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Hepatoprotective Effect of Radish (Leaves and Roots) in CCl_4 Induced Hepatic rats

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Abstract

Effect of different concentrations 2.5 and 5 % of radish leaves and roots as powder on biological and biochemical changes of hepatic rats was investigated. Sixty three male Albino rats were used and divided to 6 groups, each group (6) rats. The rats treated with carbon tetra chloride (CCl_4). Results indicated that the highest ALT liver enzyme of treated groups (hepatic groups) recorded for 2.5 % radish leaves, while the lowest value recorded for 5.0% radish roots with significant differences. The mean values were 133.0 and 87.0 U/L, respectively. The highest GOT and GPT liver enzyme of hepatic groups recorded for 2.5 % radish leaves, while the lowest value recorded for 5.0% radish roots with significant differences. The highest serum triglycerides and serum cholesterol levels of hepatic groups recorded for 2.5% radish leaves, while the lowest value recorded for 5.0 % radish roots with no significant differences. On the other hand, the highest high density lipoprotein cholesterol levels of hepatic groups recorded for 5.0 % radish roots, while the lowest value recorded for 2.5% radish leaves with significant differences. The *verse versa* recorded for LDL-c and VLDL-c. Also, the highest glucose levels of treated groups (hepatic groups) recorded for 2.5 % radish leaves, while the lowest value recorded for 5.0% radish roots with significant differences. The highest serum urea, uric acid and creatinine levels of hepatic groups recorded for 2.5% radish leaves, while the lowest value recorded for 5.0 % radish roots with significant differences. As conclusion, 5% radish leaves and roots recorded the best levels for hepatoprotective, improvement lipid profile, kidney functions and glucose levels.

Key words: Chicory, Thyme, Healthy liver and Rats.

Introduction

Liver is a major site of metabolism and excretion. It is continuously exposed to xenobiotics which result in a variety of serious liver disorders. Plant based formulations are frequently employed for the liver diseases, but there are few effective suitable drugs available **(Chaterrjee, 2000)**.

The liver is a vital organ that plays a central role in transforming and clearing chemicals and is susceptible to the toxicity from these agents; therefore it is an important target organ of the toxicity of drugs, xenobiotics, and oxidative stress. Hepatotoxicity is presently the most widespread pathology worldwide, representing up to 83% of all cases and the most serious health problems. Free radicals and reactive oxygen species are increasingly believed to play a crucial role in the initiation and progression of liver diseases, independent of the original causal agent. Carbon tetrachloride (CCl_4) is a selective hepatotoxic chemical agent that is metabolized by the cytochrome P450 into highly reactive metabolites including trichloromethyl free radical (CCl_3•) and trichloromethylperoxy radical (CCl_3O_2•) (**Al-Harbi *et al.*, 2014)**.

The plant-based hepatoprotective agents or drugs contains diversity of major active constituents such as phenols, coumarins, lignans, terpenoids, carotenoids, glycosides, flavonoids, organic acids, alkaloids and xanthenes. Several phytomolecules have been reported as having potent hepatoprotective principles. So, investigations into the lead molecules, that may produce better therapeutic effects, is required to overcome the pharmaceutical imbalance between remedies that protect the liver and drugs that induce hepatotoxicity **(Ahmed *et al.*, 2008)**.

Epidemiological studies have shown that consumption of fruits and vegetables is associated with reduced risk of chronic diseases. Hepatic dysfunction due to ingestion or inhalation of hepatotoxins such as acetaminophen, cadmium chloride, ethanol, carbon tetrachloride (CCl_4) and allyl alcohols are increasing worldwide. Carbon tetrachloride is metabolized by cytochrome P450 in the liver cell endoplasmic reticulum leading to the generation of an unstable complex of CCl3 radical, which reacts rapidly with O_2 to yield highly reactive hepatotoxic trichloromethyl peroxy radical **(Cha *et al.*, 2010)**.

Carbon tetrachloride is used as a solvent in synthetic chemistry research. It is one of the most potent hepatotoxins and is widely used in scientific research to evaluate hepatoprotective agents **(Seifert *et al.*, 1994).**

Radish (*Raphanus sativus*, L.) commonly known as radish is a member of the *Brassicaceae* family. It is an essential vegetable crop in India. It is thought to have originated in southern China from where it

has spread to Japan and other parts of Asia. Its roots, leaves and fruits are edible. All parts of this plant have immense ethno medicinal uses. Some of the activities shown by this plant are anticancer, antimicrobial, anti-diabetic, diuretic, anti-fertility, hypertensive, antimicrobial, nephro-protective, gastro protective and hepatoprotective **(Anwar and Ahmad, 2006)**.

It has been used as a medicinal plant from a long time. It has laxative effects on intestine and acts as an appetizer, used for curing liver dysfunction and poor digestion, acts as antioxidant, anti-tumorigenic, anti-mutagenic, anti-diabetic, and anti-proliferative. It is also very well known for its use in the treatment of bronchitis and diarrhea **(Lugasi *et al.*, 2005)**.

A number of plants contain substances that can protect or treat hepatic injury and several agents with the ability to protect liver toxicity have been isolated from plants. One of these plants is radish which is gaining much attention **(Curtis, 2003)**.

Lee *et al.*, (2012) evaluated the hepatoprotective activity of radish (*Raphanus sativus*) enzyme extract (REE) *in vitro* and *in vivo* test. The results showed that the radish enzyme extract has a protective effect on tacrine-induced hepatotoxicity in HepG2 cells and the administration of REE prevented biochemical and histomorphological alteration induced by CCl_4. The findings support the use of REE for the improvement of liver disorders because enzyme extraction is after than methanol extraction in toxicity.

The powered of radish leaves as well as its aqueous and ethanolic extracts were found to have hepatoprotective effect against paracetamol induced hepatotoxicity. Its aqueous leaf extract was found to show hypertensive and vasoconstrictor effect, while the ethyl acetate extracts of its leaves was found to have antihypertensive effect by increasing the activities of antioxidant enzymes **(Chung *et al.*, 2012)**.

Al-Showiman, and Marshall, (2002) reported that crude extract of radish seed in dose of (600 and 800 mg/kg) may be good enough to protect liver damage induced by CCL_4.

This work was conducted to study the effect of different concentrations of radish leaves and roots as powder on biological and biochemical changes of hepatic rats.

Materials And Methods

Materials

Source Of Radish

Commercially dried & ground radish (*Chicorium intybes*) leaves and roots were obtained from local market in 2016 from local market at Menoufia Governorate, Egypt.

Experimental animals

A total of 36 adult normal male albino rats Sprague Dawley strain weighing 140±10 g were obtained from Vaccine and Immunity Organization, Ministry of Health, Helwan Farm, Cairo, Egypt.

Cholesterol powder:

Pure white crystalline cholesterol powder and saline solutions were purchased from SIGMA Chemical Co., (USA).

Casein, cellulose, choline chloride, and DL Methionine

Casein, cellulose, choline chloride powder, and DL methionine powder, were obtained from Morgan Co. Cairo, Egypt.

The chemicals and chemical kits

Chemical kits used in this study (TC, TG, HDL-c, ALT, AST, ALP, bilirubin, urea, creatinin, albumin) were obtained from AlGomhoria Company, Cairo, Egypt. While, malondialdehyde kits was obtained from SIGMA Chemical Co., Cairo, Egypt.

Methods

Preparations of radish

To prepare the dried radish leaves and roots powder, leaves and roots were washed thoroughly under running tap water, shade dried, and ground to a fine powder using an air mill, high speed mixture (Molunix, Al-Araby, company, Egypt, and then serving as powder seize.

Experimental design

Sixty three adult male white albino rats, Sprague Dawley Strain, 10 weeks age, weighing (140±10g) were used in this experiment. All rats were fed on basal diet (casein diet) prepared according to **American Institute of Nutrition (AIN) (1993)** for 7 consecutive days. After this adaptation period, rats were divided into 6 groups, six rats per each as follows: group (I): rats fed on basal diet as negative control. Group (2): injected by 0.2 ml/100 g body weight of 40 ml/l CCl_4 (Morgan Chemical Factory, Egypt) dissolved in paraffin oil (Morgan Chemical Factory, Egypt) (**Dong *et al.*, 2005)**. Carbon tetrachloride was injected three times per week for 6 consecutive weeks and used as a positive control group. Group (3): group hepatic rats fed on radish leaves as powder by 2.5% (of diet) of the weight of the rat. Group (4): group hepatic rats fed on radish leaves as powder by 5% (of diet) of the weight of the rat. Group (5): group hepatic rats fed on the radish roots 2.5% (of diet) of the weight of the rat. Group (6): group hepatic rats fed on the radish roots 5% (of diet) of the weight of the rat. During the experimental period, the experiment continued for 28 days, at the end of the experimental period each rat weight separately then, rats are slaughtered and blood samples collected.

Blood sampling

After fasting for 12 hours, blood samples were obtained from hepatic portal vein at the end of each experiment. Two kinds of blood samples were taken. The blood samples were collected into a dry clean centrifuge glass tubes and left to clot in water bath (37°C) for 30 minutes, then centrifuged for 10 minutes at 2000 rpm to separate the serum, which were carefully aspirated and transferred into clean cuvette tube and stored frozen in deep freezer till analysis.

Biochemical Analysis

Lipids profile

Serum total cholesterol was determined according to the colorimetric method described by **Thomas (1992)**.

Serum triglycerides

Serum triglycerides was determined by enzymatic method using kits according to the **Young, (1975) and Fossati, (1982)**.

High density lipoprotein (HDL-c)

HDL-c was determined according to the method described by **Fredewaid (1972) and Grodon and Amer (1977)**.

Very low density lipoprotein cholesterol (VLDL-c)

VLDL-c was calculated in mg/dl according to **Lee and Nieman (1996)** was using the following formula:

VLDL-c (mg/dl) = Triglycerides / 5

Calculation of Low density lipoprotein cholesterol (LDL-c)

LDL-c was calculated in mg/dl according to **Lee and Nieman (1996)** as follows:

LDL-c (mg/dl) = Total cholesterol – HDL-c – VLDL-c

Liver functions

Determination of serum alanine aminotransferase (ALT), serum asparatate aminotransferase (AST), serum alkaline phosphatase (ALP) were carried out according to the method of **Clinica Chimica Acta, (1980)**, **Hafkenscheid (1979) and Moss (1982**), respectively.

Kidney functions

Serum urea

Serum urea was determined according to the enzymatic method of (**Patton and Crouch ,1977**). Serum uric acid was determined calorimetrically according to the method of **Barham and trinder (1972)**.

. Creatinine was determined according to kinetic method of (**Henry, 1974**).

Blood glucose

Enzymatic determination of plasma glucose was carried out calorimetrically according to the method of **Tinder (1969).**

Statistical analysis

The data were analyzed using a completely randomized factorial design **(SAS, 1988)** when a significant main effect was detected. The means were separated with the Student-Newman-Keuls Test. Differences between treatments at $P \leq 0.05$ were considered significant using Costat Program. Biological results were analyzed by One Way ANOVA.

Results And Discussion

Effect of radish leaves and roots on liver functions levels of hepatic rats:

Data given in Table (1) show the effect of radish leaves and roots on liver functions levels (ALT, GOT and GPT) of hepatic rats. It is clear to mention that the highest ALT liver enzyme levels recorded for positive control group, while negative control group recorded the lowest value with significant differences. The mean values were 195.0 and 93.0 U/L, respectively. On the other hand, the highest ALT liver enzyme of treated groups (hepatic groups) recorded for 2.5 % radish leaves, while the lowest value recorded for 5.0% radish roots with significant differences. The mean values were 133.0 and 87.0 U/L, respectively. In case of GOT liver enzyme, the highest levels recorded for positive control group, while negative control group recorded the lowest value with significant differences. The mean values were 54.82 and 8.22 U/L, respectively. On the other hand, the highest GOT liver enzyme of treated groups (hepatic groups) recorded for 2.5 % radish leaves, while the lowest value recorded for 5.0% radish roots with significant differences. The mean values were 38.40 and 16.21 U/L, respectively. In case of GPT liver enzyme, the highest levels recorded for positive control group, while negative control group recorded the lowest value with significant differences. The mean values were 19.70 and 5.50 U/L, respectively. On the other hand, the highest GOT liver enzyme of treated groups (hepatic groups) recorded for 5 % radish leaves, while the lowest value recorded for 5.0% radish roots with significant differences. The mean values were 9.93 and 5.00 U/L, respectively. These results are in agreement with **Lee *et al.*, (2012),** they reported that radish enzyme extract (REE) has a protective effect on tacrine-induced hepatotoxicity in HepG2 cells and the administration of REE prevented biochemical and histomorphological alteration induced by CCl_4. The findings support the use of REE for the improvement of liver disorders because enzyme extraction is safer than methanol extraction in toxicity.

Effect of radish leaves and roots on serum triglycerides and serum total cholesterol levels of hepatic rats:

Data presented in Table (2) show the effects of radish leaves and roots on serum triglycerides and serum total cholesterol levels of hepatic rats. The obtained results indicated that the highest serum

triglycerides levels recorded for positive control group, while negative control group recorded the lowest value with significant differences. The mean values were 133.15 and 53.81 mg/dl, respectively. On the other hand, the highest serum triglycerides levels of treated groups (hepatic groups) recorded for 2.5% radish leaves, while the lowest value recorded for 5.0 % radish roots with no significant differences. The mean values were 76.33 and 55.63 mg/dl, respectively. In case of serum total cholesterol levels, it could be concluded that the highest serum triglycerides levels recorded for positive control group, while negative control group recorded the lowest value with significant differences. The mean values were 138.0 and 92.0 mg/dl, respectively. On the other hand, the highest serum cholesterol levels of treated groups (hepatic groups) recorded for 2.5% radish leaves, while the lowest value recorded for 5.0 % radish roots with significant differences. The mean values were 128.0 and 101.0 mg/dl, respectively. These results are in agreement with **Torres-Duran *et al*., (1998)** they reported that levels of TG and TC in the liver also have been estimated to explain the status of liver. High level of TG and TC in the liver is the indication of the liver injury. They also indicated that TC and TG increased in CCl4-induced fatty liver.

Effect of radish leaves and roots on serum lipid profile levels of hepatic rats:

Data presented in Table (3) show the effects of radish leaves and roots on high density lipoprotein cholesterol (HDL-$_C$), low density lipoprotein cholesterol (LDL-$_C$) and very low density lipoprotein cholesterol (VLDL-$_C$), levels of hepatic rats. The obtained results indicated that the highest high density lipoprotein cholesterol levels recorded for negative control group, while positive control group recorded the lowest value with significant differences. The mean values were 43.05 and 27.67 mg/dl, respectively. On the other hand, the highest high density lipoprotein cholesterol levels of treated groups (hepatic groups) recorded for 5.0 % radish roots, while the lowest value recorded for 2.5% radish leaves with significant differences. The mean values were 45.51 and 37.61 mg/dl, respectively. Data also indicated that the highest low density lipoprotein cholesterol levels recorded for positive control group, while negative control group recorded the lowest value with significant differences. The mean values were 83.70 and 38.19 mg/dl, respectively. On the other hand, the highest low density lipoprotein cholesterol levels of treated groups (hepatic groups) recorded for 2.5% radish leaves, while the lowest value recorded for 5.0 % radish roots with significant differences. The mean values were 75.12 and 44.36 mg/dl, respectively. In case of very low density lipoprotein cholesterol levels, it could be concluded that the highest VLDL-c levels recorded for positive control group, while negative control group

recorded the lowest value with significant differences. The mean values were 26.63 and 10.76 mg/dl, respectively. On the other hand, the highest low density lipoprotein cholesterol (VLDL-c) levels of treated groups (hepatic groups) recorded for 2.5% radish leaves, while the lowest value recorded for 5.0 % radish roots with significant differences. The mean values were 15.27 and 11.13 mg/dl, respectively. These results are in agreement with **Wu *et al.*, (2008)**, they reported that the extract of radish stimulate stomach and intestinal vermicular motion, this shortens the retention time of dietary lipid in the digestion system. This may help avoid the accumulation of lipid (LDL-c and VLDL-c) in liver.

Effect of radish leaves and roots on glucose levels of hepatic rats:

Data presented in Table (4) show the effect of radish leaves and roots on glucose levels of hepatic rats. It is clear to notice that the highest glucose levels recorded for positive control group, while negative control group recorded the lowest value with significant differences. The mean values were 130.0 and 108.0 mg/dl, respectively. On the other hand, the highest glucose levels of treated groups (hepatic groups) recorded for 2.5 % radish leaves, while the lowest value recorded for 5.0% radish roots with significant differences. The mean values were 123.50 and 108.10 mg/dl, respectively. These results are in agreement with **Saleem (2017)**, they reported that radish were found to be beneficial for diabetic conditions. Radish seeds were found to ameliorate insulin resistance and enhance glucose uptake, while radish leaves were found to reduce intestinal glucose absorption.

Effect of radish leaves and roots on kidney functions (serum urea, serum uric acid and serum creatinine) levels of hepatic rats:

Data given in Table (5) show the effects of radish leaves and roots on kidney functions (serum urea, serum uric acid and serum creatinine), levels of hepatic rats. The obtained results indicated that the highest serum urea levels recorded for negative control group, while positive control group recorded the lowest value with significant differences. The mean values were 71.65 and 40.20 mg/dl, respectively. On the other hand, the highest serum urea levels of treated groups (hepatic groups) recorded for 2.5% radish leaves, while the lowest value recorded for 5.0 % radish roots with significant differences. The mean values were 58.03 and 44.25 mg/dl, respectively. The obtained results showed that the highest serum uric acid levels recorded for positive control group, while negative control group recorded the lowest value with significant differences. The mean values were 3.47 and 1.61 mg/dl, respectively. On the other hand, the highest serum uric acid levels of treated groups (hepatic groups) recorded for 2.5% radish leaves, while the lowest value recorded for 5.0 % radish roots with significant differences. The mean values were 2.41 and 1.77 mg/dl, respectively.

The obtained results showed that the highest serum creatinine levels recorded for positive control group, while negative control group recorded the lowest value with significant differences. The mean values were 8.17 and 3.60 mg/dl, respectively. On the other hand, the highest serum creatinine levels of treated groups (hepatic groups) recorded for 2.5% radish leaves, while the lowest value recorded for 5.0 % radish roots with significant differences. The mean values were 5.80 and 4.14 mg/dl, respectively. These results are in agreements with **Kishor *et al.*, (2013)**, they reported that administration of radish juices to dimethoate intoxicated mice restored these altered biochemical parameter levels to within normal limits and improved kidney dysfunction. This could be due to the phytoconstituents detected in the plant materials of radish juices which may be responsible for their nephroprotective activity. In addition, these bioactive molecules also possess antioxidant activity.

Table (1): Effect of radish leaves and roots on liver functions (ALP, GOT and GPT) of hepatic rats

Groups	(ALT) U/L	(GOT) U/L	(GPT) U/L
G_1 C (-)	$93^{e} \pm 1.70$	$8.22^{f} \pm 1.10$	$5.50^{d} \pm 0.80$
G_2 C (+)	$175^{a} \pm 0.90$	$54.82^{a} \pm 1.35$	$19.70^{a} \pm 0.40$
G_3 (2.5% radish leaves)	$133^{b} \pm 2.10$	$38.4^{b} \pm 2.05$	$8.20^{c} \pm 1.20$
G_4 (5% radish leaves)	$121^{c} \pm 0.50$	$30.0^{c} \pm 0.60$	$9.93^{b} \pm 0.90$
G_5 (2.5% radish roots)	$103^{d} \pm 1.10$	$26.15^{d} \pm 1.25$	$7.81^{c} \pm 0.50$
G_6 (5% radish roots)	$87^{f} \pm 0.80$	$16.21^{e} \pm 0.90$	$5.0^{d} \pm 0.60$
LSD	**2.30**	**2.23**	**1.15**

Mean under the same column bearing different superscript letters are different significantly
($P < 0.05$).

Table (2) Effect of radish leaves and roots on serum triglyceridesand serum total cholesterol of hepatic rats

Groups	Triglycerides mg/dl	Total cholesterol mg/dl
G_1 C (-)	$53.81^{e} \pm 0.52$	$92.00^{f} \pm 0.70$
G_2 C (+)	$133.15^{a} \pm 3.81$	$138.00^{a} \pm 1.10$
G_3 (2.5% radish leaves)	$76.33^{b} \pm 1.10$	$128.00^{b} \pm 0.30$
G_4 (5% radish leaves)	$68.14^{c} \pm 2.15$	$126.00^{c} \pm 0.50$
G_5 (2.5% radish roots)	$58.42^{d} \pm 0.70$	$105.00^{d} \pm 0.60$
G_6 (5% radish roots)	$55.63^{de} \pm 2.66$	$101.00^{e} \pm 0.80$
LSD	**3.65**	**1.34**

Mean under the same column bearing different superscript letters are different significantly ($p < 0.05$).

Table (3): Effect of radish leaves and roots on high density lipoprotein cholesterol ($HDL\text{-}_C$), low density lipoprotein cholesterol (LDL_{-C}) and very low density lipoprotein cholesterol ($VLDL_{-C}$), of hepatic rats

Groups	Parameters		
	$HDL\text{-}_C$ (mg/dl)	LDL_{-C} (mg/dl)	$VLDL_{-C}$ (mg/dl)
G_1 C (-)	$43.05^{ab} \pm 2.80$	$38.19^{e} \pm 0.93$	$10.76^{d} \pm 0.69$
G_2 C (+)	$27.67^{d} \pm 1.71$	$83.70^{a} \pm 1.58$	$26.63^{a} \pm 1.20$
G_3 (2.5% radish leaves)	$37.61^{c} \pm 0.50$	$75.12^{b} \pm 2.41$	$15.27^{b} \pm 0.90$
G_4 (5% radish leaves)	$40.46^{bc} \pm 1.38$	$71.90^{b} \pm 0.83$	$13.64^{bc} \pm 1.60$
G_5 (2.5% radish roots)	$39.94^{c} \pm 0.90$	$53.38^{c} \pm 1.91$	$11.68^{cd} \pm 1.72$
G_6 (5% radish roots)	$45.51^{a} \pm 1.9$	$44.36^{d} \pm 2.15$	$11.13^{cd} \pm 2.20$
LSD	**3.00**	**3.20**	**2.60**

Mean under the same column bearing different superscript letters are different significantly ($p < .05$).

Table (4): Effect of radish leaves and roots on glucose levels hepatic rats

Groups	Glucose (mg/dl)
G_1 C (-)	$108.00^{e} \pm 0.70$
G_2 C (+)	$130.00^{a} \pm 1.10$
G_3 (2.5%radish leaves)	$123.50^{b} \pm 0.90$
G_4 (5%radish leaves)	$114.20^{c} \pm 0.80$
G_5 (2.5%radish roots)	$110.70^{d} \pm 0.50$
G_6 (5%radish roots)	$108.10^{e} \pm 0.40$
LSD	**1.37**

Mean under the same column bearing different superscript letters are different significantly ($P < 0.05$).

Table (5): Effect of radish leaves and roots on serum urea, serum uric acid and serum creatinine of hepatic rats

Groups	Urea (mg/dl)	Uric acid (mg/dl)	Creatinine (mg/dl)
G_1 C (-)	$40.20^{e} \pm 1.10$	$1.61^{b} \pm 0.10$	$3.60^{d} \pm 0.27$
G_2 C (+)	$71.65^{a} \pm 2.20$	$3.47^{a} \pm 0.60$	$8.17^{a} \pm 1.56$
G_3 (2.5% radish leaves)	$58.03^{b} \pm 1.10$	$2.41^{ab} \pm 40$	$5.80^{b} \pm 0.21$
G_4 (5% radish leaves)	$56.27^{b} \pm 0.50$	$2.10^{b} \pm 0.20$	$4.93^{b} \pm 0.70$
G_5 (2.5% radish roots)	$48.96^{c} \pm 1.30$	$1.94^{b} \pm 1.20$	$4.92^{c} \pm 0.53$
G_6 (5% radish roots)	$44.25^{d} \pm 0.30$	$1.77^{b} \pm 0.10$	$4.14^{cd} \pm 0.14$
LSD	**3.36**	**1.18**	**1.21**

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التأثير الحافظ للكبد لأوراق وجذور الفجل فى الفئران المصابة بالكبد المستحث برابع كلوريد الكربون

عادل عبد المعطى أحمد ـ عماد محمد الخولى ـ أميرة صلاح إبراهيم
قسم التغذية وعلوم الأطعمة- كلية الأقتصاد المنزلى ـ جامعة المنوفية

الملخص العربى:

تم دراسة تأثير تركيزات مختلفة ٢,٥ , ٥٪ من أوراق جذور الفجل على شكل مسحوق على التغيرات البيولوجية والكيميائية الحيوية فى الفئران المصابة بالكبد بواسطة رابع كلوريد الكربون . حيث تم استخدام ستة وثلاثون من ذكور الفئران من نوع الألبينو وقسمت إلى ٦ مجموعات، كل مجموعة بها (٦) فئران .فئران. وأشارت النتائج المتحصل عليها أن أعلى قيم لإنزيم الكبد (ALT) من المجموعات المصابة بالكبد سجل مع تركيز ٢,٥٪ من مسحوق أوراق الفجل، في حين سجلت أقل قيم لجذور الفجل كانت مع تركيز ٥٪ مع وجود فرق معنوى .حيث كان متوسط القيم ١٣٣ , ٨٧ وحدة /لتر على التوالي .بينما سجلت أعلى قيم لانزيمات الكبد (GOT & GPT) مع تركيز ٢.٥٪ من الفجل, في حين سجلت أقل قيمة مع تركيز ٥٪ من جذور الفجل مع وجود فرق معنوى .سجلت أعلى قيم من الدهون الثلاثية و الكوليسترول في الدم من المجموعات المصابة بالكبد مع تركيز ٢.٥٪ من أوراق الفجل في حين سجلت أقل قيم لجذور الفجل كانت مع تركيز ٥٪ مع عدم وجود فروق معنوية. من ناحية أخرى، سجلت أعلى مستويات الكولسترول عالي الكثافة من المجموعات المصابة بالكبد مع تركيز ٥٪ من جذور الفجل, في حين أن أقل قيم سجلت مع تركيز ٢,٥٪ مع وجود فروق معنوية. والعكس صحيح مع قيم الكولسترول منخفض الكثافة و الكولسترول منخفض الكثافة جدا. كما سجلت أعلى مستويات من الجلوكوز لمجاميع الفئران المصابة بالكبد مع أوراق الفجل بنسبة ٢,٥٪، في حين سجلت أقل قيمة لجذور الفجل بتركيز ٥٪ مع وجود فروق معنوية .سجلت أعلى مستويات لكلا من اليوريا، وحمض اليوريك والكرياتينين لمجاميع الفئران المصابة بالكبد لأوراق الفجل بتركيز ٢,٥٪، في حين سجلت أقل قيمة لجذور الفجل بتركيز ٥٪ مع وجود اختلافات كبيرة .وخلاصة القول أن تركيز ٥٪ من أوراق وجذور الفجل سجلت أفضل مستويات ل للمحافظة على صحة الكبد، وتحسين صورة دهون الدم ووظائف الكلى ومستوى الجلوكوز.

الكلمات الدالة: أوراق الفجل ـ جذور الفجل ـ صحة الكبد ـ الفئران.