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The potential white radish roots and leaves as anti-hepatotoxicity in experimental rats

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Abstract:

The aim of this study is to ascertain the hepatoprotective ability of white radish (both roots and leaves) and their water extract on hepatotoxicity Carbon Tetrachloride (CCl_4) in rats (2mg/Kg BW; twice a week). Chemical composition, minerals and phytochemicals were measured. Also, male Sprague-Dawley rats (36 rats) were divided 6 groups; G1 as control negative (C-) for all the experimental period. Rats in G2- G6 were injected by CCl_4 to induced hepatotoxicity for 2 weeks (twice a week). G2 as positive control (C+) till untreated all the experimental period. Rats in (G3, G4) were treated by (2 ml/ rat/day) orally with water extract of radish roots and leaves. Rats in (G5, G6) were treated by fed on diet containing 10% (10g/100g diet) radish powder roots and leaves for 2 months. Results: Radish is considered as a good source of fiber, minerals (K, Fe and Zn) and antioxidants content (total phenols and flavonoids). White radish both powder and water extracts (roots and leaves) improved the liver functions,

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antioxidant enzymes (such as GSH and SOD) and kidney functions. As well as, both radish (roots and leaves) powder and water extract were decreased of TC, TG, LDL-c, VLDL-c and risk factor. Results indicated the white radish powder (roots and leaves) was better than their water extracts. Concerning histopathological changes; white radish (all treatments) was improved liver and kidney damages. Potatoes purée with radish (boiled roots or fresh leaves) were accepted by the panelists. But, potatoes purée only (control) had the highest scores of sensory evaluation. From above results; it could be seen the benefits of radishes. So, this study concluded that, might be promote people about benefits radish and promote intake radish in their meals as hepatoprotective of the environment toxicity which intake with food.

Key words: Radish, Liver, biochemical changes, histopathological changes, hepatotoxicity

INTRODUCTION

Some organs are very importance of human body like liver. It has a role of metabolism processes whereas; it metabolizes protein and fat by secreting bile salts. Also, it could be store glycogen and fat soluble vitamins. As well as, it has a role of synthesizes blood clotting factors. Moreover, liver has the potential to remove waste and toxins from blood, regulates blood volume and destroys old red blood cells **(Kim, 2020 and Kim, 2019).**

Concerning liver diseases are going to most healthy problems about 2 million persons were deaths worldwide. Current drugs

which used these days for treat hepatic toxicity associated but, it has many adversely side effects as reported by **Asrani et al., (2019)**

Many plants have potential hepatoprotective effects like (*Raphanus sativus var. Sativus*). The plant, commonly known as radish and belonging to the root vegetable family **(Stuart, 2014).** The leaves and roots of *R. sativus* contained many phytochemical compounds, including, alkaloids, nitrogenous compounds, enzymes, and phenols (**Gutiérrez and Perez 2004)**.

Some previous studies explained that, phenols and flavonoids are known to have various healing properties including antioxidant, free radical scavenging, antioxidant enzyme secretion enhancement, and body defense towards free oxygen species activities **(Hanlon and Barnes, 2011).**

On the other hand, damage of liver cells resulted in inter toxic subjects such as CCl_4 into human body. This status caused to increase levels of serum alanine amino transferase (ALT) activity and hepatic lipid peroxidation after a day **(Al-Harbi, et al., 2014).** But, **Ahn, et al., (2018)** studied the effect of radish on injury rats by CCl_4. They found that black radish extracts alleviated the side effect of CCl_4 and doses of radish improved the inhibition process of lipid accumulation by oxidative stress. Also, **You et al., (2015)** who reported that, sprouts and roots of radish could be decrease the severity of fatty liver as the authors studied on mouse experimental models.

Moreover**, Rahman et al., (2020)** found that the *R. sativus* extract significantly reduced the hepatotoxic effect of CCl_4 and

protection of liver tissues from oxidative damage. The authors concluded that, the hepatoprotective effects of *R. sativus* rhizome ethanol extract is attributed to a high phenols and flavonoid contents.

Khattak (2011) found that radish contained dietary fibers, a low protein, and fat. In addition, it contained various water-soluble vitamins (B complex and C) and minerals (calcium, iron, magnesium, manganese zinc, potassium, fluoride and phosphorous). Moreover, roots and leaves of radishes consist of vital nutritional values and diverse secondary metabolites with antioxidant properties. According to, (**Goyeneche, et al., 2015)** found that, roots of radish had a high levels of protein, Ca and vitamin C in leaves. While, leaves had two-fold of phenol content more than roots.

Na, et al., (2021) reported that radish (both roots and leaves) has abundant of functional ingredients such as glucosinolates, isothiocyanates, flavonoids, anthocyanins, alkaloids, saponins, and phenolic acids.

This study aimed to investigate the effect of radish (*Raphanus sativus;* both roots and leaves powder) of CCl_4 hepatotoxicity using rats as experimental models. And, their water extract. Interring radish roots or leaves in some dishes for liver patients.

Materials and Methods

Materials

Radish roots and leaves were purchased from local market in Giza, Egypt. Potatoes, salt, oil and spices were purchased from Benha, Local market, Egypt. Rats were purchased from the

Laboratory Animal Department, Food Technology Research, Agricultural Research Center, Ministry of Agriculture, Giza, Egypt.

Carbon tetra chloride (CCl_4), Folin-Ciocalteu's phenol reagent (2N), Sodium Carbonate (99.8%) (NaCo3, sodium nitrite (NaNO2), Aluminum chloride (AlCl3), sodium hydroxide (NaOH) and 2, 2-Diphenyl-1-picryhydrazyl (DPPH) were purchased from Sigma-Aldrich (St. Louis, Mo, USA). The kits were punched from Gamma-Tread Company, Cairo, Egypt.

Methods

Drying radish roots and leaves

After washing, the roots and leaves of radish were dried each alone by solar energy at the National Research Center (NRC), Dokki, Egypt. Then grind it into a fine powder in an electric grinder and pack it in polyethylene bags and kept it in the refrigerator at 4 ± 1°C.

Preparation of water extract

100 g of each plant was added to liter of boiling tap water in a stainless-steel pot (10 %, W/V). Boiling continued for 10 minutes. Then, the pot was left to cool at room temperature. Then, it filtered through cotton cloths to superannuated solution as according by (**Salem and Hassanan, 2009**).

Chemical Analysis

Approximate content

Approximate analysis (moisture, fat, crude protein, ash and crude fiber) were determined as according to the methods of **AOAC, (2000).** Carbohydrates were calculated by difference as the following equation:

Available Carbohydrates = 100 - [Moisture + fat + protein + ash + fiber]

Caloric value

Caloric value of the materials was calculated using the appropriate factor as described by **(FAO/WHO/ UNU, 1985)**.

Determination of minerals

Mineral contents (iron (Fe), zinc (Zn), calcium (Ca), potassium (K), sodium (Na) and Phosphor (P) in samples were digested by using a pye Unicum SP 1900 Atomic Absorption Spectroscopy instrument (Perkin Elmer model 4100 ZL) as described by the **A.O.A.C. (2000)**, at Soils, Water and Environment Research Institute (SWERI), ARC, Giza, Egypt.

Total phenols, total flavonocds and Antioxidant Activity

Total phenols and total flavonoids contents estimated based on procedures described by (**Batista, et al., 2011)**. The electron donation ability of the obtained ethanol extracts was measured by 2,2-diphenyl-1-picrylhdrazyl radical (DPPH) according to the method of **Hanato, et al., (1988).**

Biological Study

Adult male (36 rats) Sprague-Dawley rats (200 ± 10g) were purchased from the Laboratory Animal Department, Food Technology Research Institute. Then, housed in plastic cages and feeding on basal diet as according to **(Reeves et al., 1993)**

Experimental Design:

After the adaptation period (a week); the rats were randomly divided into (two main groups). First main group: (6 rats) was fed on basal diet as a (negative control). The second main group: (30 rats) were subcutaneously injected with (CCl_4) in paraffin oil (50% v/v) at the rate 2 ml/kg BW twice a week to induce liver toxicity according to the method described by **(Jayasekhar et al., 1997)**. Then, the second main hepatotoxic rats group was randomly assigned to 5 subgroups (6 rats / each) as following in **Table (1).**

The duration of the study was 8 weeks. Body weight of rats was measured once a week. The total body weight gain was calculated at the end of experiment. Liver and kidney were removed from each rat, washed by saline solution and weighed then stored in formalin solution 10% it was calculating the absolute.

Table (1) Distribution of animals to work groups

Group	Description

G1	Fed on basal diet (Negative control).
Hepatotoxicity Groups	
G2	Fed on basal diet (Positive control).
G3	G2 + (1250mg =2 ml day/rat) of radish leaves water extract.
G4	G2 + (1240 mg =2 ml day/rat) of radish roots water extract.
G5	G2 (90%) + 10% of radish roots powder.
G6	G2 (90%) + 10% of radish leaves powder.

*All animal drink Tap water throughout experimental period.

Biochemical Evaluation

Triglycerides (TG) were determined in serum using (**Fassati and Prenceipe, 1982**). Total cholesterol (TC**)** was calorimetrically determined as according to the enzymatic method of **Rifai *et al*., (1999)**. HDL-c and was determined using the method of **Lopez-Virella et al., (1977).** Very low-density lipoprotein cholesterol [VLDL-C] and low density of lipoprotein cholesterol [LDL-C] were calculated as according to **Lee and Nieman (1996).** Coronary risk index [CRI] was calculated

according to **(Adeneye *et al*., 2010).** Serum Aspartate aminotransferase [AST] and Alanine aminotransferase [ALT] were estimated according to **Moss and Henderson (1999).** Serum alkaline phosphatase was calculated according to **Bessay *et al*., (1946).** Serum uric acid and creatinine were determined according the method of **Barham and Trinder, (1972).** Urea was determined as carried out by **Fawcett and Scott (1960).** Antioxidant enzymes; Glutathione reduced (CSH) in Erythrocytes was determined by enzyme color -meteoric UV-method according to **Beutler *et al.* (1963**). SOD activity in serum was determined using **(Sun, Oberley, Li, 1988).**

Histopathological Examination

Tissues of the heart, liver and kidney preserved in 10% formalin, were dehydrated in different grades of alcohol, cleared in xylene, embedding in paraffin, sectioned with microtome at 5µ thickness and finally stained with hematoxylin and eosin (H&E) and Masson's trichrome (MTC) according to **(Banchroft et. al., 1996)**.

Technology part (Application part):

Preparation of potatoes purée:

Potatoes and radish root (100g) were cooked by boiled method; using tap water (1:2, food/water) in a covered stainless-steel pot and cooked on a moderate flame. Then, taken off the fire and left to cooling. After cooling, each ingredient was mashed separately. Finally, oil, spices and salt were added to the samples, put in an oven for 5 min, and dishes were serviced (**Alloush and**

Salem, 2014). Frist product was made by boiled potatoes (mesh) with boiled radish roots the following formulas were designed are shown in **table (2).**

Table (2): Potatoes purée with radish roots (g/100g FW).

Ingredients	Sample(1)	Sample(2)	Sample(3)	Sample(4)
Potatoes	96.5	86.5	76.5	66.5
Radish roots	_	10	20	30
Salt and spices	1.5	1.5	1.5	1.5
Corn oil	2	2	2	2

Where: S1= Control; S2=10%; S3= 20% and S4= 30%

Second product was made by boiled both potatoes (mesh) with fresh radish leaves the following formulas were designed are shown in **table (3).**

Table (3) Potatoes purée with fresh radish leaves (g/100g FW).

Ingredients	Sample (1)	Sample(2)	Sample(3)	Sample(4)	Sample(5)	Sample (6)
Potatoes	96.5	96	95.5	95	94.5	93.5
Fresh radish leaves	_	0.5	1	1.5	2	3
Salt and	1.5	1.5	1.5	1.5	1.5	1.5

spices						
Corn oil	2	2	2	2	2	2

Where: S1= Control; S2=0.5%; S3= 1%, S4= 1.5%, S5=2% and S6=3%

Sensory evaluation

Sensory evaluation i.e., color, taste, odor, texture and overall acceptability of different produces were evaluated by 10 panelists of Home Economics Department, Faculty of Specified Education, Banha University and members of Nutrition and Special Food Dep., Food Tech. Res. Inst. – Agri. Res. Center - Giza - Egypt, according to the method described by **Rangana, (1978).**

Statistical Analysis

Statistical analysis was carried out by SPSS program (Version 19). Data were expressed as means ± SEM and the statistical analysis was per formed using one-way analysis of variance followed by Duncan's tests **(Snedecor and Cochran, 1989).**

Results and Discussion

Chemical composition and energy value of white radish leaves and roots.

The results in table (4) showed that, radish leaves had the highest percentages of crude protein (20.39%) and ash content (19.89%). While, radish roots were the highest value of crude fiber (14.71%), carbohydrates (51.54%) and Energy value

(311Kcal/100g). These results were agreements with **(Ibrahim, 2017)** who found almost the same results of protein, fat and fiber.

Table (4): Chemical composition of white radish roots and leaves (% DW).

Components	White radish	
	Roots	Leaves
Chemical composition (g/100g DW)		
Crude protein	15.40±0.06	20.39±0.13
Fat	4.84±0.29	4.85±0.49
Ash	14.00±0.40	19.89±0.02
Crude Fiber	14.71±0.33	12.22±0.13
Available carbohydrates	51.54±1.19	42.55±0.36
Energy value (Kcal/100g)		
Energy	311±1.51	295±1.22

* Means of triplicate.

Minerals content of radish leaves and roots.

Some mineral contents of white radish leaves and roots were illustrated in Table (5). Results indicated that, radish leaves recorded higher percentage of P, Ca, Fe and Zn content than

radish roots. But, radish root showed higher value of K and Na than radish leaves. These results are disagree with **(Goyeneche, *et al.*, 2015)** because the authors determined minerals contents as fresh weight and may also have been influenced by differences in harvesting and environmental conditions during experimental work.

Table (5) Minerals content of radish leaves and roots (mg/100g DW).

Minerals	White radish	
	Roots	Leaves
P	713.00±5.00	753.00±4.00
K	137.00±6.00	118.00±5.00
Ca	35.760±0.577	79.833±2.60
Fe	83.386±1.201	97.593±1.45
Zn	1.068±0.004	1.838±0.01
Na	318.00±0.8	255.00±3.00

* Means of triplicate.

Total Phenols, Flavonoids and Antioxidants activity of white radish roots and leaves

Table (6) showed that, total phenols, flavonoids and antioxidants activity of white radish roots and leaves. Results showed that, total flavonoids were higher contents both powder and water extracts than total phenols of white radish plant. Also, water extracts of both white radish roots and leaves had higher T. phenols and T. flavonoids than white radish powders. While, white radish powders had a high levels of antioxidant activity by DPPH compared with water extract. These results are in the lines

with **(Goyeneche, *et al.*, 2015)** who found total flavonoids content was more than two fold of total phenols content in white radish**.**

Table (6): Some phytochemicals contents of white radish roots and leaves.

Items	White radish		Water extracts	
	Roots	Leaves	Roots	Leaves
Total phenols (mg GAE/100g DW)	22771.84±5.80	19257.12±6.35	45184.77±0.96	54.975.76±0.43
Total flavonoids (mg QE/100g DW)	54438.81±5.80	53523.35±5.63	56902.49±1.57	55921.47±0.91
Antioxidants activity DPPH (%)	75.70±0.74	75.87±0.64	65.64±0.26	67.50±0.27

* Total phenols as Gallic acid (GAE) and total flavonoids as quercetin (QE). *** Means of triplicate.

Effect of feeding on withe radish on body weight gain (BWG) and some organs in rats

Results in table (7) showed that, rats were injected CCl_4 in positive control had the lowest increasing of BWG (28.50%). While, hepatic rats (injected CCl_4) and treated with water extract of white radish (both roots and leaves) were lower

BWG than rats treated with white radish powders. There were significant differences between groups for BWG as resulted in feeding. On the other hand, rats in negative control had the lowest liver and kidney weights compared with hepatic rats.

Table (7): Effect of feeding on withe radish on Body weight gain and some organs in hepatic rats

Groups	Initial weight (g)	Final weight (g)	BWG (g)	BWG (%)	Organ's weight (g)	
					Liver	Kidney
G1	199.33±3.57a	305.33±12.83a	106.03±9.26b	53.18	6.99±0.07b	1.43±0.04c
G2	197.67±3.82a	254.00±7.23b	56.33±3.14f	28.50	7.73±0.53b	1.66±0.06b
G3	198.00±2.80a	267.67±19.64b	69.67±16.84d	35.19	7.19±0.22b	1.62±0.05bc
G4	205.50±3.58a	267.67±4.66b	62.17±1.08e	30.25	7.90±0.18b	1.67±0.03b
G5	196.83±4.83a	315.00±6.93a	118.17±2.1a	60.04	8.91±0.23a	2.08±0.01a
G6	196.00±2.67a	279.00±10.11ab	83.04±7.44c	42.35	8.91±0.22a	1.55±0.05bc

* Each value in a column followed by the same subscript is not significantly different at ($p \leq 0.05$). **G1; negative

control, G2; positive control, G3; treated by 2ml/day/rat of water extract of radish leaves, G4; treated by 2ml/day/rat of water extract of radish roots, G5; treated by 10% of diet with radish roots powder and G6; treated by 10% of diet with radish roots powder.

Also, the results indicated that, rats injected CCl_4 and treated by 10% of radish powders (both roots and leaves) had liver and kidney weight higher than rats treated by their water extracts. These results are not in the line with **Hwang, et al., (2022)** who studied the effect of ethanol extract (70% con.) of turnip and radish roots on Acetaminophen-induced liver damage only. The authors reported that, no significant differences for BWG and organs weights between groups.

Effect of feeding on white radish on liver functions in hepatic rats

Effect of feeding on white radish leaves and roots on liver functions in rats are shown in Table (8). It is obvious from the results showed that, rats untreated (C+) had the highest levels of liver functions and had the lowest levels of GSH and SOD (antioxidant enzymes) compared with normal rats (C-). White radish powder (both roots and leaves) were improved the liver functions, GSH and SOD in hepatic rats. Moreover, white radish powder improved liver functions more than their water extracts. These results are convergent with (**Lee, et al., 2012**) who found that, extracts of radish improved the liver functions (ALT and AST) in rats injected CCl_4. And, **Abd El-Mouty *et al.*, (2017)** who

reported that, white radish powder improved liver functions (ALT, AST and ALP) in rats injected CCl_4. Moreover, **Hwang *et al.*, (2022)** who studied the effect of ethanol extract (70% con.) of turnip and radish roots on Acetaminophen-induced liver damage. Results indicated the ethanol extract of radish improved GSH and SOD as antioxidant enzymes.

Table (8): Effect of feeding on white radish (roots and leaves) on liver functions in hepatic rats

Groups	**ALT (U/L)**	**AST (U/L)**	**ALP (U/L)**	**Enzymes**	
				GSH (pg/ml)	**SOD (U/ml)**
G1	17.00 ± 1.15^{d}	21.67 ± 1.86^{c}	75.33 ± 0.88^{d}	226.33 ± 1.46^{b}	2.70 ± 0.06^{b}
G2	44.00 ± 2.31^{a}	51.00 ± 0.58^{a}	103.00 ± 135^{a}	216.00 ± 2.08^{c}	2.06 ± 0.03^{d}
G3	30.67 ± 1.20^{b}	31.67 ± 0.88^{b}	90.67 ± 1.45^{b}	241.00 ± 0.58^{a}	3.37 ± 0.09^{a}
G4	32.33 ± 0.88^{b}	30.65 ± 0.88^{b}	91.66 ± 1.20^{b}	239.33 ± 0.88^{a}	3.23 ± 0.07^{a}
G5	22.66 ± 0.20^{c}	25.00 ± 0.58^{c}	84.333 ± 0.88^{c}	229.66 ± 0.88^{b}	2.50 ± 0.21^{bc}
G6	25.67 ± 0.88^{c}	23.33 ± 0.88^{c}	83.32 ± 0.88^{c}	229.33 ± 1.20^{b}	2.30 ± 0.06^{cd}

* Each value in a column followed by the same subscript is not significantly different at ($p \leq 0.05$). **G1; negative control, G2; positive control, G3; treated by 2ml/day/rat of water extract of radish leaves, G4; treated by 2ml/day/rat of water extract of radish roots, G5; treated by 10% of diet with radish roots powder and G6; treated by 10% of diet with radish roots powder.

Effect of feeding on white radish leaves and roots on kidneys functions in hepatic rats

Effect of fed on white radish leaves and roots on kidneys functions in rats were illustrated in Table (9). It is obvious from the results showed that, rats untreated (C+) had the highest levels kidney functions compared with normal rats (C-). White radish powder (both roots and leaves) were improved the kidney functions in hepatic rats. Moreover, white radish powder improved kidney functions more than their water extracts. These results are in agreements with (**Kishor, et al., 2013 and Abd El-Mouty *et al.*, 2017)** who reported that, administration rats injected CCl_4 by radish juices improved kidney dysfunctions and restored biochemical parameters with in a normal line**.** These results may be due to the phytochemicals detected in radish which could be responsible for nephroprotective affect (**Kishor, et al., 2013**).

Table (9): Effect of feeding on white radish roots and leaves on kidney functions in hepatic rats

Groups	Urea (mg/dl)	Creatinine (mg/dl)	Uric acid (mg/dl)
G1	20.00 ± 1.15^{d}	0.82 ± 0.01^{e}	1.67 ± 0.09^{d}
G2	53.33 ± 1.45^{a}	1.85 ± 0.01^{a}	5.63 ± 0.15^{a}
G3	29.00 ± 1.16^{b}	1.14 ± 0.01^{c}	2.50 ± 0.15^{c}
G4	31.67 ± 0.88^{b}	1.23 ± 0.01^{b}	3.33 ± 0.12^{b}

Groups	Urea (mg/dl)	Creatinine (mg/dl)	Uric acid (mg/dl)
G5	24.00 ± 0.58^{c}	0.95 ± 0.02^{d}	1.67 ± 0.88^{d}
G6	22.33 ± 0.88^{cd}	0.92 ± 0.01^{d}	1.40 ± 0.12^{d}

* Each value in a column followed by the same subscript is not significantly different at ($p \leq 0.05$). **G1; negative control, G2;positive control, G3; treated by 2ml/day/rat of water extract of radish leaves, G4; treated by 2ml/day/rat of water extract of radish roots, G5; treated by 10% of diet with radish roots powder and G6; treated by 10% of diet with radish roots powder.

Effect of feeding on withe radish leaves and roots on serum lipid profile content in rats

Data presented in Table (10) show effect of feeding on white radish leaves and roots on serum lipid profile content in rats. It is obvious from the results showed that, rats untreated (C+) had the highest of levels serum lipid compared with normal rats (C-). White radish powder (both roots and leaves) were improved serum lipid in hepatic rats. Moreover, white radish powder improved serum lipid more than their water extracts. These results are in agreements with **(Lee, et al., 2012)** who found that, rats injected CCl_4 and treated by radish enzyme extract (REE) had decreased in TC and TG**.** Also, **Abd El-Mouty *et al.*, (2017)** who found that, effect of feeding hepatic

rats (injected CCl_4) on radish roots and leaves powders (2.5% and 5%). The results showed decrease in TC, TG, LDL-c and VLDL-c levels, and HDL-c was increased. CCl_4 caused to accumulate the lipid in liver **(Lee, et al., 2012)**. In addition, CRI had the same results

Table (10): Effect of feeding on white radish (roots and leaves) on serum lipid profile in hepatic rats

Groups	T.C (mg/dl)	TG (mg/dl)	HDL-c (mg/dl)	VLDL-c (mg/dl)	LDL-c (mg/dl)	CRI
G1	104.33±0.88^{c}	95.33±1.45^{c}	47.00±1.53^{c}	19.07±0.29^{c}	38.27±0.38^{bc}	2.23±0.09^{ab}
G2	118.00±0.58^{a}	111.00±2.08^{a}	48.00±2.65^{bc}	22.20±0.42^{a}	47.80±2.72^{a}	2.47±0.13^{a}
G3	114.00±1.15^{b}	103.67±1.20^{b}	54.00±1.15^{ab}	20.73±0.24^{b}	39.27±1.84^{bc}	2.11±0.06^{b}
G4	115.00±1.15^{ab}	103.00±1.53^{b}	53.00±2.52^{abc}	20.60±0.31^{b}	41.4±1.51^{b}	2.18±0.08^{b}
G5	107.00±1.15^{c}	87.67±1.45^{d}	55.00±1.73^{a}	17.53±0.29^{d}	34.47±2.27^{c}	1.95±0.08^{b}
G6	106.00±1.15^{c}	86.66±0.88^{d}	53.33±1.86^{abc}	17.33±0.18^{d}	35.33±1.22^{bc}	1.99±0.06^{b}

* Each value in a column followed by the same subscript is not significantly different at ($p \leq 0.05$). **G1; negative control, G2;positive control, G3; treated by 2ml/day/rat of water extract of radish leaves, G4; treated by 2ml/day/rat of water extract of radish roots, G5; treated by 10% of diet with radish roots powder and G6; treated by 10% of diet with radish roots powder.

Potatoes purée

Sensory evaluation for potatoes purée with boiled radish roots:

Sensory evaluation of potatoes purée with boiled radish roots was shown in table (11). The highest score was found in control and the lowest score in sample (4) which contained a high percent of radish roots. In addition, the result showed that overall acceptability score was ranged from 32.40 to 39.20. The high percent of radish roots caused to decrease in sensory characters compared with control sample.

Table (11): Sensory evaluation for potatoes purée with boiled radish roots

Items	Taste (10)	Odor (10)	Texture (10)	Appearance (10)	Overall acceptability (40)

S1	10.00±0.04[a]	10.00± 0.05[a]	9.60±0 .16[a]	9.60± 0.16[a]	39.20±0.24[a]
S2	9.10±0.27[b]	9.00±0. 05[b]	8.90±0 .31[ab]	9.30± 0.30[a]	36.30±0.83[ab]
S3	8.80±0.38[b]	8.30±0. 30[c]	8.10±0 .34[b]	8.30± 0.30[b]	33.50±1.30[bc]
S4	7.80±0.35[c]	8.00±0. 14[c]	8.20±0 .41[b]	8.40± 0.42[b]	32.40±1.30[c]

* Each value in a column followed by the same subscript is not significantly different at ($p \leq 0.05$). ** S1= Control; S2=10%; S3= 20% and S4= 30%

Sensory evaluation for potatoes purée with fresh radish leaves:

Table (12) show Sensory evaluation of puree potatoes with fresh radish leaves. The same obtained results showed for potatoes purée with fresh radish leaves. These results may be due to the taste of radish which many people do not like it.

Table (12): Sensory evaluation for potatoes purée with fresh radish leaves

Items / Samples	Taste (10)	Oder (10)	Texture (10)	Appearance (10)	General acceptability

No.					(40)
S1	8.40±0.43[a]	9.00±0.21[a]	8.40±0.22[a]	9.50±0.16[a]	35.30±0.70[a]
S2	8.10±0.51[ab]	8.70±0.26[ab]	8.10±0.27[ab]	9.80±0.20[a]	34.70±0.71[ab]
S3	7.00±0.36[bc]	8.00±0.33[b]	8.00±0.29[ab]	8.50±0.50[ab]	31.50±0.92[bc]
S4	6.70±0.42[c]	7.80±0.36[b]	7.40±0.30[bc]	7.70±0.76[b]	29.60±1.49[c]
S5	6.30±0.51[c]	7.80±0.36[b]	6.80±0.29[c]	8.20±0.59[ab]	29.10±1.35[c]
S6	6.10±0.48[c]	8.00±0.33[b]	6.70±0.39[c]	7.60±0.68[b]	28.40±1.60[c]

* Each value in a column followed by the same subscript is not significantly different at ($p \leq 0.05$). ** S1= Control; S2=0.5%; S3= 1%, S4= 1.5%, S5=2% and S6=3%

Total phenols, total flavonoids and antioxidant activity of potatoes purée with radish both roots and fresh leaves

Total phenols, flavonoids and antioxidants activity of puree potatoes with boiled of radish roots and fresh radish leaves are found in table (13). Additional of radish both boiled

roots and fresh leaves caused to increase in total phenol, total flavonoids and antioxidant activity by DPPH in potatoes purée. This increasing was raised with increase percent of additional of radish.

Table (13): Total phenols, total flavonoids (g/100g) and DPPH (%) of potatoes purée with radish both roots and fresh leaves.

Samples	Total phenols (mg GAE/100g DM)	Total flavonoids (mg QE/100g DM)	DPPH (%)
Control	938.697±5.713^{d}	47.216±0.618^{d}	81.232±0.540^{c}
Potatoes purée with radish root			
S1	1037.016±6.070^{c}	75.393±0.646^{c}	81.418±0.656^{c}
S2	1180.313±5.794^{b}	652.553±5.634^{b}	84.268±0.604^{b}
S3	1270.366±5.687^{a}	1071.454±5.816^{a}	93.440±0.509^{a}
Potatoes purée with fresh radish leaves			
S1	1029.40±5.87^{d}	46.64±0.34^{f}	81.36±0.50^{b}
S2	1045.75±5.71^{e}	705.40±0.61^{c}	81.55±0.71^{b}
S3	1050.94±8.66^{f}	1700.60±5.70^{b}	82.32±0.44^{b}
S4	1060.48±5.89^{b}	142.66±0.51^{e}	92.33±0.58^{a}
S5	1064.23±5.65^{a}	166.55±5.62^{d}	92.47±0.61^{a}

* Total phenols as Gallic acid (GAE) and total flavonoids as quercetin (QE).

Histopathological tests:

A) Histopathological features of liver:

The results in figures (1, 2 and 3) explained the histopathological changes for normal rats, injected rats by CCl_4 (0.4ml/rats) twice a week for 2 weeks induced hepatic rats and effect of treatment hepatic rats by white radish roots and leaves. Rats after injected showed severe changes characterized by vacuolar degeneration of hepatocytes, massive hepatocellular necrosis and apoptosis associated with inflammatory cells infiltration Fig.1 (a, b). At the end of experimental period; liver from rats in negative control showed a normal histological architecture of hepatic lobule Fig.1 (c and d). In contrast, liver of rats from control positive were injected CCl_4 untreated rats showed vacuolar degeneration of hepatocytes (fatty change), hyperplasia of biliary epithelium, fibroplasia in the portal triad (Fig.1e); focal hepatocellular necrosis and apoptosis associated with inflammatory cells infiltration and portal infiltration with inflammatory (Fig.1f).

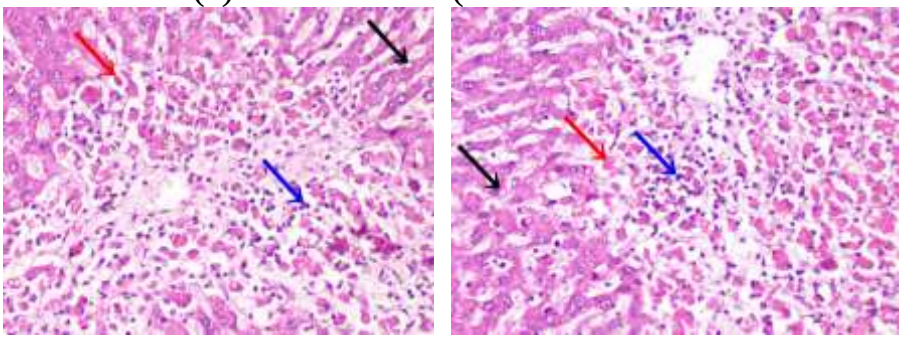
Concerning rats injected CCl_4 and treated by water extracts of radish roots and leaves are shown in fig. 2. Liver of rats from group 3 which treated by water extract of radish leaves (2ml/rat/day) described vacuolar degeneration of hepatocytes (fatty change), hyperplasia of oval cells, appearance of newly formed bile ductules (Fig.2a), Kupffer cells proliferation and fine

strands of fibroblasts proliferation (Fig.2b). Otherwise, some examined sections from group 4 which treated by water extract of radish roots (2ml/rat/day) exhibited no histopathological damage (Fig.2c), and small focal hepatocellular necrosis associated with inflammatory cells infiltration (Fig.2d).

Meanwhile rats injected CCl_4 and treated radish roots and leaves powder (10% of diet) are shown in fig, 3. Liver of rats from group 5 which treated by powder of radish roots exhibited slight vacuolization of some hepatocytes (Fig.2a), focal hepatocellular necrosis and apoptosis associated with inflammatory cells infiltration (Fig.2b). Otherwise, sections from group 6 which treated by powder of radish roots manifested no histopathological alterations (Fig.2c) except slight Kupffer cells activation (Fig.2d).

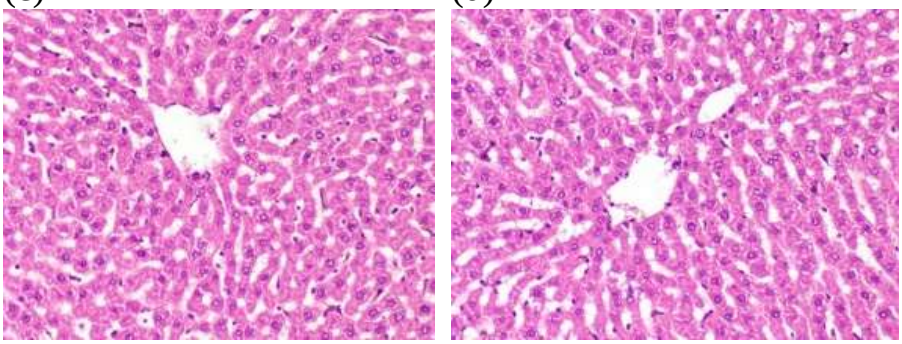
After injection

(a) (b



At the end experimental period

(c) (d)



(e) (f)

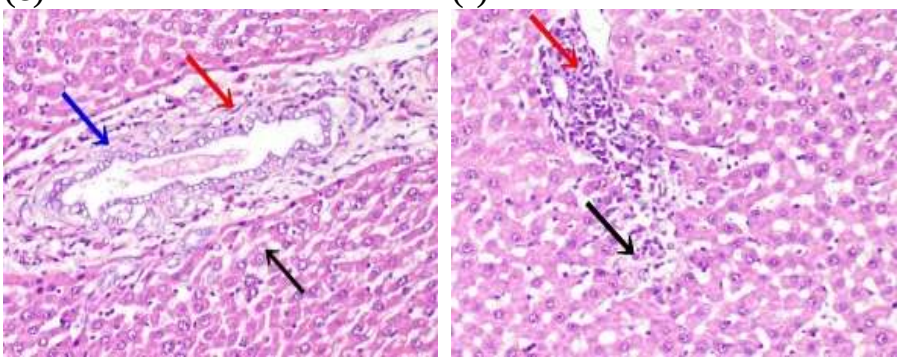
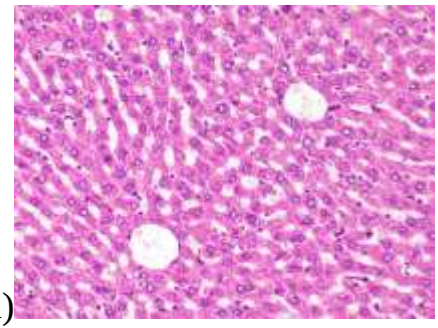


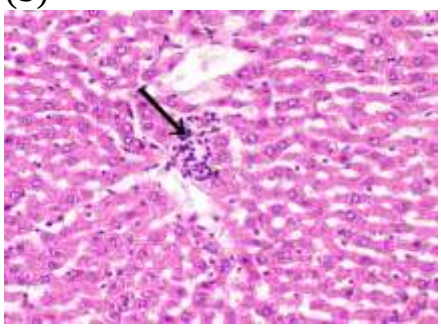
Fig. (1) liver of different controls (negative and positive) and after injection; a) Figomicrograph of liver of rat after injected CCL_4 (0,4ml/rat) showing vacuolar degeneration of hepatocytes (black arrow), massive hepatocellular necrosis and apoptosis (red arrow) associated with inflammatory cells infiltration (blue arrow);b) Figomicrograph of liver of rat after injected CCL_4 (0.4ml/rat)showing vacuolar degeneration of hepatocytes (black

arrow), massive hepatocellular necrosis and apoptosis (red arrow) associated with inflammatory cells infiltration (blue arrow); At the end of experimental period the results showed, c)and d) liver rat negative control showing no change or normal histopathology; e) Figomicrograph of liver of rat after injected CCL_4 (0.4ml/rat) showing vacuolar degeneration of hepatocytes (fatty change) (black arrow), hyperplasia of biliary epithelium (blue arrow) and fibroplasia in the portal triad (red arrow);f) Figomicrograph of liver of rat after injected CCL_4 (0.4ml/rat) showing focal hepatocellular necrosis and apoptosis associated with inflammatory cells infiltration (black arrow) and portal infiltration with inflammatory (red arrow).

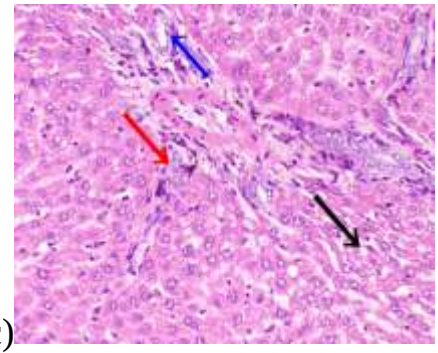
(a)



(b)



(c)



(d)

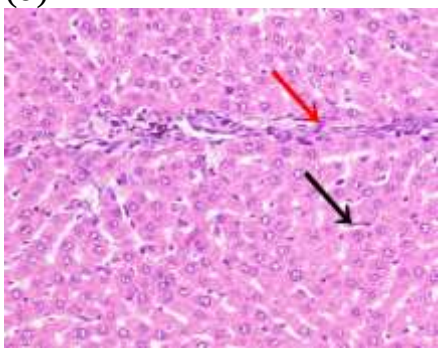


Fig. (2): Figomicrograph of liver of rat treated by water extracts of radish (root and leaves); a) Figomicrograph of liver of rat treated by water extracts of radish root showing no histopathological damage ;b) Figomicrograph of liver of rat treated by water extracts of radish root showing small focal hepatocellular necrosis associated with inflammatory cells infiltration (arrow);c) Figomicrograph of liver of rat treated by water extracts of radish leaves showing vacuolar degeneration of hepatocytes (fatty change) (black arrow), hyperplasia of oval cells (red arrow) and appearance of newly formed bile ductuoles (blue arrow);d) Figomicrograph of liver of rat treated by water extracts of radish leaves showing Kupffer cells proliferation (black arrow) and fine strands of fibroblasts proliferation (red arrow).

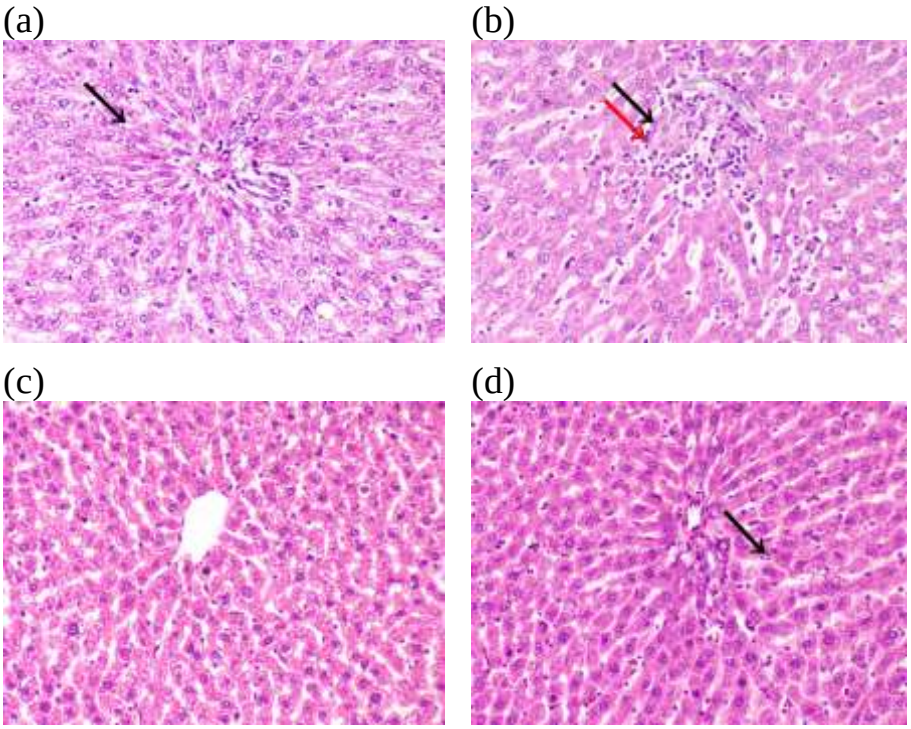


Fig. (3): Figomicrograph of liver of rat treated by radish (root and leaves); a) Figomicrograph of liver of rat treated by radish root showing slight vacuolization of some hepatocytes (arrow);b) Figomicrograph of liver of rat treated by radish root showing focal hepatocellular necrosis and apoptosis (black arrow) associated with inflammatory cells infiltration (red arrow);c) Figomicrograph of liver of rat treated by radish leaves showing no histopathological alterations ;d) Figomicrograph of liver of rat treated by radish root showing slight Kupffer cells activation (arrow).

B) Histopathological features of kidneys:

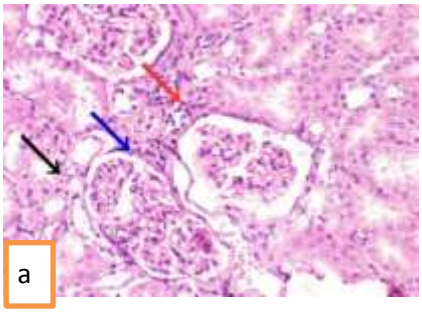
The results in figures (4, 5 and 6) explained the histopathological changes for normal rats, injected rats by CCl_4 (0.4ml/rats) twice a week for 2 weeks induced hepatic rats and effect of treatment hepatic rats by white radish roots and leaves. After injected; the histopathological test showed revealed necrobiosis of renal tubular epithelium (Fig.4a, b), focal inflammatory cells infiltration (Fig. 4a), congestion of glomerular tufts (Fig.4b), and thickening of the parietal layer of Bowman's capsule (Fig.4a, b). At the end of experimental period; negative control the kidney of rats was no changes or normal histopathology 9fig.4c, d). On contrary, kidneys of rats from group 2 which injected CCl4 showed vacuolar degeneration of renal tubular epithelium (Fig.4 e, f), congestion of renal blood vessel and glomerular tuft (Fig. 4e), interstitial inflammatory cells infiltration (Fig.4f). In contrast, kidney of rats from positive control were injected CCl_4 untreated showed vacuolar degeneration of renal tubular epithelium (Fig. 4e, f), congestion of renal blood vessel and glomerular tuft (Fig. 4e) and interstitial inflammatory cells infiltration (Fig. 4f).

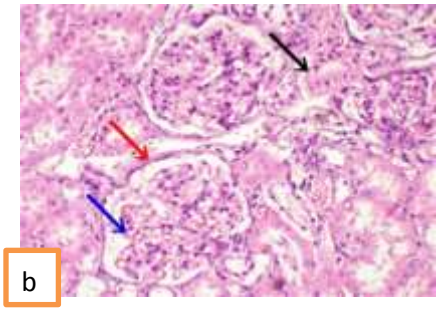
Concerning rats injected CCl_4 and treated by water extracts of radish roots and leaves are shown in (fig.5). kidneys of rats from group 3 which treated by water extract of radish leaves (2ml/rat/day) exhibited slight vacuolar degeneration of some renal tubular epithelium, congestion of renal blood vessels and glomerular tuft (Fig.5 a, b). Likewise, kidneys of rats from groups

4 which treated by water extract of both radish roots (2ml/rat/day) showed slight vacuolar degeneration of some renal tubular epithelium and congestion of renal blood vessels (Fig. 5c, d).

Likewise, rats injected CCl_4 and treated radish roots and leaves powder (10% of diet) are shown in (fig, 6). Kidneys of rats from group 5 which treated by powder of radish roots powder (10%) revealed histologically normal renal tissue (Fig. 6a) except slight vacuolar degeneration of some renal tubular epithelium (Fig. 6b) Kidneys of rats from group 6 which treated by powder of radish leaves powder (10%) manifested congestion of renal blood vessels (Fig. 6c) and slight vacuolar degeneration of some renal tubular epithelium (Fig. 6d).

After injection





At the end experimental period

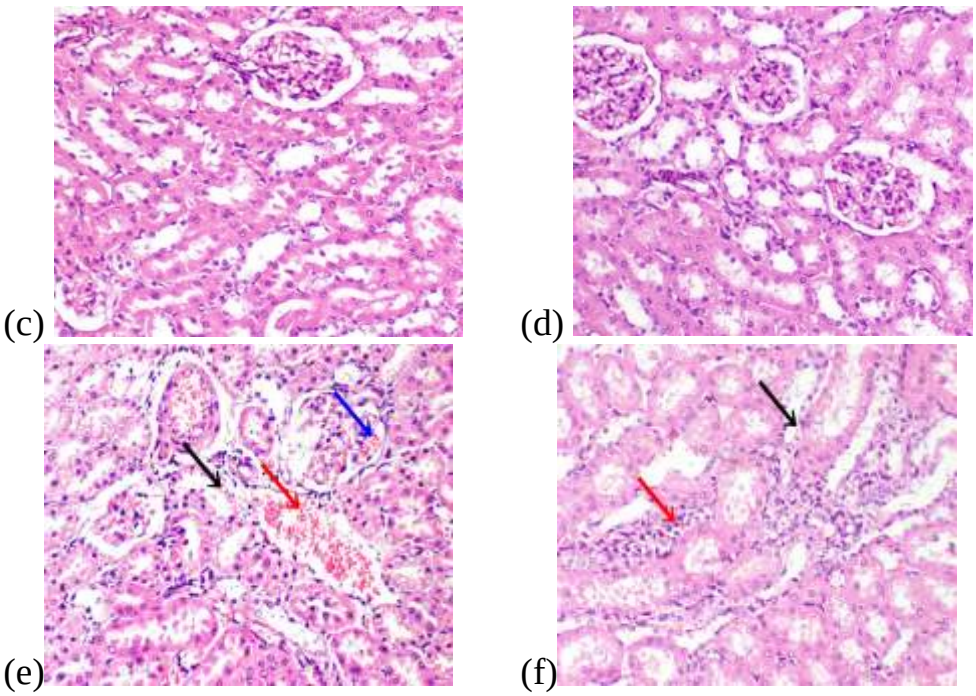


Fig. (4) kidney of different controls (negative and positive) and after injection. a) Photomicrograph of kidney of rat after injection showing necrobiosis of renal tubular epithelium (black arrow), focal inflammatory cells infiltration (red arrow) and thickening of the parietal layer of Bowman's capsule (blue arrow); b) Photomicrograph of kidney of rat from hepatic rats showing necrobiosis of renal tubular epithelium (black arrow), congestion of glomerular tuft (blue arrow) and thickening of the parietal layer of Bowman's capsule (red arrow) (H & E); at the end of experimental period; c)and d) kidney rat negative control showing no change or normal histopathology ;e)

Figomicrogragh of kidney of rat after injected CCL4 (0.4ml/rat) showing necrobiosis of renal tubular epithelium (black arrow), focal inflammatory cells infiltration (red arrow) and thickening of the parietal layer of Bowman's capsule (blue arrow);f) Figomicrograph of kidney of rat after injected CCL4 (0.4ml/rat) showing necrobiosis of renal tubular epithelium (black arrow), congestion of glomerular tuft (blue arrow) and thickening of the parietal layer of Bowman's capsule (red arrow);

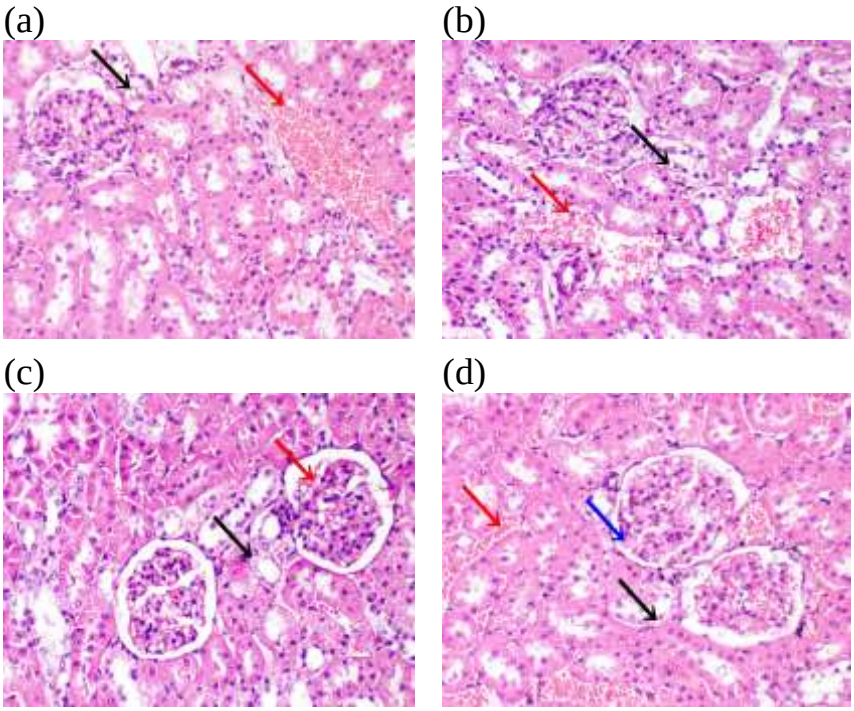
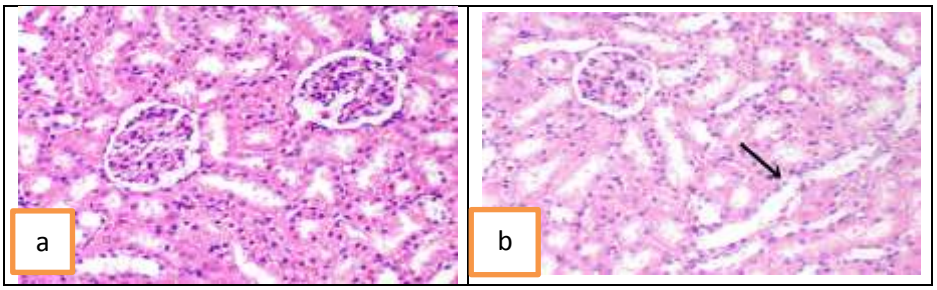


Fig. (5): Figomicrograph of kidney of rat treated by water extracts of radish (root and leaves) : a) Figomicrograph of kidney of rat treated by water extracts of radish root (2ml/rat/day) showing slight vacuolar degeneration of some renal tubular epithelium (black arrow) and congestion of renal blood vessels (red arrow);b) Figomicrograph of kidney of rat treated by water extracts of radish root (2ml/rat/day) showing slight vacuolar degeneration of some renal tubular epithelium (black arrow) and congestion of renal blood vessels (red arrow).;c) Figomicrograph of kidney of rat treated by water extracts of radish leaves (2ml/rat/day) showing slight vacuolar degeneration of some renal tubular epithelium (black arrow) and slight congestion of glomerular tuft (red arrow);d) Figomicrograph of kidney of rat from group treated by water extracts of radish leaves (2ml/rat/day) showing slight vacuolar degeneration of some renal tubular epithelium (black arrow) and congestion of renal blood vessels (red arrow) and glomerular tuft (blue arrow).



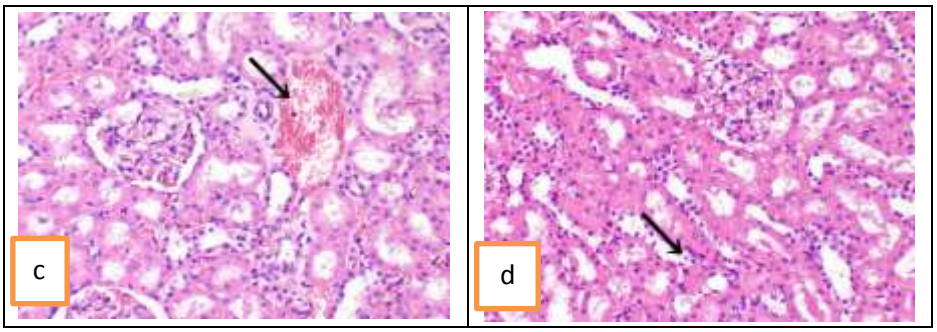


Fig. (6) Figomicrograph of kidney of rat treated by radish (root and leaves); a) Figomicrograph of kidney of rat treated by radish root powder (10%) showing histologically normal renal tissue; b) Figomicrograph of kidney of rat treated by radish root powder (10%) showing slight vacuolar degeneration of some renal tubular epithelium (black arrow);c) Figomicrograph of kidney of rat treated by radish leaves powder (10%) showing congestion of renal blood vessels (arrow); d) Figomicrograph of kidney of rat treated by radish leaves powder (10%) showing slight vacuolar degeneration of some renal tubular epithelium (black arrow).

Conclusions: Radish (*Raphanus sativus L.*) is a source of nutrients and phytochemicals, particularly proteins, glucosinolates, flavonoids, β-carotene, and minerals. Many of these phytochemicals are highly concentrated in leaves and roots, which could be considered part of a healthy diet, especially in diets where the roots consumption is prioritized. Moreover, the results of present study indicate that of radish (roots and leaves) they have antioxidant activity and phenolic compounds and therefore they have an important role as possess hepatoprotective.

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Ethics approval and consent to participate: All experimental animal conduct in this study was approved by the National Institute of the healthy guide for laboratory animal care and used NIH (publication No. 8023 revised 1978 and updated 2011). Animal experiments strictly complied with the legal requirements or guidelines in the country and/or state or province for the care and use of animals including [Arrival guideline.
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فاعليه الفجل الابيض (الجذور والورق) كمضادات للسمية الكبدية في فئران التجارب

المستخلص:
تهدف هذه الدراسة إالى التأكد من مقدرة الفجل الأبيض (الجذور والأوراق) ومستخلصاتها المائيه على حماية الكبد من السموم مثل رابع كلوريد الكربون (CCl4) باستخدام فئران التجارب. تم دراسه التركيب الكيميائي والمعادن والمركبات الكيميائية النباتيه. تم استخدام (٣٦ فأر) مقسم على ٦ مجموعات كالاتى مجموعه (١) وهى عباره عن المجموعة الحاكمه الطبيعيه خلال فترة التجربة. من المجموعه (٢) الى المجموعه(٦) تم حقن الفئران بماده رابع كلوريد الكربون CCl4 لمدة أسبوعين (مرتين في الأسبوع) بمعدل ٢ملجم/كجم من وزن الجسم. بعد ذلك تم تغذيه المجموعه(٢) على الوجبه القياسيه خلال فترة التجربة. اما مجموعه (٣ و ٤) تم تغذيتهم على الوجبه القياسيه مع اعطاء (٢ مل / فأر / يوم) من المستخلص المائي من جذور الفجل اوأوراق الفجل. اما مجموعه (٥ و ٦) تم تغذيتهم على وجبة القياسيه مع استبدال ١٠٪ من الوجبة الحاكمة بمسحوق جذور الفجل اوالأوراق المجففه والمطحونه لمدة شهرين.
أهم النتائج المتحصل عليها : يعتبر الفجل مصدرًا جيدًا للألياف والمعادن (K و Fe و Zn) و مضادات الأكسدة (الفينولات والفلافونويد). حسن المستخلص المائى ومسحوق الفجل الأبيض (للجذور والأوراق) وظائف الكبد والإنزيمات المضادة للأكسدة مثل(GSH و SOD) ووظائف الكلى. بالإضافة إلى ذلك ، انخفاض TC و TG و LDL-c و VLDL-c فى المعاملات بالمستخلص المائى ومسحوق الفجل الأبيض (للجذور والأوراق). وأشارت النتائج أن مسحوق الفجل الأبيض (الجذور والأوراق) كان أفضل من المستخلصات المائية. كما حسن الفجل الأبيض (جميع المعاملات) تلف الكبد والكلى فى الفحص الباثولوجى. واوضحت نتائج التقييم الحسى للبطاطس البيوريه بالفجل (جذور مسلوقة أو أوراق طازجة) كانت مقبولة ، لكن البطاطس البوريه الحاكمه حصلت على أعلى درجات التقييم الحسي. من النتائج أعلاه يمكن ملاحظة

فوائد الفجل. لذلك ، توصى هذه الدراسة على تشجيع الناس على تناول الفجل لفوائده المضاده للسموم الموجوده بالبيئه و المتناولة مع الأغذية .