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The role of nutrition in maintaining the effectiveness of the liver (enzymes and some blood variables) against heavy metals efficacy of leek powder in maintaining liver functions against cadmium-negative effects

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Abstract

Interacting Cadmium as a critical pollution dilemma which includes human health risks currently in sight is one of the key issues in today's context because of the severe impacts to human health. Here, the experiment was aimed specifically at the effect of powder of leaves of leek plants on blood parameters and internal organs when toxicity effects of cadmium elements on rats were considered. The experimental groups consisted of a negative control (T₁: Option 1: For the experiment, T₁ was used as the control in which cadmium was injected into rats at a concentration of 0.4 µg/L, T₂ was chosen as the positive control with 25.7 µg/L of cadmium injected to rats, while T₃ and T₄ were the therapeutic interventions where rats were given 2%. Results demonstrated that cadmium (T₂) significantly impacted blood cadmium levels (25.7 µg/L) compared to control (T₁: Concentrations of 2 µm/L and higher were lethal (kidneys 5.4 g/L, testes 5.1 g/L, liver 19.1 g/L, heart 0.8g/L and spleen 2.2 g/L) and were damaging to internal organs compared to control (T₁: Kidneys 2.8 g/ As to Cadmium, we had increased enzyme levels in the blood at the conclusion compared to the control. AST was 22.5 U/l, ALT was 29.1 U/l and Alkaline Phosphatase was 18.3 IU/l in T₁, and in T₂, AST was 60.1 U/l, ALT was The pharmaceutical approach with leek was the best option compared to the others that gave the better outcomes which made the livers' functionality disrupted, blood cadmium levels, and internal organ weights. The article suggests leek, covering 2% of the dose, being a promising therapeutic agent in heavy metal cadmium detoxification. To date, such a study is the first in the line of such research that aims to demonstrate leek's presence as a component in cadmium toxicity remedy.

Keywords: Cadmium, leek, liver, kidneys, rat testicles

Introduction

Heavy metals are very often used in most various industrial, agricultural, and medical operations as well. Although the dominance of heavy metals over industries is considered priceless, these substances are an extremely critical phenomenon of danger and a great challenge for the companies. This project is focused on the habits of the certain personalities and the level of which they are performed in the present time and also the transport of metals in the human body through indirect actions of heavy metals with respect to their toxicity (Kang *et al.*, 2019; Yu *et al.*, 2020; Zou *et al.*, 2021) [6, 17, 20]. Cadmium is recognized as one of the mutually toxic heavy metals accumulated in human body (Hayat *et al.*, 2018; Wang *et al.*, 2017; Zheng *et al.*, 2020; Zou *et al.*, 2021) [3, 16, 19, 20]. On the whole, the individuals are exposed to the pollutants of cadmium anytime, as it is connected to inhaling gases, mining industries, plastic, ceramics and colored materials (Hayat *et al.*, 2018; Wang *et al.*, 2017; Zheng *et al.*, 2021; Zou *et al.*, 2021) [3, 16, 19, 20]. We witnessed the consequences of this first-hand, experiencing symptoms such as fatigue, dizziness and heaviness of body. In addition, there were also indirect exposure examples, which involved the consumption of products coming from affected agriculture ecosystems like fruits, vegetables, fish, and seafood (Wang *et al.*, 2017; Zheng *et al.*, 2020) [16, 19].

Cadmium is not very essential minute for life of many things. Besides, the burning of fossil

fuels another pollutant that is not discouraged by nature is also a threat to the environment (Hirao-Suzuki *et al.*, 2021; Karami *et al.*, 2022; Sun *et al.*, 2021; Wang *et al.*, 2017) [4, 7, 13, 16]. The reverses cadmium threat will rape all through the woman pregnancy due to the nature of the toxin being able to diffuse from the placenta and reach the fetus (Ibiwoye *et al.*, 2019) [5]. Also, during the course of gestation, this metal can enter and not leave blood but will head for breast milk - where reproductive organs and blood vessels (Ibiwoye *et al.*, 2019; Liu *et al.*, 2020; Sola *et al.*, 2022) [5, 9, 12] get impacted in babies. Cream focuses on the overall health of a person (liver, kidneys, intestine) and other special organs. (Hirao-Suzuki *et al.*, 2021; Yuan *et al.*, 2021; Zheng *et al.*, 2020) [4, 18, 19]. Intrinsically, cadmium is a cumulative contamination, showing pathogenic effects and the structural modification of the cellular tissues of different cells (Wang *et al.*, 2017) [16]. It is even worse and, additionally, it can attack the skeleton, the tissue of the bone, the stem cells (Wang *et al.*, 2017; Zheng *et al.*, 2020) [16, 19]. The first experiments showed the possibility of cadmium transference to the cells of the reprogrammed testes and especially of the reprogrammed tubule, as well as the risk of cadmium effects on the testes in fashion (Hirao-Suzuki *et al.*, 2021; Liu *et al.*, 2020; Wang *et al.*, 2017) [4, 9, 16]. The impact of nuclear radiation on an individual biological tool the nucleus is the interruption of translation into the DNA and RNA of every exerciser (Dong *et al.*, 2021; Hirao-Suzuki *et al.*, 2021; Suzuki *et al.*, 2017; Yuan *et al.*, 2021) [2, 4, 14, 18]. For this purpose, it can be considered that cadmium is the tissue of a disastrous and dangerous solution, and it is carcinogenic.

Leek is the part of the crop that is usually utilized across the world. It has plenty of endowable advantages, in addition to its natural fibres, due to its high content of active biological constituents (Venditti *et al.*, 2021) [15]. Thanks to its structure being rich in sulfur compounds, leek could be useful in having antibacterial properties (Venditti *et al.*, 2021) [15]. Polyphenols material of the plant vary from triphenolic acid and ananthochlorin to (Bernaert *et al.*, 2013) [1]. Hence, the objective of the study was to evaluate the possibility of utilization of leek powder in unique proportions in rat diet for the obtaining of positive results in cadmium toxicifying and pathogenic effects in rats.

Materials and Methods

Preparation of medicinal plants

Leek leaves (*Allium porrum* L.) were collected from local grocery markets in Najaf, Iraq. The fresh fine leek leaves were selected, sorted, and washed with D.W three times (Pierart *et al.*, 2018) [11]. Then, the leaves were spread as a thin layer on perforated aluminium foil (5.50 m x 7.50 m) on the laboratory benches and left for 8 h to air dry at 28±2 °C. The dry leek material was processed by crushing and grinding to be mix with the regular feed (Razi Vaccine and Serum Research Institute, Karaj, Iran).

Cadmium source

Cadmium has been used as (CdCl₂) Gew.379.34 E. Merck, Darmstadt, Germany (Hirao-Suzuki *et al.*, 2021; Sola *et al.*, 2022; Wang *et al.*, 2017; Yuan *et al.*, 2021; Zheng *et al.*, 2020) [4, 12, 16, 18, 19]. Groups T (2, 3, 4) have been Intraperitoneal Injected (LD) Lethal dose) 0.4 mg /kg body weight, 5 times per week) (Hirao-Suzuki *et al.*, 2021; Sola *et al.*, 2022; Wang *et al.*, 2017; Yuan *et al.*, 2021; Zheng *et al.*, 2020) [4, 12, 16, 18, 19].

Experimental design and data analysis

We used 28 pairs of rats; the Sprague-Dawley male rats were about 150-180 grams each as our model (Razi Vaccine and Serum Research Institute, Karaj, Iran). The rats been divided into 4 groups of 7 and were kept separately in individual cages with dimensions measured from the side 380 mm by 200 mm to 590 mm (Sun, *et al.*, 2021; Ibiwoye, *et al.*, 2019) [13, 5]. Rats in the lab have dwelt for a week and named housed to permit them to acclimatize to their new environment (Wang *et al.*, 2017) [16]. With respect to this, Wang *et al.* (2017) [16] enlighten that the rats had been kept under care, inside the managed laboratory condition with a temperature of 22±2 °C, a humidity of 30-35% and a 12-hour light/dark cycle. The trial lasted eight weeks. Water could be consumed by all the groups in the laboratory who wanted them without being limited to a restricted allowance (Wang and co-workers, 2017) [16]. The treatment was to be allocated randomly to the four groups (Treatments). Traditional balance diets were solely infused either at T₁ (treatment) which were all cadmium-fed rats and at T₂ that have their leek leaf diet supplied with talcum powder in their normal feed (4 and 8 per cent mixture respectively) while treatments T₃ and T₄ were injected with specialists galvanised diet feed from which rats with 20% portion of leek leaf (20 The feed with being deprived of masticating into solids with appearance and consistency similar to the one in the usual eating manner as by accomplishing this requirement of using 0.6 litres per 1 kg feed, pressing in the moulds and serving out for rats. Weight of rats from various companies has been measured daily, fluctuations are marked in the quantity of food and water feed, and if any exceptions are noted, an investigation is held.

Experimental measurements

Blood tests

Each rat was given five milliliters of blood after being put to sleep (Lee *et al.*, 2017) [8]. The samples were separated using EDTA tubes with serum Sep clot activator. Kavush Laboratory and the National Iranian Standardization Organization tested the blood.

Alkaline Phosphate Determination:

The liver enzyme ALT (Alanine aminotransferase) was tested using the Commercial ALAT (GPT) Test base (DGKC) Method.

$$P - \text{Nitrophenyl phosphate} + H_2O \xrightleftharpoons{ATP} \text{Phosphate} + P - \text{Nitrophenol}$$
 (Mohamed Basuony, Ezar Hafez, Ehab Tousson, Ahmed Massoud, Samar Elsomkhraty and Zoology, 2018) [10].

The AST Determination

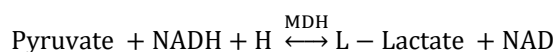
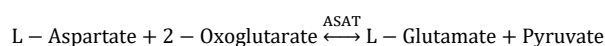
Aspartate aminotransferase (AST) was determined using the commercial method ASAT (cot) by the IFCC in order to quantify liver enzyme.

$$L - \text{Aspartate} + 2 - \text{Oxoglutarate} \xrightleftharpoons{ASAT} L - \text{Glutamate} + \text{Oxoglutarate}$$

$$\text{Oxoglutarate} + \text{NADH} + \text{H} \xrightleftharpoons{MDH} L - \text{Malate} + \text{NAD}$$

(Mohamed Basuony, Ezar Hafez, Ehab Tousson, Ahmed Massoud, Samar Elsomkhraty and Zoology, 2018) [10].

Alanine Aminotransferase (ALT) Assessment: The ALT (alanine aminotransferase) was tested using the commercial technique ALAT (GPT) by the IFCC to determine the liver enzyme.



Internal organs: kidneys, heart, testes, and liver

Following the experiment, the rats were put under anaesthesia and put to death by euthanasia and the weights of their internal organs were then calculated.

Statistical analysis

In this study, the interaction between the different dosages of leek leaf powder was investigated by topical tests utilizing a complete random design (CRD). Least significant difference (LSD) and general statistics (2012) were employed in the statistical analysis of the data reviewed to analyze statistically significant differences between the treatment averages.

Results

Internal organs

The analysis demonstrated that cubic lead-based rats with cadmium participated in the positive control resulting in destructive effects on the internal organs whose size was

abnormal as indicated by the different weight of kidneys (5.4 g), testes (5.1 g), liver (19.1 g), heart (0.8 g), and spleen (2.2 g) about the kidney weights of the From the outcomes, it was detected that rats from a T₃ or T₄ group (Supplementation with 20% or 30% leek powder, respectively) are resistant to cadmium negative effects. T₃ and T₄ increases in intraabdominal organ weight and led to kidney weights of 3.2 g and 3.6 g, testes weight of 5.4 g and 5.5 g, liver weight of 11.9 g and 12.1 g, heart weight of 1g and 0.9 g and spleen weights of 0.8 g and Table 1. Effect of injection with cadmium and feeding on a diet supplemented with leek (*Allium porrum* L.) powder on rat's Internal organs: 3 replications are things like Heart, abdominal, Kidney, and Testicles, *Values are means of this. Experiments will be carried out in seven different tanks with the first two tanks (T₁ and T₂) containing animals injected with cadmium and the third (T₃) and fourth (T₄) tanks containing cadmium-injected animals fed on a diet supplemented with 2% and 3% leek powder, respectively. The Duncan's Multiple Ranges test shows the "P=0.05" level is significantly differed by ($p \leq 0.05$) within a column in the case of the same letter or letters. The result of the analysis has found the weight quantities of kidneys, liver and spleen all rise, the evidence shows kidney poisoning, inflammation inside organs (Figure 1). The effect of cadmium on both the weight of the heart and testicles leads to a decrease in their weight, and this is evidence of a decrease in their efficiency and atrophy of these organs.

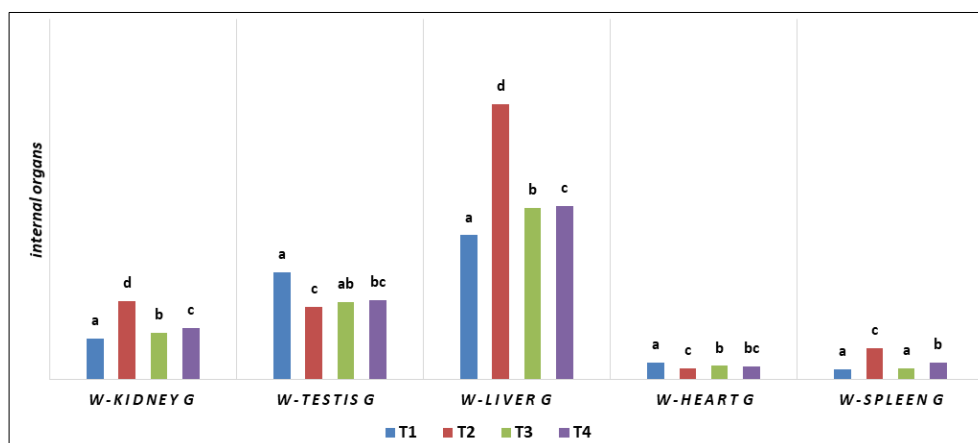


Fig 1: Shown evidence of a state of inflammation and poisoning at the level of the internal organs of the body.

Table 1: Effect of injection with cadmium and feeding on diet supplemented with leek (*Allium porrum* L.) powder on rat's internal organs: Heart, Liver, Spleen, Testicles, and Kidney

Treatments (T)	Parameters					
	Kidney weight	Testis Weight	Liver Weight	Heart weight	Spleen weight	
T ₁	2.8a±0	7.5a±0	10.0a±0	1.2a±0	0.7a±0	
T ₂	5.4d±0	5.1 c±0	19.1d±0	0.8c±0	2.2c±0	
T ₃	3.2b±0	5.4ab±0	11.9b±0	1.0b±0	0.8a±0	
T ₄	3.6c±0	5.5bc±0	12.1c±0	0.9bc±0	1.2b±0	
P-Value	Treatment	<.0001	<.0001	<.0001	<.0001	<.0001
	Time (Ti)	<.0001	<.0001	<.0001	<.0001	<.0001
	T*Ti.	<.0001	<.0001	<.0001	<.0001	<.0001

*Values are means of 3 replications. Treatments are control (T₁), positive control T₂ (animal injected with cadmium), and T₃ and T₄ for cadmium-injected animals fed on a diet supplemented with 2% and 3% leek powder, respectively. Means followed by the different letter(s) with in a column are significantly different according to Duncan's multiple ranges test ($p \leq 0.05$)

Figure 1. Cadmium negative effect on the rat's internal organs weights. *Values are means of 3 replications. Treatments are control (T₁), positive control T₂ (animal

injected with cadmium), and T₃ and T₄ for cadmium-injected animals fed on a diet supplemented with 2% and 3% leek powder, respectively. Bars that have different letter

(s) are significantly different according to Duncan's multiple ranges test ($p \leq 0.05$).

Blood cadmium levels and liver enzymes (AST, ALT, and Alkaline Phosphatase)

It was observed that the highest levels of cadmium in rat's blood ($25.7 \mu\text{g/L}$) were recorded in T₂ (positive untreated control), while the control T₁ recorded $0.4 \mu\text{g/L}$ which was the lowest among the treatments. On the other hand, leek leaf powder was effective in decreasing cadmium levels in

rat's blood compared to T₂. The therapeutic treatments T₃ and T₄ resulted in cadmium levels of $5.3 \mu\text{g/L}$ and $5.6 \mu\text{g/L}$, respectively. The liver enzymes (AST, ALT, Alkaline Phosphatase) were highly affected by cadmium (Figure 2). Cadmium in the T₂ treatment led to a significant increase in the levels of these enzymes compared to the T₁ control and the groups fed on leek powder T₃ and T₄ treatments. The latter two treatments significantly lowered the enzyme levels (Table 2) under study.

Table 2: Cadmium negative effect on the rat's blood parameters: cadmium [$\mu\text{g/L}$], Alkaline Phosphatase, Alanine Transaminase and Aspartate Transaminase level.

Treatments (T)		Parameters			
		Cadmium [$\mu\text{g/L}$]	AST (U/l)	ALT (U/l)	ALP (IU/L)
T1		0.4a \pm 0	22.5a \pm 0	29.1a \pm 0	18.3a \pm 0
T2		25.7d \pm 0	60.1d \pm 0	117.0c \pm 0	49.0d \pm 0
T3		5.3b \pm 0	29.4b \pm 0	37.2b \pm 0	20.6b \pm 0
T4		5.6c \pm 0	33.7c \pm 0	37.9b \pm 0	21.3c \pm 0
P- Value	T	<.0001	<.0001	<.0001	<.0001
	Time	<.0001	<.0001	<.0001	<.0001
	T*Ti	<.0001	<.0001	<.0001	<.0001

*Values are means of 3 replications. Treatments are control (T₁), positive control T₂ (animal injected with cadmium), and T₃ and T₄ for cadmium-injected animals fed on a diet supplemented with 2% and 3% leek powder, respectively. Duncan's multiple ranges test indicates that the means in a column that are followed by a different letter or letters are statistically different ($p \leq 0.05$)

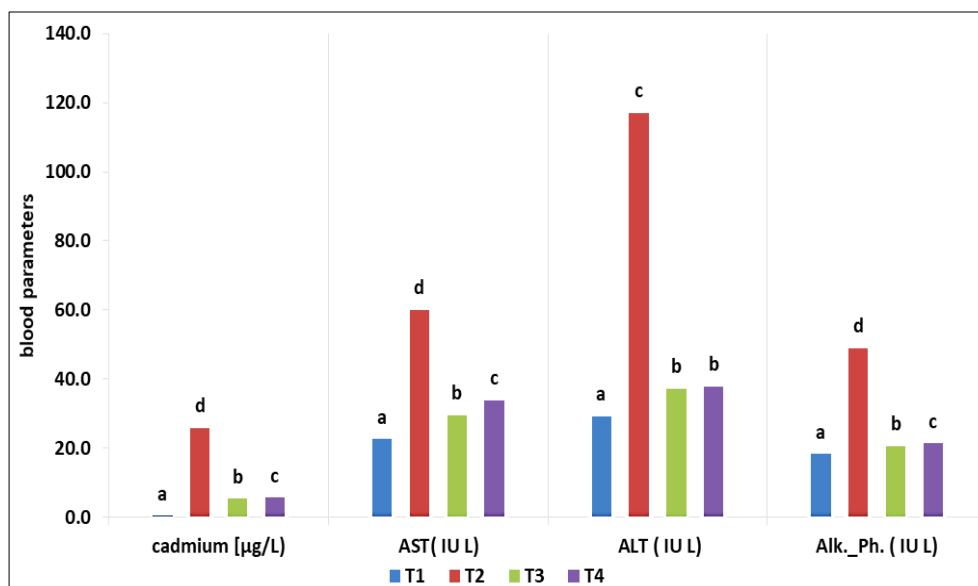


Fig 2: Cadmium negative effect on the rat's blood parameters: cadmium [$\mu\text{g/L}$], Alkaline Phosphatase (Alk. Ph), Alanine Transaminase (ALT) and Aspartate Transaminase (AST) level. Values are means of 3 replications. The animal injected with cadmium (positive control T₂), control (T₁), and cadmium-injected animals provided a meal supplemented with 2% and 3% leek powder, respectively, are the treatments. Duncan's multiple ranges test indicates that bars with distinct letter(s) are significantly different ($p \leq 0.05$)

Discussion

The discussion part could focus on the implications related to the results, showing the comparisons with the existing precedents, giving possible explanations for the observed effects and suggesting possible conclusions about the overall implications. This is the space for discussing your findings and the context of research questions as well as the chances to share others' insights and produce a more scientific view on a topic. Concerning the influence of cadmium on the targeted body organs that came out as

results in agreement position with other researches in the field by cadmium (Ibiwoye *et al.*, 2019; Wang *et al.*, 2017) [5, 16]. Your results discussion would detail the importance of this data, look at other works on the topic, give possible reasons for the findings and talk about the general implication these findings might have. This is the place to translate your findings in line with the primary research question and give as much of your own insight as you might into the whole scientific study of the motive considered. Apart from that, there are also other substantial aspects to

talk about such as how these results affect the field in particular and the applications that are possible in the future (Venditti *et al.*, 2021) [15].

Conclusion

The investigation showed the negative effects of cadmium on the weights of internal organs and various liver enzymes, in addition to the levels of cadmium in the blood. The study found that Leek powder has an effective role in reducing the effects caused by cadmium, the treatment T₄ showed very good results, while the best results were the result of T₃ in reducing those toxic effects of cadmium. These results showed the Leek important role for health by reducing the negative effects heavy metals (Cadmium).

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Authors' contributions

The authors collaborated with each other to complete the study. Mortada designed the study and supervised its implementation. Mortada and Ali performed the laboratory analyses, as well as preparing the manuscript first draft. Zinah and Hasan analyzed the data and reviewed the literature for this study. All authors have read the study (final version) and confirmed it for publication

Conflict of Interest

Neither the authors nor the researchers involved in this study have any financial or personal interests that could potentially lead to conflicts of interest. The research was conducted with a focus solely on contributing to the scientific knowledge and understanding within the field.

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