THE HEPATOPROTECTIVE EFFECT OF CARROT (*DAUCUS CAROTA* L.) AS ANTIOXIDANT ON INTOXICATED RATS WITH CCL_4

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ABSTRACT

The effect of feeding dry powder of carrot at three graded concentrations (5,10,20 %) mixed with the basal diet to carbon tetrachloride (Ccl4) intoxicated male rats for 4 weeks was studied. Intoxication of rats was done by s/c injection of Ccl4 (1 ml/kg) in the first (treatment group) and the last (prophylaxis) two days of feeding period, as a single dose per day.

Results of this study revealed that prophylaxis is more powerful than treatment groups. Both groups significantly increased feed intake, body weight gain percent and feed efficiency ratio. Biochemical analyses cleared that carrot supplementation to diet significantly lowered serum total cholesterol, triglycerides and LDL cholesterol, but increased HDL cholesterol. Serum liver enzymes(AST and ALT) as well as concentrations of urea nitrogen, uric acid and creatinine decreased in rats fed carrot supplemented diet .Histopathological examinations of liver and kidneys of these rats showed a decrease or amelioration of pathological lesions and damages caused by Ccl4 intoxicated rats.

INTRODUCTION

Carrot is a vegetable known scientifically as *Daucus carota* which belongs to family Umbelliferae (Apiaceae). Regarding its nutritive value, the carrot has abundant amount of beta carotenes (provitamin A) which give the vegetable its characteristic color. Moreover, carrots are rich in dietary fibers, antioxidants and minerals, especially potassium. The nutrient contents of each 100 *g* raw carrot were estimated to be as follow: water (89 *g*), carbohydrates (8.71 *g*), proteins (0.98 *g*), lipids (0.24 *g*), dietary fibers (2.24 *g*), vitamin A (12 mg), vitamin C (7.1 mg), calcium (33 mg), magnesium (18 mg) and potassium (240 mg), as recorded by Ensminger and Ensminger (1986).

Concerning health benefits, the carrots are an excellent source of several antioxidant compounds such as phenolic compounds that play an

important role in antioxidant properties of carrots and the other hydroxycinnamic derivatives such as dicaffeoylquinic acids in the extracts may exert some strong antioxidant activities along with chlorogenic acid (Zhang and Hamauzu ,2004).The antioxidant compounds of carrot protect against cardiovascular diseases and cancer.Beta carotene protects especially night vision plus it acts as a powerful antioxidant and provides protection against macular degeneration and development of snile cataracts (Ensminger and Ensminger, 1986).

Experimental and clinical studies on carrots (powder or extract) and its active constituents (mainly carotenoids) revealed that they have hyperglycemic effect **(**Suzuki et al., 2002 and Ylonen et al., 2003); anticancer activity due to the presence of alpha carotene and falcarinol (Michaud et al.,2002 and Kobaek-Larsen et al., 2005) protective effect against coronary heart disease (Gaziano et al.,1995 and Krichevesky, 1999), hypocholesterolemic and hypolipidemic activities (Nicolle et al., 2003 and Nicolle et al., 2004).

On the other hand, excessive consumption of carotene rich foods as carrots may lead to a condition called "carotenoderma" in which the palms and other skin develop a yellow color because the body slowly convert carotene to vitamin A. Fortunately, this condition disappears after reduction of carrot consumption (Ensminger and Ensminger, 1986).The aim of this research was to study the effect of feeding different concentrations of carrot on hepatotoxic rats.

MATERIAL AND METHODS

Material:

1- Carrot:

Carrot was purchased from a local market and dried in an oven under a vacuum and grinded in an electrical mixer to a fine powder.

2- Rats:

Seventy male albino rats of Sprague Dawley strain weighing 150-180 grams body weight and 10-12 weeks old were obtained from Laboratory Animal Colonies, Helwan, Egypt.

3- ***Induction of acute Hepatitis in rats:***

Carbon tetrachloride (Ccl4) an agent that is used to induce experimental acute hepatitis in rats. It was purchased from El Gomhorya Co., Egypt in the form of 40% liquid dispensed in 1 L plastic bottles.

4- ***Kits for biochemical analysis:***

Kits required for estimating parameters of lipid profile, liver and kidneys function were purchased from Gamma trade for Pharmaceutical and Chemical analysis, Dokki, Egypt.

Methods:

Preparation of the basal diet:

The basal diet for rats was prepared using AIN-93 according to **Reeves et al., (1993)**. The salt mixture was prepared according to Hegsted et al., (1941) .The vitamin mixture was prepared according to Cambpell (1963).

Grouping of rats and experimental design:

The experiment was conducted in the Faculty of Home Economics, Helwan University, Cairo. The rats were housed in wire cages at a room temperature maintained at 25°C (+/- 2°C) with a 12 hour lighting system. All rats were fed the basal diet for one week before starting the experiment for acclimatization. After the acclimatization period, the rats were allocated into two main equal groups as follows:

-The first main group consists of 35 rats divided into 5 equal subgroups as follows :

Subgroup (1) was fed on the basal diet only ; control (-Ve).

The other 4 subgroups were subcutaneously administered a single dose of Ccl4 (30% V/V) in paraffin oil (1ml/kg) for 2 days from start of the experimental period, to induce acute hepatic damage according to the method described by Nadeem et al., (1996).

Subgroup (2) was fed on the basal diet only; control (+Ve).

Subgroup (3) was fed on the basal diet containing 5% carrot powder.

Subgroup (4) was fed on the basal diet containing 10% carrot powder.

Subgroup (5) was fed on the basal diet containing 20% carrot powder.

-The second main group consists of 35 rats divided into 5 equal subgroups as follows :

Subgroup (1) was fed on the basal diet only ; control (-Ve).

At the end of the experiment in days 28 and 29, the rats were subcutaneously injected with 1 ml/kg of Ccl4 and divided into 4 subgroups as follows :

Subgroup (2) was fed on the basal diet only; control (+Ve).

Subgroup (3) was fed on the basal diet containing 5% carrot powder.

Subgroup (4) was fed on the basal diet containing 10% carrot powder.

Subgroup (5) was fed on the basal diet containing 20% carrot powder.

Determination of body weight gain % and feed efficiency ratio in rats:

Daily feed intake (FI) per group was calculated throughout the experimental period (28 days). The biological values of different diets were assessed by the determination of body weight gain (BWG) % and feed efficiency ratio (FER), according to the method of Chapman et al., (1959) .

At the end of the experimental period all rats were fasted overnight then sacrificed. Blood samples were immediately collected in clean and dried Wiesserman tubes from the portal vein and then centrifuged at 3000 rpm for 15 minutes .Serum samples were separated and frozen at -10°C until further determination of the tested parameters. The liver and kidneys were removed by careful dissection and blotted free of adhering blood immediately after sacrificing the rats. The organs were washed with cold saline solution and dried between two filter papers then weighed and kept for the histo-pathological examination.

Analytical Methods :

Serum cholesterol, triglycerides, high density lipoprotein cholesterol , low and very low density lipoprotein cholesterol , were determined according to the methods described by Trinder and Ann (1969), Wahlefeld (1974), Richmond (1973) and Friedwald, et. al.,(1972) respectively. The activities of aspartate amino transferase and alanine amino transferase were measured according to the method described by Reitman and Frankel (1957). Serum urea nitrogen**,** uric acid**,** creatinine were determined according to the methods described by Patton and Crouch, (1977), Fossati et al., (1980)and Husdan and Rapoport, (1968) respectively.

Histopathological Examination of Some Internal Organs:

Specimens from the liver and kidneys were taken immediately after sacrificing the rats and immersed in 10% neutral buffered formalin. The fixed specimens were then trimmed, washed, and dehydrated in ascending grades of alcohol, then cleared in xylene, embedded in paraffin, sectioned at 4-6 micron thickness and stained with Hematoxylen and Eosin (Carleton, 1979) and examined microscopically.

Statistical analysis :

Data were presented as mean ±SDM and statistically analyzed using one way analysis of variance (ANOVA).Student "t" test was used for significance according to Armitage and Berry (1987) .

RESULTS And DISSCUTION

Effect of feeding carrot powder on daily feed intake, body weight gain and feed efficiency ratio in hepatotoxic rats:-

Administration of Ccl4, s/c to male rats in the first and the last two days of experimental period decreased daily feed intake compared to control - ve. Feeding carrot powder to Ccl4 intoxicated rats at concentrations of 5, 10 and 20% increased daily feed intake compared to control +ve as shown in Table (1). Concerning body weight gain (BWG) percent, administration of Ccl4 significantly ($P<0.05$) decreased BWG% by 58.2 % compared to control – ve in the treatment group. Feeding carrot at 5, 10 and 20% significantly ($P<0.05$) improved BWG% by 36.32, 39.9 and 62.9% respectively compared to control + ve intoxicated rats in the first two days of the experimental period as shown in Table (1). Feeding carrot at 5, 10 and 20% for 28 days to rats received Ccl4 (s/c) in the last 2 days of the experimental period significantly ($P<0.05$) increased BWG by 46.8, 78.2 and 85.77% respectively compared to control + ve. The increase in body weight gain by feeding carrot could be attributed to its high content of beta carotenes, provitamin A, which cause an improvement of growth as reported by Koch and Goldman (2004) who established that carotenoids as beta carotenes are health functional phytochemicals that occur in many fruits and vegetables, especially carrots. However, Guangwen et al., (2005) concluded that human consumptions of spinach and carrots can provide a significant amount of vitamin A, but this amount is not as great as previously reported. The authors explained this finding on the basis that food matrix greatly affect the bioavailability of plant carotenoids and/or their efficiency of

conversion to vitamin A. Carbon tetrachloride when injected s/c with Ccl4 to rats at last 2 days of the experimental period significantly ($P<0.05$) reduced BWG% by 38.2% compared to control - ve as recorded in Table (1) . Administration of Ccl4 to rats in the first two days of the experimental period significantly decreased feed efficiency ratio compared to control -ve. Feeding of carrot at concentrations 5, 10 and 20% to these rats increased feed efficiency ratio compared to control + ve. The same results were obtained when Ccl4 was injected in the last two days of feeding period as recorded in Table (1).

Table (1): Effect of feeding different concentrations of carrot on daily feed intake (*g* /day) , body weight gain percent (BWG%) and feed efficiency ratio(FER) in rats injected s/c with Ccl4 in the first (A) and the last (B) two days of the experimental period (n = 7 rats).

Groups	Mean of daily feed intake (*g*/day)		Mean ± SE			
			BWG %		FER	
	A	B	A	B	A	B
Control (-)Ve	11.6	11.6	55.333 ± 3.429^{a}	55.333 ± 3.429^{b}	0.226 ± 0.008^{a}	0.226 ± 0.008^{a}
Control (+)Ve Ccl4	9.88	10.42	23.116 ± 2.075^{d}	34.180 ± 2.953^{c}	0.105 ± 0.011^{c}	0.167 ± 0.014^{b}
5 % Carrot	10.39	11.89	31.514 ± 1.577^{b}	50.183 ± 3.788^{b}	0.176 ± 0.008^{b}	0.169 ± 0.012^{b}
10 % Carrot	10.8	12.47	32.332 ± 2.196^{c}	60.915 ± 2.633^{a}	0.178 ± 0.015^{b}	0.198 ± 0.006^{a}
20% Carrot	11.9	13.07	37.665 ± 1.790^{c}	63.498 ± 2.865^{a}	0.189 ± 0.012^{b}	0.219 ± 0.007^{a}

Effect of feeding carrot powder on some serum constituents in hepatotoxic rats:-

Results of biochemical analyses revealed that administration of Ccl4 to rats in the first two days of experimental period significantly ($P<0.05$) increased the level of both total cholesterol and triglycerides compared to control - ve as shown in Table (2) .

subcutaneous administration of Ccl4 to male rats in the first and the last two days of the experimental period significantly increased both total cholesterol by 50.7, 23.8% and triglycerides by 86.8, 58.3% respectively as recorded in Table (2).

Feeding of carrot at 5, 10 and 20% in diet significantly (P<0.05) decreased serum total cholesterol by 10.34, 14.44 and 20.6% respectively compared to control + ve. The corresponding percentages of increases of triglycerides were 16.33, 20.6 and 24.6% compared to control + ve.

As shown in Table (2), administration of Ccl4 (s/c) at the last 2 days of carrot feeding significantly increased serum total cholesterol and triglycerides levels compared to control - ve.

Feeding of carrot at 5, 10 and 20% significantly (P<0.05) lowered the level of total cholesterol by 9.9, 12.4 and 19.15%, respectively compared to control + ve. The corresponding increases in serum triglycerides were 25.19, 32.25 and 35.29%, respectively compared to control + ve .

Table (2): Effect of feeding different concentrations of carrot on serum levels of cholesterol and triglycerides injected s/c with Ccl4 in the first (A) and the last (B) two days of the experimental period (n = 7 rats).

Groups	Parameters			
	Cholesterol (mg/dL)		Triglycerides (mg/dL)	
	(A)	(B)	(A)	(B)
Control (-) Ve	93 ± 1.612 ^{c}	93 ± 1.612 ^{d}	56.833 ± 2.151 ^{d}	56.833 ± 2.151 ^{c}
Control (+) Ve (Ccl4)	140.167 ± 3.525 ^{a}	118.121 ± 1.928 ^{a}	106.167 ± 3.772 ^{a}	90 ± 1.850 ^{a}
5 % Carrot	125.669 ± 3.512 ^{b}	103.725 ± 2.321 ^{b}	88.833± 2.313 ^{c}	67.332 ± 2.422 ^{b}
10 % Carrot	114.922 ± 2.552 ^{b}	100.855 ± 1.991 ^{bc}	84.292 ± 1.990 ^{b}	60.975 ± 2.568 ^{c}
20 % Carrot	111.3 ± 2.552 ^{c}	93.124 ± 1.585 ^{cd}	80 ± 3.504 ^{bc}	58.243 ± 1.537 ^{c}

Effect of feeding carrot powder on lipid profile in hepatotoxic rats:-

Administration of Ccl4 (s/c) to rats in the first and the last two days of the feeding period (28 days) significantly (P<0.05) decreased HDL-c by 33.6,20.7% respectively. While increased LDL-c and VLDL-c compared to control – ve as shown in Table (3).

Feeding carrot at 5, 10 and 20% significantly (P<0.05) increased HDL-c in the first two days of the experimental periods by 7.98,19.77 and 31.75% respectively compared to control +ve as shown in Table (3). The

corresponding percentages of increases of HDL-c in the last two days of the experimental periods by 4.29,16.05 and 23.86% respectively compared to control +ve as shown in Table (3).

Feeding of carrot at 5, 10 and 20% significantly ($P<0.05$) lowered the level of LDL-c in the first and the last two days of the experimental periods by 19.34 ,39.32 ,50 ,25.33 ,41.57 and 65.17% respectively compared to control + ve as shown in Table (3). The corresponding decreases in VLDL-c in the first and the last two days of the experimental periods by were 16.32 , 20.6 , 24.64 , 25.18 , 32.25 and 35.28 %respectively compared to control + ve as shown in Table (3). feeding carrots to Ccl4 intoxicated rats, either in the first or in the last two days of feeding period, significantly decreased the serum level of total cholesterol, triglycerides and LDL cholesterol, but increased HDL cholesterol. These findings agree with those reported by Esmaiel et al., (1992); Tsai et al., (1992), Sukemori et al., (1995); Whittaker et al., (1996); Balasubraniam et al., (1998) and Nicolle et al., (2003) in rats and Nicolle et al., (2004) in mice**.** The hypocholesterolemic effect of carrots, reported in this study, could be explained on the basis that carrots are rich in dietary fibers and it was reported by Esmaiel et al., (1992) that diets containing high crude fibers prevent or delay intestinal absorption and/or utilization of cholesterol. Moreover, Nicolle et al., (2004) concluded that carrot consumption protects against cardiovascular disease as it decreases lipideamia, decreases cholesterol absorption and improves antioxidant status in mice. The authors attributed these actions to the synergistic effect of crude fibers and the associated antioxidant active principles of carrots.

Table (3): Effect of feeding different concentrations of carrot on serum HDL , LDL and VLDL Cholesterol levels in rats injected s/c with Ccl4 in the first (A) and the last (B) two days of the experimental period (n = 7 rats).

Groups	parameters					
	HDL- c (mg/dL)		LDL –c (mg/dL)		VLDL-c (mg /dL)	
	(A)	(B)	(A)	(B)	(A)	(B)
Control (-) Ve	66 ± 2.380 a	66±2.380 a	15.633 ± 1.395 c	15.633±1.395 e	11.367±0.430 d	11.367±0.430 c
Control (+) Ve (Ccl4)	43. 833 ± 1.537 c	52.34±0.885 b	75.1 ± 1. 348 a	47.781±0.742 a	21.233±0.754 a	18±0.370 a
5 % carrot	47.333 ± 2.109 b	54.588±1.796 b	60.57 ± 1. 737 b	35.675±0.564 b	17.766±0.463 c	13.466±0.484 b
10 % carrot	52.5 ± 0.919 bc	60.742±2.239 a	45.564 ± 1. 689 b	27.918±0.967 c	16.858±0.398 b	12.195±0.514 c
20 % carrot	57.75 ± 2.120 a	64.833±1.454 a	37.55 ± 1. 589 c	16.642±0.359 d	16±0.701 bc	11.649±0.307 c

Effect of feeding carrot on serum liver enzymes (AST) and (ALT) intoxicated rats:-

Administration of Ccl4 (s/c) to rats in the first and the last two days of the feeding period (28 days) significantly (P<0.05) decreased AST and ALT by 16.670 ,9.35, 75.764 and 44.839% respectively. compared to control – ve as shown in Table (4).

Feeding carrot at 5, 10 and 20% significantly (P<0.05) decreased AST in the first two days of the experimental periods by 5.134 ,8.066 and 8.939% respectively compared to control +ve as shown in Table (4). The corresponding percentages of decreased AST in the last two days of the experimental periods by 3.607,5.901 and 8.392% respectively compared to control +ve as shown in Table (4).

Feeding carrot at 5, 10 and 20% significantly (P<0.05) decreased ALT in the first two days of the experimental periods by 14.477 ,20.791 and 26.423% respectively compared to control +ve as shown in Table (4). The corresponding percentages of decreased ALT in the last two days of the experimental periods by 12.216 , 22.656 and 28.56% respectively compared to control +ve as shown in Table (4) .These findings are similar to those reported by Bishayee et al., (1995) who evaluated the effect of carrot extract on Ccl4-induced acute liver damage in rats. The results revealed that carrot

decreases the levels of AST, ALT and ALP in the serum of rats pretreated with the extract. The authors concluded that carrot can afford a significant protective action in the alleviation of Ccl4 induced hepatocellular injury. Moreover, Balasubrmanian et al., (1998) mentioned that carrot (*Daucus carrot*, L) is widely used in European folk medicine to treat jaundice and liver disorders. The authors, experiment showed that oral administrations of carrot extract for 30 days to lindane hepatotoxic rats decreased the serum levels of AST, ALT and ALP in lindane + carrot extract also restored the depressed antioxidant and HDL cholesterol levels by lindane to near normal. In addition, the increased activity of liver enzymes (AST and ALT) following carrot feeding to Ccl4 hepatotoxic rats is confirmed by presence of an improvement or alleviation of Ccl4 induced hepatocellular damage after histopathological examination of the liver, in the present study. The mechanism of hepatoprotective activity of carrot as attributed to presence of excellent antioxidant phytochemicals in carrots (Nicolle et al., 2003 and Nicolle et al., 2004).

Table (4): Effect of feeding different concentrations of carrot on serum levels of AST and ALT enzyme in rats injected s/c with Ccl4 in the first (A) and the last (B) two days of the experimental period (n = 7 rats).

Groups	Parameters			
	AST(U/L)		ALT(U/L)	
	(A)	(B)	(A)	(B)
Control (-) Ve	65.775±1.807 ^{d}	65.775±1.807 ^{d}	31.452±2.008 ^{d}	31.452±1.008 ^{c}
Control (+) Ve (Ccl4)	76.74±1.682 ^{a}	71.925±1.347 ^{a}	55.253±2.819 ^{a}	45.555±1.016 ^{a}
5 % carrot	72.8±1.167 ^{b}	69.33±1.274 ^{ab}	47.254±2.002 ^{b}	39.99±1.239 ^{b}
10 % carrot	70.55±1.879 ^{c}	67.68±1.433 ^{b}	43.765±1.604 ^{c}	35.234±1.554 ^{c}
20 % carrot	69.88±1.553 ^{c}	65.889±1.617 ^{c}	40.653±1.970 ^{c}	32.544±1.532 ^{c}

Effect of feeding carrot powder on urea nitrogen, uric acid and Creatinine serum levels in hepatotoxic rats:-

Results of biochemical analyses revealed that administration of Ccl4 (s/c) in the first two days of the experimental period significantly ($P<0.05$)

increased the levels of urea nitrogen, uric acid and creatinine in serum of hepatotoxic rats compared to control -ve.

Feeding of carrot at 10 and 20% in the first two days of the experimental period significantly ($P<0.05$) decreased urea nitrogen, uric acid and creatinine while at concentration of 5% non significant decreases were recorded compared to control +ve as shown in Table (5) .

Administration of Ccl4 (s/c) at the last 2 days of carrot feeding significantly increased the levels of urea nitrogen, uric acid and creatinine in serum of hepatotoxic rats by 26 ,11.58 and 53.09 % respectively compared to control -ve.

Feeding of carrot at 5, 10 and 20% for 28 days in rats injected with Ccl4 (s/c) in the last 2 days of the experimental feeding period showed significant ($P<0.05$) decreases the levels of urea nitrogen, uric acid and creatinine compared to control +ve as shown in Table (5) .

Table (5): Effect of feeding different concentrations of carrot on serum levels of urea nitrogen (mg/dL), uric acid(mg/dL) and creatinine (mg/dL) in rats injected s/c with Ccl4 in the first (A) and the last (B) two days of the experimental period (n = 7 rats).

Groups	Parameters					
	Uric acid (mg/dL)		Urea Nitrogen (mg/dL)		Creatinine (mg/dL)	
	(A)	(B)	(A)	(B)	(A)	(B)
Control (-) Ve	2.02±0.124^{d}	2.02±0.124^{b}	22.667±0.83^{c}	22.667±0.83^{d}	0.55±0.022^{c}	0.55±0.022^{c}
Control (+) Ve (Ccl4)	3.317±0.187^{a}	2.254±0.054^{a}	39.5±0.847^{a}	28.564±1.66^{a}	1.917±0.040^{a}	0.842±0.026^{a}
5 % carrot	3.125±0.116^{ab}	1.875±0.066^{b}	35.167±1.78^{a}	26.888±0.49^{b}	1.75±0.096^{a}	0.715±0.018^{b}
10 % carrot	2.753±0.152^{bc}	1.975±0.053^{b}	34.777±1.73^{b}	25.765±0.882^{bc}	1±0.113^{b}	0.675±0.017^{b}
20 % carrot	2.558±0.056^{c}	1.953±0.060^{b}	32±1.483^{b}	23.532±0.677^{cd}	0.633±0.033^{c}	0.597±0.008^{c}

Histopathological examinations

The histopathological examination of kidneys obtained from these rats showed an amiloration of renal damage induced by Ccl4, these findings can be possibly explained on the basis that carrots are an excellent source of vitamin A and a very good source of vitamin C according to the World's

Healthiest Food Rating System. The study of Kanter et al., (2005) documented the protective effect of vitamin A and C combination against oxidative renal damage induced by endotoxin in rats. Results of the previous study by Kanter et al., (2005) showed that treatment with both vitamin A and C significantly decreased malondialdehyde levels, serum nitric oxide, urea and creatinine concentrations and prevent renal tissue damage in endotoxemic rats. The authors concluded that treatment with combination of vitamin A and C may be beneficial in preventing endotoxin induced oxidative renal tissue damage as shows potential for its clinical use.

Histopathological examination of the liver and kidneys revealed that feeding carrot supplemented diet to Ccl4-intoxicated rats reduced or prevented the hepato renal damages and lesions induced by Ccl4 intoxication. These findings agree with those reported by Senoo and Wake (1985) Sarker et al., (1995) and He et al., (1997) on the liver and by Kanter et al., (2005) on the kidneys. In conclusion, due to both nutritive value and medicinal properties of carrot as it is rich in carotenoids, vitamins, minerals and crude fibers it may be useful in preventing acute hepato renal damage. Moreover, carrot possess marked hypocholesterolemic and antihyperlipidemic activities, so it may be beneficial for preventing hypercholes-terolemia associated with hyperlipidemia. Carrot is an excellent source of vitamin A and a very good source of vitamin C, therefore it may be useful in reducing oxidative stress on the body cells and improving growth, especially in preschool children.

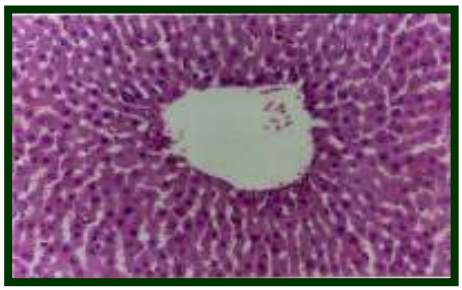

Fig (1): C.S. of a liver of control , untreated rats showing the normal histological hepatic lobule.

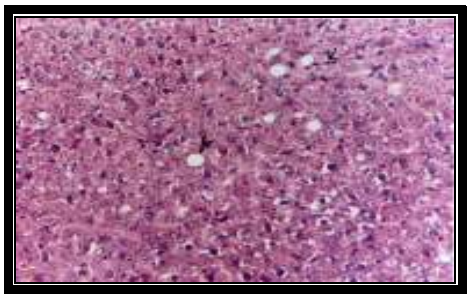

Fig (2): C.S. of a liver of rats intoxicated with Ccl4 at the first 2 days showing activation of Kupffer cells .

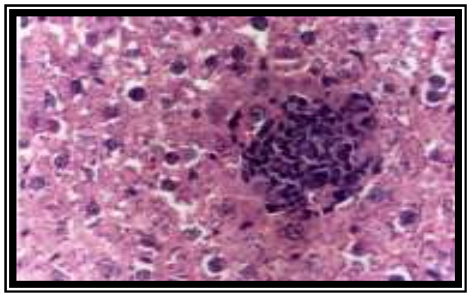

Fig (3): C.S. of a liver of rats intoxicated with Ccl4 and fed with 5% carrot at the first 2 days showing small focal hepatic necrosis .

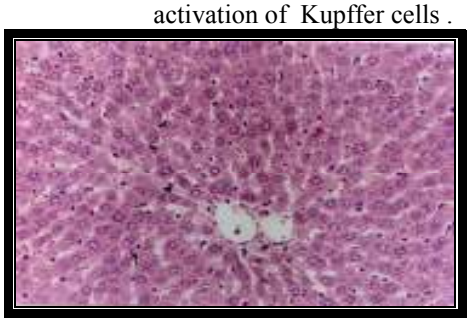

Fig (4): C.S. of a liver of rats intoxicated with Ccl4 and fed with 20% carrot at the first 2 days showing only a slight activation of Kupffer cells .

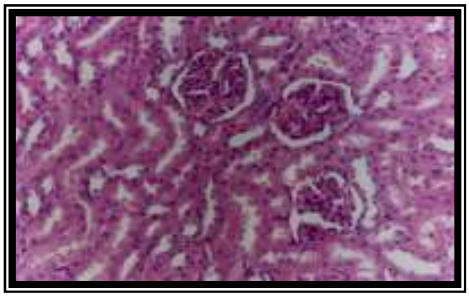

Fig (5): C.S. of a kidney of control , untreated rats showing the normal histological structure of renal parenchyma.

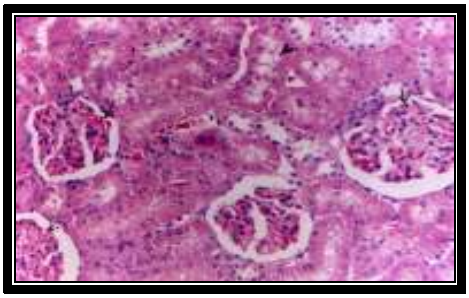

Fig (6): C.S. of a liver of rats intoxicated with Ccl4 at the first 2 days showing activation of Kupffer cells .

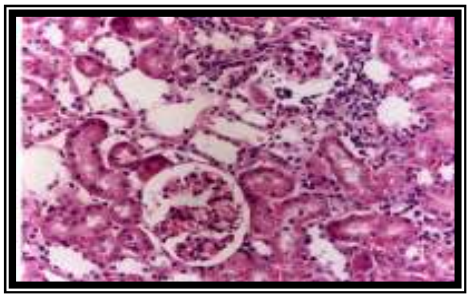

Fig (7): C.S. of a kidney of rats intoxicated with Ccl4 and fed with 5% carrot at the first 2 days showing a focal tubular necrosis associated with mononuclear cells infiltration.

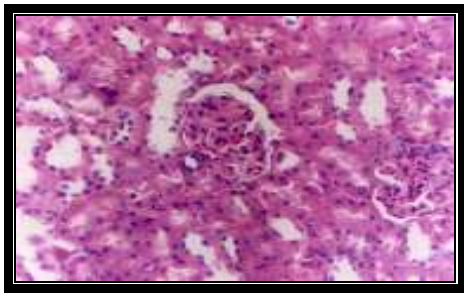

Fig (8): C.S. of a kidney of rats intoxicated with Ccl4 and fed with 20% carrot at the first 2 days showing appearantly normal architecture**.**

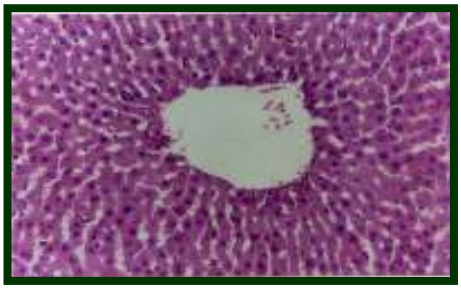

Fig (9): C.S. of a liver of control, untreated rats showing the normal histological hepatic lobule.

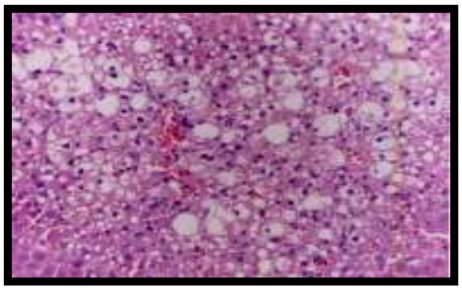

Fig (10): C.S. of a liver of Ccl4 intoxicated rats at the last 2 days showing multiple centrilobular hepatocytic lipidosis.

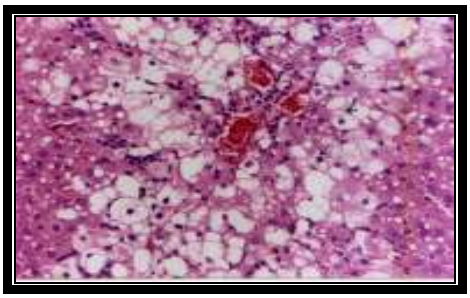

Fig (11): C.S. of a liver of rats intoxicated with Ccl4 and fed with 5% carrot at the last 2 days showing congestion and ballooning degeneration of hepatocytes.

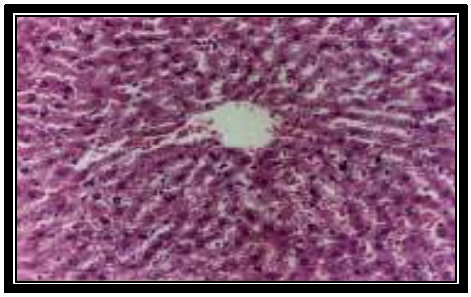

Fig (12): C.S. of a liver of rats intoxicated with Ccl4 and fed with 20% carrot at the last 2 days showing some apparent normal hepatocytes and the other hepatocytes with slight cytoplasmic vacuolations .

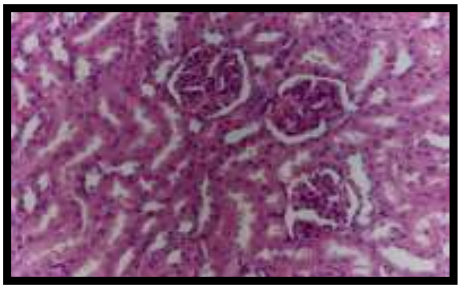

Fig (13): C.S. of a kidney of control , untreated rats showing the normal histological structure of renal parenchyma.

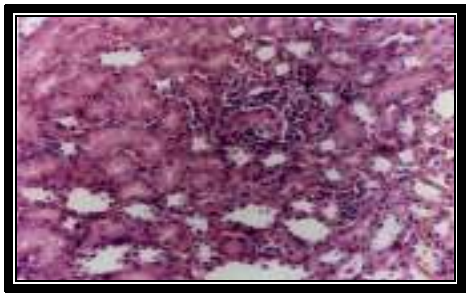

Fig (14): C.S. of a kidney of Ccl4 intoxicated rats at the last 2 days showing focal tubular necrosis infiltrated with mononuclear cells.

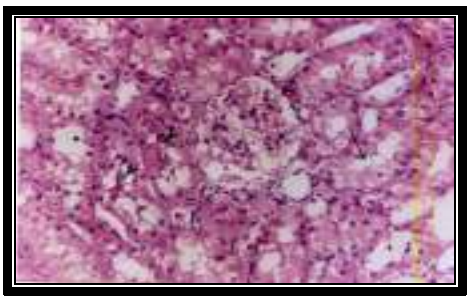

Fig (15): C.S. of a kidney of rats intoxicated with Ccl4 and fed with 5% carrot at the last 2 days showing hypertrophy of glome-rular tuft .

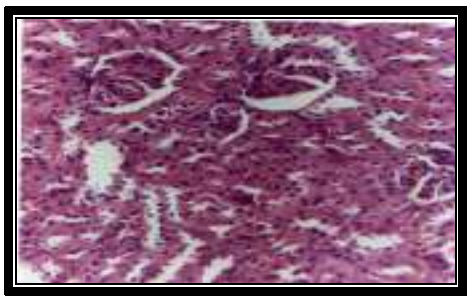

Fig (16): C.S. of a kidney of rats intoxicated with Ccl4 and fed with 20% carrot at the last 2 days showing apparent normal histo-logical structure .

In conclusion, this research proved that carrot exerts a marked hepatoprotective effect against Ccl4 induced liver damage in rats. Moreover , the hepatoprotective effect of carrot is more marked than its curative effect.

Therefore ,this study recommend consumption of carrot as a hepatoprotective to reduce incidence of liver diseases.

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