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Effects of Parsley Administration Preventing Lead-Induced Toxicity to Liver and Kidney Tissues

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Abstract

Lead is a heavy metal that pollutes the environment and has a variety of hazardous effects on the human body. The purpose of this research was to determine the protective effect of parsley leaf powder at various doses against lead acetate poisoning in the liver and kidney tissues of (Sprague – Dawley rats) which had significant liver tissue damage like (liquefactive necrosis, amyloidosis, Etc.) and kidney (blood vessel congestion, Etc.). Oral dosing of parsley powder reversed these lead-induced effects on liver and kidney tissues. This is the first study about parsley preventing effect lead-induced toxicity to liver and kidney tissues.

Keywords: Lead acetate; Parsley; Medicinal Plants; Kidney Damage; Liver Damage.

Highlights

Exposure to lead causes damage to kidney tissue.
Exposure to lead causes damage to liver tissue.
Parsley's resistance to lead in kidney and liver tissue damage, according to the different concentrations of parsley.
Renal and liver tissue response to parsley treatment.

1.Introduction

Lead (Pb) is one of the oldest environmental toxins with a great impact on humans it is a toxic abiotic metal[1], [2]. The presence of lead in the air, soil and water is due to the fact that lead is one of the elements of the earth's natural crust[2], [3]. Man used lead in many ancient industries (pipes, pottery and paint) and modern industries (batteries, pesticides, and other industries), which made lead impact on humans from an environmental and health increase significantly [4]. The quantities of lead used by humans in the twentieth century exceeded the amounts used over the previous centuries (combined)[5]. The sources of human exposure are varied, the most important of which are lead contamination of food and water, and inhalation of lead particles (car exhaust, mining)[6].

Lead is a cumulative toxicant because it is difficult to break down in the body, and small amounts are detrimental in the long run because of its accumulation, which may lead to behavioral problems, physiological disorders and biochemical problems for humans [2], [7]. Chronic exposure to lead affects the integrity of human systems and organs. Lead exposure

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weakens the nervous system and affects the kidneys and liver[8]. Lead has a negative effect on the soft tissues and internal organs of the human being, as well as it affects various blood variables and various enzymes, endocrine glands, the renal reproductive system, weakness of blood formation and gastrointestinal disorders [4]. Chronic exposure to lead has a significant impact on the cognitive and behavioral functions, especially for children, as well as a close association with cases of hearing loss, short periods of concentration and hyperactivity[9]. Lead affects not only mammals, but plants as well. The presence of lead nitrate in the soil causes a decrease in the soluble protein content of plants, especially parsley, and the presence of lead nitrate causes oxidative stress and a deficiency in the photosynthetic pigments of parsley leaves[10].There are many studies that examined the possibility of reducing or treating the negative effects of lead on general health and blood parameters of laboratory animals including the rodent [11] and fruit flies [9]. With regard to parsley and about its good effects on health. The use of parsley reduced the damage caused by cadmium to newborn mice, in terms of neuronal formation, oxidative stress and other damages[12]. The aqueous extract of the parsley plant contains a group of active compounds such as flavonoids, especially the aqueous extract of its flat leaves[13]. Parsley plays an important role as an antioxidant, especially scavenging free radicals[14]. The extract of parsley leaves was distinguished by providing the best results as an antibiotic for bacteria, as well as its protective role in human cells in terms of colon and rectal cancer due to its antioxidant activities[15]. As far as we know, the effect of parsley was not detected in reducing the toxic effects of lead on liver and kidney tissues in rats. We presumed that the negative effect of lead on the liver and kidneys could be histologically reduced in rats by using different concentrations of parsley powder. It probably that parsley works to modify and restore the histological state of the liver and kidneys in rats, which may provide a nutritional approach to reduce or limit lead poisoning. The aim of this study was to evaluate the effect of exposure to lead on the tissues of the liver and kidneys and the extent of the protective efficacy of parsley powder at different concentrations.

2.Materials and Methods

2.1Animals and general experimental procedure

In view of the great importance of the internal organs referred to above and the impact of environmental pollution, especially with lead, in addition to the many advantages of the plant (parsley) as mentioned in the introduction, it is very important to study whether this plant (parsley) has a positive effect on resisting the negative effect of lead acetate on liver tissues and the kidneys. This study was conducted in the laboratories of the University of Tehran using 28 male Sprague Dawley rats (about 90–100 g body weight) (Razi Vaccine and Serum Research Institute). All the animals were weighed and observed in individual polypropylene cages (380 mm × 200 mm × 590 mm). The rats were kept in a room at a temperature of 22 ± 2 °C and light cycle (12 h light/12 h dark)[16], [17]. were bred for 8 weeks. Rats were randomly distributed into four groups, depending on feeding. The first group (T1) was treated as a control group with free access to regular food as well as distilled water; group T2 was treated as a negative control group, meaning it was provided with regular fodd (Alborz

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Province, Karaj, Hesarak, Iran) and distilled water + lead acetate 0.46% (Merck, Darmstadt - Germany 539924) with the possibility of supplying water freely. The therapeutic feeding groups (T3, T4) were provided with distilled water containing lead acetate 0.46%. As for the food, a special diet was formed for it from regular food, in addition to different concentrations of parsley powder at the rate of (T3) 4% parsley and (T4) 2%.

2.2 Preparation of parsley powder

Parsley was chosen as a functional food in this study and was obtained from local markets in Najaf, Iraq. Parsley leaves were thoroughly washed with distilled water and were spread in a thin layer on perforated aluminum foil (5.50 m×7.50 m)(Eshtehard Industrial Estate, Iran) on the room floor and left at a controlled temperature of 22 ° C for 5 days until the final drought status. After the leaves dried, they were ground in a home mill and the resulting powder was mixed in different concentrations with the components of the regular fodd (after it was also ground) according to the treatment. In (T3 parsley 4%) 120 gm of parsley powder was mixed with 2880 gm of regular fodd powder either (T4 parsley 2%), the added amount of parsley powder is 120 gm to 2880 gm of regular fodd powder. to reforming and converting powder mixtures into a moldable paste, 4250 ml of distilled water was added to each mixture separately, then the dough was formed in the fingers form and transferred to the drying room, and after 96 hours had passed, the fodd for this study was obtained. The experimental animal's diet was administered with an average of (20 g / week) of the special diets for each of the four treatments.

2.3 Preparation of Histological sections

In the laboratories of Tehran University (Iran - Karaj), after the rats were anesthetized by (Diethyl ether, Merck KgaA,64271, Darmstadt -Germany), liver and kidney tissues were prepared (slides) According to the method [18], tissue sections were prepared and examined for the purpose of identifying the damages caused by lead to the tissues of the liver and kidneys. The sections are stained by haematoxylin and eosin (H&E) stain. captured using light microscope with digital camera via 10 magnifiers. The section is stained by haematoxylin and eosin (H&E) stain. via 10 magnifiers.

3. Results

3.1. Liver tissue Results

As far as liver tissue is concerned, the results of the current study showed negative effects of lead acetate within the range (LD50) the treatment (T2) as shown in figure (1 b1). The figure indicates multiple necrotizing area (liquefactive necrosis) (Black arrow) and infiltration of structureless, pinkish, diffused, homogenous martial (amyloidosis, amyloid degeneration) (Yellow arrow). Figure 1 b2 shows severe blood vessel congestion with dilatation of hepatic vein diameters (black arrow) and increased vein wall thickness (Yellow arrow). Fibrous connective tissue was seen in the liver parenchyma (mild liver fibrosis) (Blue arrow), whereas the liver tissue of control treatment T1 (Figure 1a) (Histological section for rats in control group) showed a normal texture of liver parenchyma without any significant occupied lesion (SOL). The section is stained by haematoxylin and eosin (H&E) stain. The

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section is captured using light microscope with digital camera via 10 magnifiers. the parsley ameliorated effect on liver tissues exposed to lead acetate poisoning, it showed what was expected in terms of treatment results (T3, T4). The results of treatment (T3) for this study showed a clear development in liver tissue recovery (T3) (Figure 1c) (shows the normal hepatic tissue without any significant occupied lesion (SOL)). As for the best results of this study, they appeared through the results of (T4) (Figure 1d) (shows the normal texture of liver parenchyma without any significant occupied lesion (SOL), and the fourth treatment outperformed the third morphologically. Previous This study is the first in this field.

3.2. Renal tissue Results

This study showed results with a significant effect on kidney tissues after feeding the rats with lead acetate without therapeutic feeding (T2) Figure (2b1, 2b2) when compared to the control treatment (T1). (T2) Figure (2b1) shows sever blood vessels congestion (renal vein and artery, Black arrow) with glomerular tuft atrophy and increasing of glomerular space (blue arrow). The distal convoluting renal tubes shows sever hydropic degenerative lesion (yellow arrow). Figure (2b2) shows the glomerular tuft atrophy (glomeruli atrophic lesion, blue arrow) with increasing of glomerular space, there is a clear hemorrhage in the renal tissue section (yellow arrow). Therapeutic feeding of the (T3) led to much less damage and wonderful significant differences compared to (T2) , as in Figure (2c)shows the normal texture of renal tissue, the glomeruli are normal in their size and the glomerular tuft shows normal size and texture with normal glomerular capsule) Black arrow).The proximal convoluted tubules are normal in their size, diameter and texture with mild degenerative changes (Yellow arrow), while the best results for this study regarding kidney tissues were what was shown by the fourth treatment (t4), as noted in the figure (2c) (shows the normal glomeruli (yellow arrow) structure and texture with normal tuft size and capsule. The renal tubules are also normal in their size and texture. The best treatment in terms of the curative effect of parsley on kidney tissue is the fourth treatment (2% parsley), and this is the first study in this field.

4.Discussion

When discussing the results of this study, it is necessary to shed some light on the negative role of lead on health, which was indicated by previous studies. Lead is a rare and unnecessary heavy metal, but it is important from the health side because of its severe toxic effects. Lead has toxic effects on the internal organs, especially the liver and kidneys, from the functional and histological aspect of these organs. Lead has many mechanisms through which it accumulates in the liver and is associated with many compounds, the most important of which is glutathione, which leads to oxidative stress[19]. The accumulation of lead in the liver has an effect on lipid enhancement, inflammatory responses, oxidative stress and reactive oxygen species (ROS) [19]. Liver lead poisoning has physiological and histological variables and other obvious effects on rats[20], [21]. Lead acetate has an important role and a severe impact on the liver and kidneys in terms of oxidative stress and inflammation, as well as at the cellular and tissue level, such as congestion of blood vessels and necrosis of liver cells and kidneys, and consequently a decrease in the proliferation rate of fibrous tissues and organs referred to [22]. Lead poisoning of the kidneys leads to many structural and functional changes to the kidneys of rats [23]–[25]. Chronic exposure to lead has many indicators, the most important of which at the histological level in rats is proximal tubular degeneration [26].

Through the results of the current study, we find that many of the devastating effects of lead mentioned in the above studies have been confirmed, and even more so, especially with regard to the histological aspect of the liver and kidneys. Which confirms the danger of this element to health in general and the safety of the organs referred to (liver and kidneys) in particular, which highlights the importance of finding a new type of therapeutic nutrition (possible for everyone) that can reduce the toxic effects of lead. The current study indicates the important role of the parsley in improving the cellular tissue of liver cells and kidneys and reducing the dangerous effects of lead acetate poisoning on these organs. The application of treatment (T3) for this study led to amazing results in getting rid of the effects of lead acetate on liver tissue and cells (no negative signs appeared on tissue when compared to the control treatment), while the results of treatment (T3) were less impressive and did not differ from the treatment of (T1) Control in terms of renal tissue, except in the presence of (mild degenerative changes), and this in itself indicates the effective role of this treatment in avoiding the negative effects of lead acetate. Treatment (T4) shows the best results in terms of reducing the toxic and destructive effects of lead acetate on the tissues and cells of the liver and kidneys. No effect of the toxic effects of lead acetate on cells and tissues within this treatment appeared. Thus, we can indicate here that the desired goal of the study has been achieved, and that the best treatment in preventing the effects of lead is (T4). From the foregoing, this study is the first in this field.

5. Source of Support: Self

6.Ethical clearance: This study was conducted within university laboratories (University of Tehran, Iran) & Iranian National Standardization Organization.

7. Conflict of Interest – Nil

8.Conclusions:

After the results of the current study showed the devastating negative effects of lead at the tissue level Sprague-Dawley Rats, so it became necessary to find a diet that can be relied upon to reduce the risks of this metal as in the current study. After using different concentrations of parsley powder and the excellent results for it, we conclude that the diet containing different concentrations of parsley has a wonderful role in reducing toxicity as in (T3) at the histological level of the liver, while the treatment (T4) showed better results on the histological level of the liver and kidneys alike. This means that this natural medicinal plant (available at the disposal of everyone) has an important role in reducing the effects of pollution in heavy metals, and this is what we aspired to prove in this study.

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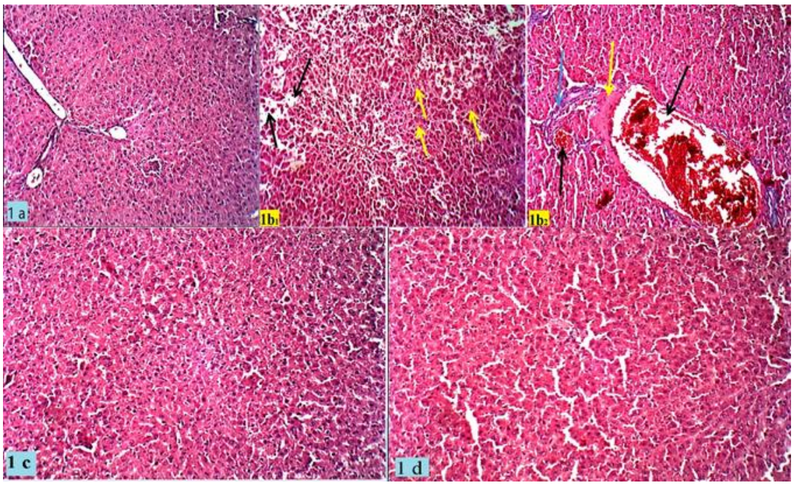

Figure 1; a. Histological section for rats in control group shows the normal texture of liver parenchyma without any significant occupied lesion (SOL). 1b$_1$ the histopathological section of liver (hepatic tissue) in rats of T_2 group shows multiple necrotizing area (liquefactive necrosis) (Black arrow) and infiltration of strectureless, pinkish, diffused, homogenous martial (amyloidosis, amyloid degeneration) (Yellow arrow). 1b$_2$ the histopathological section in liver of rats in T_2 group shows sever blood vessels congestion with dilatation of hepatic vein diameter (black arrow) and increasing of vein wall thickness (Yellow arrow). The fibrous connective tissue can be seen in the liver parenchyma (mild liver fibrosis) (Blue arrow). 1c the histopathological section in liver of rats in T_3 group shows the normal hepatic tissue without any significant occupied lesion (SOL). 1d Histopathological section for rats in T_4 group shows the normal texture of liver parenchyma without any significant occupied lesion (SOL). The sections are stained by haematoxylin and eosin (H&E) stain. The sections are captured using light microscope with digital camera via 10 magnifiers.

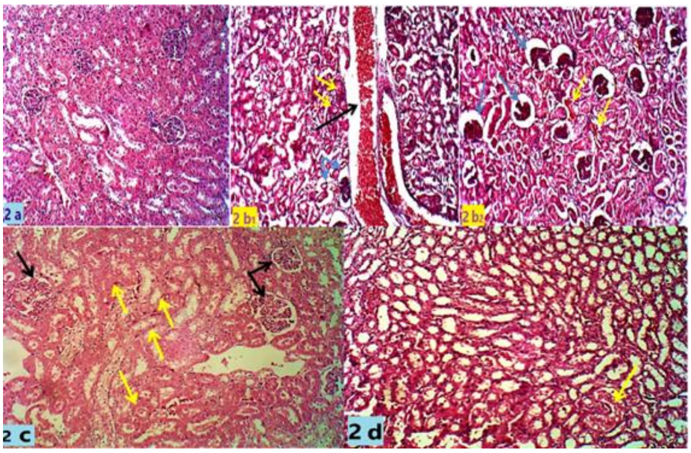

Figure 2; a. Histological section for rats in control group shows the normal texture of renal tissue without any significant occupied lesion (SOL). 2b$_1$ the T_2 group shows sever blood vessels congestion (renal vein and artery, Black arrow) with glomerular tuft atrophy and increasing of glomerular space (blue arrow), the distal convoluted renal tubules show sever hydropic degeneration lesion (yellow arrow). 2b$_2$ the T_2 group shows the glomerular tuft atrophy (glomeruli atrophic lesion, blue arrow) with increasing of glomerular space. There is a clear hemorrhage in the renal tissue section (yellow arrow). 2c the T_3 group shows the normal texture of renal tissue, the glomeruli are normal in their size and the glomerular tuft shows normal size and texture with normal glomerular capsule (Black arrow). The proximal convoluted tubules are normal in their size, diameter and texture with mild degenerative changes (Yellow arrow). 2d the T_4 group shows the normal glomeruli (yellow arrow) structure and texture with normal tuft size and capsule. The renal tubules are also normal in their size and texture. The sections are stained by haematoxylin and eosin (H&E) stain. The sections are captured using light microscope with digital camera via 10 magnifiers.