gentamycin. Journal of Specific Education Studies and Research, 10.21608/jsezu.236979.
- Hend, F., Raya, A. and Hassan, B. (2022).** Ameliorative and Antioxidative Potential of Lactobacillus plantarum-Fermented Oat (*Avena sativa*) and Fermented Oat Supplemented with Sidr Honey against Streptozotocin-Induced Type 2 Diabetes in Rats. MDPI Journal, Antioxidants, 11(6), 1122.
- Henry, R. (1974).** Creatinine measurement with colorimetric method. In clinical Chem., Principles and technics. Second edition, Haper and Row publishers. hepatocytes. Cancer Lett., 97, 61-67.
- Hong, C.C., Chien, N. H., Da-Ming, Y., Shing, J. W., Chiung, H. P. and Chau, J.W. (2013).** Oat Prevents Obesity and Abdominal Fat Distribution, and Improves Liver Function in Humans, 68,18-23.
- Hu, X., Zheng, J., Li, X., Xu, C. and Zhao, Q. (2014).** Chemical composition and sensory characteristics of oat flakes: A

- comparative study of naked oat flakes from China and hulled oat flakes from western countries. *Journal of Cereal Science*, 60, 297-301.
- Ilias, M., Karym, E., Nezha, S., Bouchra, M., Mourad, K., Azlarab, M., Mounya, B., Layachi, C. and El Abbes, F. (2017).** In Vitro and In Vivo Antioxidant and Anti-Hyperglycemic Activities of Moroccan Oat Cultivars. *Antioxidants*, 6(4), 102.
- Khan, M., Mostofa, M., Jahan, M., Sayed, M. and Hossain, M. (2008).** Effect of garlic and vitamin b-complex in lead acetate induced toxicities in mice. *Bangl. J. Vet. Med.*, 6 (2), 203-210.
- Kim, IS., Hwang, CW., Yang, WS., Kim, CH. (2021).** Multiple Antioxidative and Bioactive Molecules of Oats (*Avena sativa L.*) in Human Health. *Antioxidants (Basel)*, 10(9),1454.
- Lamidi, I.Y., Mikail, H.G., Adamu, S., Akefe, I.O., Tijjani, M.B., Salihu, S.I., Olatunji, A.O., Hassan, A., Daniel, N., Adegoke, V.A. (2021).** Flavonoid fractions of diosmin and hesperidin mitigate lead acetate-induced biochemical, oxidative stress, and histopathological alterations in Wistar rats. *Toxicol Res.* 29,37(4),473-484.
- Nabil, M., Esam, A., Hossam, S. and Yasmin, E. (2012).** Effect of lead acetate toxicity on experimental male albino rat. *Asian Pac J Trop Biomed*, 2(1), 41-46.
- Newairy, A. and Abdou, H. (2009).** Protective role of flax lignans against lead acetate induced oxidative damage and hyperlipidemia in rats. *Food Chem Toxicol*, 47(4),813-818.
- Nishikimi, M., Appaji, N. and Yagi, K. (1972).** The occurrence of superoxide anion in the reaction of reduced phenazine methosulphate and molecular oxygen. *Biochem. Biophys. Res. Commun.*, 46(2), 849-854.
- Parsons, P. (2001).** Analytical procedures for the determination of lead in blood and urine; approved guideline. Wayne, PA, National Committee for Clinical Laboratory Standards, 113(8),1669-1674.
- Paudel, D., Dhungana, B., Caffè, M., Krishnan, P. (2021).** A Review of Health-Beneficial Properties of Oats. *Foods*, 26, 10 (11), 2591.

- Rajasekaran, A. and Kalaivani, M. (2015).** Protective Effect of Monascus fermented Rice Against STZ-induced Diabetic Oxidative Stress in Kidney of Rats. *J. Food Sci. Technol.*, 52, 1434-1443.
- Raouf, G., Hanaa, I., Ali, K., Shima, M., Mohamed, S., El-Gerbed, S. and Samar, A. (2022).** Efficacy of Avena Sativa on Regulating Some Biochemical Parameters in Type2 Diabetic Male Albino Rats. *J. of High Institute of Public Health*, 52(1), 33- 44.
- Raya, A., Hend F. and Hassan, B. (2022).** Antidiabetic and Hypolipidemic Efficiency of Lactobacillus plantarum Fermented Oat (Avena sativa) Extract in Streptozotocin-Induced Diabetes in Rats. *MDPI Journal, Antioxidants*, 11(6), 1122.
- Reeves, P., Nielsen, F. and Fahmy, G. (1993).** Purified diets for laboratory rodents : Final report of the American Institute of Nutrition writing committee on the reformulation of the AIN-76 a rodent diet. *J. Nurtr.*, 123(51), 1939-1951.
- Roy, AV. (1970).** Rapid method for determining alkaline phosphatase activity in serum with thymolphthalein monophosphate. *Clin Chem.*, 16(5), 431-436.
- Samuel, J., Herbert, O. and Orish, E. (2017).** Lead Induced Hepato-renal Damage in Male Albino Rats and Effects of Activated Charcoal. *Front. Pharmacol., Sec. Experimental Pharmacology and Drug Discovery*, 8. 10.3389/ 00107.
- Sherwin, J. (1984).** Liver function. In: Kaplan LA, Pesce AJ eds, *clinical chemistry, theory, analyss, and correlation*, 3, 420-438.
- Snedecor, G. and Cochran, W. (1980).** *Statistical methods.*, 7<sup>th</sup> Ed., Iowa State University Press, Ames, USA (90).
- Sunderam, V., Mohammed, S.S.S., Madhavan, Y., Dhinakaran, M., Sampath, S., Patteswaran, N., Thangavelu, L. and Lawrence, A.V. (2020).** Free Radical Scavenging Activity and Cytotoxicity Study of Fermented Oats (*Avena sativa*). *Int. J. Res. Pharm. Sci.*, 11, 1259-1262.

- Wang, R., Zhang, Z., Aihemaitjiang, S., Ye, C., Halimulati, M., Huang, X., Qin, H. (2022).** Oat  $\beta$  Glucan Ameliorates Renal Function and Gut Microbiota in Diabetic Rats. *Front Nutr.*,9,875060.
- Young, D. (1990).** Effect of drugs on clinical laboratory tests . *Am. J. Clin. Pathol.*, 3(7),6-12.
- Young, S. (2001).** Effect of diseases on Clinical Laboratory Tests. 4<sup>th</sup> ed. AACCPress.

## التأثيرات التحسينية المحتملة للشوفان وفاعليته ضد التسمم بالرصاص في فئران التجارب

سها محمد يوسف<sup>1</sup> ، أسماء أحمد حسين<sup>2</sup>

التغذية وعلوم الأطعمة، قسم الاقتصاد المنزلي، كلية التربية النوعية، جامعة الفيوم<sup>1</sup>

قسم التغذية وعلوم الأطعمة، كلية الاقتصاد المنزلي، جامعة حلوان<sup>2</sup>

### الملخص العربي

هدفت الدراسة إلى تقييم الأهمية الغذائية والتأثيرات التحسينية للشوفان (*Avena Sativa L*) ضد سمية الرصاص في فئران التجارب خلال فترة نموهم. تم توزيع ثمانية وعشرون فأراً ألبينو عشوائياً بعد فترة التكيف إلى مجموعتين رئيسيتين، أبقيت المجموعة الرئيسية الأولى (G1 (7 فئران) على النظام الغذائي الأساسي كمجموعة ضابطة سالبة، وباقي الحيوانات (21 فأراً) تعرضت لتسمم الرصاص باستخدام خلات الرصاص بجرعة 200 ملجم/كجم في النظام الغذائي، ثم تم تقسيم الفئران إلى 3 مجموعات فرعية. مجموعة الفئران G2 كانت بمثابة مجموعة ضابطة موجبة، تم تغذية المجموعات الفرعية الأخرى G3، G4 على نظام غذائي يحتوى على مستويات مختلفة من الشوفان 10% و 20% على التوالي، فترة التجربة 6 أسابيع. أشارت النتائج إلى أن الفئران التي تم تغذيتها على الشوفان بنسبة 10% و 20% أظهرت انخفاضاً معنوياً في مستويات الرصاص في مصل الدم (0.016mg/dl)، (0.005mg/dl) بالترتيب، مقارنة بالمجموعة الضابطة الموجبة. كما كان هناك تحسناً ملحوظاً في مستويات الحديد و الهيموجلوبين، النتيجة الأفضل كانت في G4 (341.33mg/dl)، (14.03mg/dl) بالترتيب. بالنظر لمستويات إنزيمات الكبد ALT وAST وALP فقد أظهرت انخفاضاً معنوياً في المجموعات G3 و G4 مقارنة بالمجموعة الضابطة الموجبة. كما ظهر تحسن في وظائف الكلى في جميع المجموعات المختبرة مقارنة بالمجموعة الضابطة الموجبة. علاوة على ذلك، تحسنت مستويات إنزيمات مضادات الأكسدة SOD وCAT بشكل ملحوظ في جميع المجموعات المعالجة بالشوفان مقارنة بالمجموعة الضابطة الموجبة. ويمكن الاستنتاج أن تحسناً معنوياً كان واضحاً في التغيرات الناجمة عن التعرض لخلات الرصاص في مجموعات الفئران التي تغذت على الشوفان. أثبتت النتائج علمياً أن للشوفان تأثيرات علاجية كبيرة ضد التسمم الناتج عن خلات الرصاص. الشوفان له فوائد صحية محتملة كمكمل وظيفي حيث له دور في حماية الكبد، حماية الكلى، وتعزيز نظام مضادات الأكسدة ضد سمية الرصاص، لذلك توصي هذه الدراسة بأن زيادة تناول الشوفان الغذائي يمكن أن يكون مفيداً ضد سمية الرصاص.

**الكلمات المفتاحية:** التسمم بالمعادن الثقيلة، إنزيمات الكبد، نشاط مضادات الأكسدة، وظائف الكلى.