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مجلة البحوث في مجالات التربية النوعية

معرف البحث الرقمي DOI: 10.21608/jedu.2021.96737.1468

المجلد السابع . العدد 37 . نوفمبر 2021

الترقيم الدولي

P-ISSN: 1687-3424 E- ISSN: 2735-3346

موقع المجلة عبر بنك المعرفة المصري https://jedu.journals.ekb.eg/

موقع المجلة http://jrfse.minia.edu.eg/Hom

العنوان: كلية التربية النوعية . جامعة المنيا . جمهورية مصر العربية

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Abstract:

This investigation aimed to evaluate the effect of turmeric, curry leaves and mix diets on hepatointoxicated rats injected with CCl_4. Thirty (30) adult male Sprague Dawley rats were divided into five groups. Group (1): Normal rats fed on basal diet as control negative (C-), Group (2): Control positive (C+) (untreated group). Group (3): Hepatointoxicated rats injected with CCl_4 fed on basal diet and turmeric (4%).Group (4) Hepatointoxicated rats injected with CCl_4 fed on basal diet and curry leaves (4%). Group (5): Hepatointoxicated rats injected with CCl4 fed mix diets (4%). At the end of experiment, after 28 days of feeding, all serum samples were analyzed for biochemical parameters. Injection with CCl_4 caused significant decreases in BWG, FI, FER, TP, Alb, Glb, HDL & antioxidant enzymes with significant increases recorded also in organs weight, TC, TG, VLDL, LDL, U.A, creatinine, urea, GOT, GPT, ALP, glucose, total bilirubin, direct bilirubin (D.B) and indirect bilirubin (I.B). Rats treated with various (turmeric, curry) diets, showed the improvement in all previous parameters.

Key words: Liver, Turmeric, Carry leaves and Mix diets.

Introduction:

Medicinal herbs have been used as treatment modalities since ages in many parts of the world and have been variedly used throughout human history. The most common natural product from such herbs used for medicinal purposes is polyphenols since it has the most antioxidant effect.

Turmeric is obtained from the rhizome of *Curcuma longa L*. (Zingiberaceae family. Three curcuminoids, curcumin, demethoxycurcumin, and bisdemethoxycurcumin, of which curcumin is the most prevalent, are among many bioactive ingredients in turmeric. The yellow pigment curcumin or diferuloylmethane makes up 60% to 70% of crude turmeric extracts and is the principal curcuminoid evaluated for health-promoting activities **(Nelson *et al*., 2017)**.

In addition, turmeric contains sugars, proteins, resins, and volatile oils, such as turmerone, atlantone, and zingiberene, some of which may have bioactivity as well **(Nelson *et al*., 2017; Kawasaki *et al*., 2018)**.

Recent studies have authenticated turmeric as anticancer, anti-diabetic, antioxidant, hypolipidemic, antiinflammatory, antimicrobial, anti-fertility, anti-venom, hepatoprotective, nephroprotective, anticoagulant, etc. These medicinal properties of turmeric caused it to be considered as a spice with multifunctional medicinal properties **(Nasri *et al*., 2014)**.

Murraya koenigii, commonly known as curry leaf or curry patta in Indian dialects, which represent more than 150 genera and 1600 species. Curry leaves belongs to the family Rutaceae. *M. koenigii* is a highly valued plant for its aroma and medicinal value. *M. koenigii* contains a number of chemical constituents that interact to elicit their Pharmacodynamic response **(Jain *et al*., 2012).**

The matured curry leaves consist 63.2% of moisture, protein which is of about 1.15% of nitrogen, carbohydrate 14.6% which is of total sugars and total ash 13.06%. The bioactive components in curry leaves are oxalic acid, resin, carbazole alkaloids and the major bioactive compounds such as the koenigin, bicyclomahanimbicine, cyclomahanimbine, murrayastine, coumarine, koenidine and pypayafolinecarbazole has signaficant pharmacological activities and the major portion of volatile oil consist of bicyclomahanimbicine, mahanimbicine **(Ganesan *et al*., 2013)**.

It also revealed hepato-protective activity against ethanol-induced hepatotoxicity. Chronic ethanol consumption diminishes the cellular antioxidant levels through free radical induced injury causing hepatitis and cirrhosis with mortality in severe cases **(Patil *et al*., 2012)**.

Materials and Methods:

Materials:

Turmeric and curry leaves were obtained dry from a herb shop.

Chemicals:

CCl_4 was a Website manufacture Product, Milan Italy.

Animals:

Thirty (30) adult male Sprague Dawley rats, average body weight (150± 10 g) were used in this study.

Methods:

Basal diet composition of tested rats:

The basal diet in the experiment consisted of casein (12%), corn oil (10%), mineral mixture (4%), vitamin mixture (1%), cellulose (5%), chorine chloride (0.2%), methionine (0.3%) and the remained is corn starch (67.5%) according to **AIN (1993)**.

Preparation of materials:

All materials were milled to soft powder by using electric grinder and kept in dusky stoppered glass bottles in a cool and dry location till use according to **Russo (2001)**.

Injection with CCl_4 in rats:

Rats were injected by carbon tetrachloride (CCl_4) at 0.5 mg/Kg body weight, twice in week and for two weeks. CCl_4 dissolved firstly in olive oil **(Iredale *et al*., 1998)**.

Experimental design and animal groups:

Rats were housed in wire cages under the normal laboratory condition, and were fed on basal diet for a week as an adaptation period. The rats were divided into 5 groups each of 6 rats. All groups of rats were housed in wire cages at room temperature 25 C^0, and kept under normal healthy condition. Rats were divided into the following groups:

Group (1): Control negative group (-), in which normal rats were fed on basal diet.

Group (2): Control positive group (+), in which rats injected with CCl4 were fed on basal diet.

Group (3) Rats injected with CCl4 fed on basal diet + turmeric 4%.

Group (4): Rats injected with CCl4 fed on basal diet + curry leaves 4%.

Group (5): Rats injected with CCl4 fed on basal diet + mix diets 4%.

Determination of Biochemical Blood Parameters:

Blood samples were collected after 12 hours fasting at the end of experiment using the abdominal aorta. The rats firstly were scarified under ether anaesthesia. Blood samples were received into in clean dry centrifuge tubes, in which blood was left to clot at room temperature, and then centrifuged for 10 minutes at 3000 r.p.m to separate the serum. Serum was carefully aspirated and transferred into clean cuvette tubes and stored frozen at-20^{o}C for biochemical analysis as described by **Schermer (1967)**. All serum samples were analyzed for determination the following parameters:

Urea was determined according to the enzymatic method of **Patton and Crouch (1977)**, creatinine was determined according to kinetic method of **Henry (1974)** and uric acid was according to the enzymatic colorimetric test of **Fossati and Prencipe (1980)**. Aspartate amino transaminase (AST) and alanine amino transferase (ALT) were carried out according to the methods of **Yound (1975) and Tietz (1976)**. Alkaline phosphatase (ALP) was determined according to **Belfield and Goldberg (1971)**. Total cholesterol (TC) was determined according to **Allain (1974),** and high density lipoprotein cholesterol (HDL-c) according to **Lopez (1997)**. The calculation of low density lipoprotein cholesterol (LDL-c) was carried out according to the method of **Lee and Nieman (1996)**, atherogenic index (AI) was calculated according to **Kikuchi *et al*., (1998)** and triglycerides as **Fossati and Prencipe (1982)**.Serum glucose determined according to **Kalpan (1984)**. Serum albumin was carried out to the method of **Doumas *et al*., (1971)** and globulin was calucalted as **Charry and Sharma (2004)**. Bilirubin was determined according to **Doumas *et al*., (1985)**, direct bilirubin and indirect bilirubin were measured according to **Sepulveda and Osterberg (1943).** Antioxidant enzymes in serum were determined including SOD was assayed according the methods of **Kakkar *et al*., (1984)**, CAT activity was assayed the method of **Luck (1974)** & GPx was assayed according to the method of **Habig *et al*., (1974)**.

The liver was removed, washed in saline solution, wiped by filter paper, weighted, and stored frozen in formalin solution 10% for histological testing according to method mentioned by **(Drury and Wallington, 1980)**.

Statistical Analysis:

The data were statistically analyzed using a computerized Costat Program by one way ANOVA using a Completely Randomized Factorial Design **(SAS, 1988)**, when a significant mean effect was detected, the means were separated with the Duncan's Multiple Range Test. Differences between treatments at

$P \leq 0.05$ were considered significant. The results are presented as mean ± SD.

Results and Discussion:

Data presented in table (1) illustrate the effect of turmeric, curry and mixture of both on BWG, FI and FER of hepatointoxicated rats. It could be observed that the mean value of (BWG) of control (-) group was higher than control (+) group, being 0.64±0.007 and 0.21±0.004g respectively. The best (BWG) level was showed for groups 5 (rats fed on basal diet containing 4% mix diets) when compared to control (+) group.

It could be noticed that the mean value of FI of control (-) group was higher than control (+) group, being 21.67±0.008 and 16.50±0.003 g respectively. The best (FI) level was showed for group 5 (rats fed on basal diet + 4% mixture) when compared to control (+) group.

Also, data of table (1) observed that the mean value of (FER) of control (-) group was higher than control (+) group, being 0.030±0.0001 and 0.013±0.0009 respectively. The best FER was shown for group 5 (rats fed on basal diet +4% mixture) when compared to control (+) group.

Table (1): Effect of turmeric, curry and mix diets on body weight gain (BWG), feed intake (FI) and feed efficiency ratio (FER) on on hepatointoxicated rats injected with CCl_4

Parameters / Groups	BWG (g) Mean ± SD	FI (g) Mean ± SD	FER (%) Mean ± SD
G1: Control –ve	0.64^{a} ±0.007	21.67^{a} ±0.008	0.030^{a}±0.0001
G2: Control +ve	0.21^{e} ±0.004	16.50^{e} ±0.003	0.013^{c}±0.0009
G3: Turmeric (4%)	0.56^{c} ±0.005	18.89^{c} ±0.002	0.030^{a}±0.0005
G4: Curry (4%)	0.50^{d} ±0.002	18.30^{d} ±0.009	0.027^{b}±0.0004
G5: Mix diets (4%)	0.62^{b} ±0.009	19.90^{b}± 0.005	0.031^{a}±0.0007
LSD	0.011	0.011	0.001

Values in each column with different letters are significantly different (P<0.05).

Data presented in table (2) show the effect of turmeric, curry and mixture on organs weight of hepatointoxicated rats. It could be observed that the mean value of liver of control (+) group was higher than control (-) group, being 8.3±0.04 and 6.4±0.07g respectively. The best liver weight was showed for groups 5 (rats fed on basal diet containing 4% mixture) when compared to control (+) group.

It could be observed that the mean value of heart weight of control (+) group was higher than control (-) group, being

1.8±0.07 and 0.88±0.003g respectively. The best heart weight showed for group 5 (rats fed on basal diet + 4% mixture) when compared to control (+) group.

The same table indicated that the mean value of lungs weight of control (+) group was higher than control (-) group, being 2.3±0.03 and 1.2±0.06 g respectively. The best lungs weight showed for group 5 (rats fed on basal diet + 4% mixture) when compared to control (+) group.

Also, data of table (3) noticed that the mean value of spleen weight of control (+) group was higher than control (-) group, being 1.5±0.06 and 1.0±0.03 g respectively. The best spleen weight was shown for group 5 (rats fed on basal diet + 4% mixture) when compared to control (+) group.

It could be noticed that the mean value of kidneys weight of control (+) group was higher than control (-) group, being 2.5±0.08 and 1.8±0.05 g respectively. The best kidneys weight showed for group 5 (rats fed on basal diet + 4% mixture) when compared to control (+) group.

Table (2): Effect of turmeric, curry and mix diets on organs weight (g) on hepatointoxicated rats injected with CCl_4

Parameters / Groups	Liver (g) Mean ±SD	Heart (g) Mean ±SD	Lungs (g) Mean ±SD	Spleen (g) Mean ±SD	Kidneys (g) Mean ±SD
G1: Control –ve	6.4^{c}±0.07	0.88^{e}± 0.003	1.2^{c}±0.06	1.0^{c}±0.03	1.8^{d}±0.05
G2: Control +ve	8.3^{a}±0.04	1.8^{a}± 0.07	2.3^{a}±0.03	1.5^{a}±0.06	2.5^{a}±0.08
G3: Turmeric (4%)	6.9^{b}±0.02	1.3^{c}± 0.08	1.2^{c}±0.09	1.1^{bc}±0.08	2.1^{c}±0.04
G4: Curry (4%)	7.0^{b}±0.11	1.5^{b}± 0.04	1.5^{b}±0.02	1.2^{b}±0.02	2.3^{b}±0.09
G5: mix diets (4%)	6.5^{c}±0.01	1.0^{d}± 0. 04	1.1^{c}±0.05	0.98^{c}± 0.002	1.99^{c}± 0.002
LSD	0.11	0.09	0.1	0.1	0.1

Values in each column with different letters are significantly different ($P<0.05$).

Data presented in table (3) illustrate the effect of turmeric, curry and mixture on total cholesterol and triglycerides of hepatointoxicated rats. It could be observed that the mean value of total cholesterol (TC) of control (+) group was higher than control (-) group, being 102±0.18 and 72±0.13 mg/dl respectively. The best serum (TC) level showed for groups 5 (rats fed on basal diet containing 4% mix diets) when compared to control (+) group.

It could be noticed that the mean value of triglycerides TG of control (+) group was higher than control (-) group, being 99±0.24 and 50±0.27 mg/dl respectively. The best serum (TG) level showed for group 5 (rats fed on mix diet 4%) when compared to control (+) group.

Das and Biswas, (2012) reported that oral administration of the aerial parts of ethanolic extract of the aerial parts of curry leaves at a concentration of 150 mg/kg b.w. daily to rats for 15 days showed a significant protection against induced decrease in serum cholesterol.

Qin *et al.*, (2017) indicated that turmeric and curcumin significantly reduced serum TG & TC levels as compared to those in the control group in patients with cardiovascular risk factors.

Table (3): Effect of turmeric, curry and mix diets on total cholesterol (TC) and triglycerides (TG) on hepatointoxicated rats injected with CCl_4

Parameters / Groups	TC (mg/dl) Mean ± SD	(TG mg/dl) Mean ± SD
G1: Control –ve	72^{b}±0.13	50^{d}±0.27
G2: Control +ve	102^{a}±0.18	99^{a}±0.24
G3: Turmeric (4%)	71^{c}±0.11	54^{c}±0.21
G4: Curry (4%)	72^{b}±0.16	55^{b}±0.29
G5: Mix diets (4%)	70^{d}±0.19	50^{d}±0.23
LSD	0.28	0.45

Values in each column with different letters are significantly different ($P<0.05$).

Data presented in table (4) show the effect of turmeric, curry and mixture on HDLc, LDLc, & VLDLc of hepatointoxicated rats.

It could be observed that the mean value of ($VLDL_C$) of control (+) group was higher than control (-) group, being 19.8±0.03 and 10±0.05 mg/dl respectively. The best serum VLDLc was shown for group 5 (rats fed on basal diet + 4% mix) when compared to control (+) group.

It could be showed that the mean value of (HDLc) of control (-) group was higher than control (+) group, being 47±0.07 and 33^{d}±0.14 mg/dl respectively. The best serum HDLc was shown for group 5(rats fed on basal diet containing 4% mix) when compared to control (+) group.

The same table indicated that the mean value of (LDLc) of control (+) group was higher than control (-) group, being 49.2±0.04 and 15±0.04 mg/dl respectively. The best serum LDLc was shown for group 5 (rats fed on basal diet +4% mix) when compared to control (+) group. AI value was also best for group 5.

Xie *et al.*, (2006) found that biochemical response of curry leaf supplementation in the diet of Albino rats who were fed for 90 days, a standard laboratory rat diet plus 20% coconut oil with the addition of 10% curry leaf feed. This was offered at a level of 10% body weight. The spice resulted in a fall in total serum cholesterol, LDL+VLDL and an increase in HDL levels.

Hussein *et al.*, (2014) indicated that treatment with curcumin lowered serum LDL-C and VLDLC, concentration, in addition to, increasing HDL-C in hypercholesterolemic rats.

Table (4): Effect of turmeric, curry and mix diets on (VLDLc), (HDLc) and (LDLc) (mg/dl) on hepatointoxicated rats injected with CCl_4

Parameters / Groups	VLDL (mg/dl) Mean ± SD	HDL (mg/dl) Mean ± SD	LDL (mg/dl) Mean ± SD	AI
G1: Control –ve	10^{c}±0.05	47^{b}±0.07	15^{e}±0.04	0.53^{e}±0.001
G2: Control +ve	19.8^{a}±0.03	33^{e}±0.14	49.2^{a}±0.04	2.09^{a}±0.006
G3: Turmeric (4%)	10.8^{c}±0.03	45^{c}±0.09	15.2^{d}±0.09	0.58^{c}±0.005
G4: Curry (4%)	11^{b}±0.08	43^{d}±0.17	18^{c}±0.05	0.67^{b}±0.008
G5: Mixture (4%)	10^{c}±0.01	55^{a}±0.12	21^{b}±0.02	0.56^{d}±0.002
LSD	0.084	0.22	0.097	0.009

Values in each column with different letters are significantly different ($P<0.05$).

Data presented in table (5) show the effect of turmeric, curry and mixture on serum glucose of hepatointoxicated rats. It could be noticed that the mean value of glucose of control (+) group was higher than control (-) group, being 149±0.08 and 90±0.02 (mg/dl) respectively. The best serum glucose was observed for group 5 (basal diet containing 4% mix) when compared to control (+) group.

Disegha and Onuegbu Izionworu, (2014) reported that curry leaves improved blood sugar levels.

Su and Chi, (2017) found that glucose were decreased in varying degrees in the curcumin group in diabetic rats.

Table (5): Effect of turmeric, curry and mix diets on glucose (mg/dl) on hepatointoxicated rats injected with CCl_4

Parameters / Groups	Glucose (mg/dl) Mean ± SD
G1: Control –ve	90^{e}±0.02
G2: Control +ve	149^{a}±0.08
G3: Turmeric (4%)	100.6^{c}±0.09
G4: Curry (4%)	128.4^{b}±0.07
G5: Mixture (4%)	90.5^{d} ±0.04
LSD	0.12

Values in each column with different letters are significantly different (P<0.05).

Data of table (6) illustrate the effect of turmeric, curry and mixture on serum levels of AST, ALT& ALP enzymes of hepatointoxicated rats.

It could be noticed that the mean value of AST enzyme of control (+) group was higher than control (-) group, being 271±0.15 and 110±0.13 (U/L) respectively. The best treatment was observed for group 5 (basal diet containing 4% mixture) when compared to control (+) group.

It could be observed that the mean value of ALT enzyme of control (+) group was higher than control (-) group, being 87±0.22 and 39.4±0.04 (U/L) respectively. The best treatment was observed for group 5 (basal diet containing 4% mixture) when compared to control (+) group.

Data of the same table (6) show the mean value of ALP enzyme of control (+) group was higher than control (-) group, being 300±0.04 and 180±0.01 (U/L) respectively. Group 5

showed the lowest mean value of ALP enzyme level as compared to control (+) group which and recorded the best result**.**

Suman Singh *et al*., (2014) agreed that Curry leaf has tannins and carbazole alkaloids exhibited good hepatoprotective properties.

Mansour-Ghanaei *et al*., (2019) investigated that curcumin administration induced significant reduction of ALT and AST in patients with non-alcoholic fatty liver disease.

Table (6): Effect of turmeric, curry and mix diets on GOT, GPT and ALP (U/L) on hepatointoxicated rats injected with CCl_4

Parameters / Groups	GOT (AST) (U/L) Mean ± SD	GPT (ALT) (U/L) Mean ± SD	ALP (U/L) Mean ± SD
G1: Control –ve	110^{e}±0.13	39.4^{e}±0.04	180^{b}±0.01
G2: Control +ve	271^{a}±0.15	87^{a}±0.22	300^{a}±0.04
G3: Turmeric (4%)	197.4^{b}±0.02	49.4^{c}±0.02	133.4^{d}±0.08
G4: Curry (4%)	184^{c}±0.12	53.8^{b}±0.06	145.4^{c}±0.01
G5: Mixture (4%)	182^{d}±0.19	42^{d}±0.27	131.6^{e}±0.07
LSD	0.24	0.29	0.093

Values in each column with different letters are significantly different ($P<0.05$).

Data presented in table (7) illustrate the mean value of total bilirubin (TB), direct bilirubin (DB) & indirect bilirubin (IB) of hepatointoxicated rats fed on turmeric, curry and mixture.

It could be noticed that the mean value of TB of control (-) group was lower than control (+) group, being 0.67±0.003 and 1.46±0.008 mg/dl respectively. Hepatointoxicated rats fed on basal diet containing 4% mixture (group 5) showed the best treatment of TB when compared to control (+) group.

According data presented in the same table (7) it could be revealed that the mean value of DB of control (-) group was lower than control (+) group, being 0.11±0.005 and 0.41±0.008 respectively. The best DB was recorded for group 5 (basal diet containing 4% mixture) when compared to control (+) group.

The same table observed that the (IB) of control (-) group was lower than control (+) group, being 0.56±0.001 and 1.05±0.007 respectively. Hepatointoxicated rats fed on basal diet containing 4% mixture (group 5) showed the best IB as compared to control (+) group.

Adebajo *et al.*, (2006) chronic administration for 14 days of methanolic extract of *Murraya koenigii* leaf gave a significant ($p<0.05$) reduction in the serum bilirubin in rats.

Galaly *et al.*, (2014) indicated that thymoquinone and curcumin significantly induced reduction in total bilirubin levels in rats injected with gentamicin.

Table (7): Effect of turmeric, curry and mix diets on total bilirubin (T.B), direct (D.B) & indirect bilirubin (I.B) on hepatointoxicated rats injected with CCl_4

Parameters / Groups	T.B (mg/dl) Mean ± SD	D.B (mg/dl) Mean ± SD	I.B (mg/dl) Mean ± SD
G1: Control –ve	0.67^{e}±0.003	0.11^{e}±0.005	0.56^{d}±0.001
G2: Control +ve	1.46^{a}±0.008	0.41^{a}±0.008	1.05^{a}±0.007
G3: Turmeric (4%)	0.79^{c}±0.002	0.21^{c}±0.004	0.58^{c}±0.003
G4: Curry (4%)	0.85^{b}±0.009	0.25^{b}±0.009	0.60^{b}±0.009
G5: Mixture (4%)	0.71^{d}±0.006	0.19^{d}±0.002	0.52^{e}±0.004
LSD	0.011	0.011	0.01

Values in each column with different letters are significantly different ($P<0.05$).

Data presented in table (8) show the effect of turmeric, curry and mixture on total protein (TP), albumin (Alb) & Globulin (Glob) of hepatointoxicated rats.

It could be indicated that the mean value of (TP) of control (+) group was lower than control (-) group, being 2.23±0.01 and 6.13±0.008 g/dl respectively. The best serum TP was showed for group 5 (rats fed on basal diet + 4% mixture) when compared to control (+) group.

It could be shown that the mean value of (Alb) of control (+) group was lower than control (-) group, being 1.69±0.007 and 4.11±0.008 g/dl respectively. The best serum Alb showed for group 5 (rats fed on basal diet + 4% mixture) when compared to control (+) group.

The same table (8) results indicated that the mean value of (Glob) of control (-) group was higher than control (+) group, being 2.02±0.004 and 0.54±0.002 g/dl respectively. The best serum Glob showed for group 5 (rats fed on basal diet containing 4% mixture) when compared to control (+) group.

Adebajo *et al.*, (2006) found that acute doses (500 mg/kg) of methanolic extract of *Murraya koenigii* leaf reduced significantly serum globulin, albumin, & total protein in rats.

Galaly *et al.*, (2014) showed that thymoquinone and curcumin markedly ameliorated the gentamicin-induced decrease in serum total protein, albumin and albumin/globulin ratio in rats injected with gentamicin.

Table (8): Effect of turmeric, curry and mix diets on total protein (T.P), albumin (Alb.), globulin (Glob.) on hepatointoxicated rats injected with CCl_4

Parameters / Groups	T.P (g/dl) Mean ± SD	Alb. (g/dl) Mean ± SD	Glob. (g/dl) Mean ± SD
G1: Control –ve	6.13^{a}±0.008	4.11^{a}±0.008	2.02^{a}±0.004
G2: Control +ve	2.23^{e}±0.01	1.69^{e}±0.007	0.54^{e}±0.002
G3: Turmeric (4%)	4.92^{c}±0.005	3.60^{c}±0.001	1.32^{c}±0.009
G4: Curry (4%)	4.60^{d}±0.001	3.51^{d}±0.009	1.09^{d}±0.006
G5: Mixture (4%)	5.43^{b}±0.003	3.98^{b}±0.003	1.45^{b}±0.004
LSD	0.011	0.01	0.01

Values in each column with different letters are significantly different ($P<0.05$).

Results of table (9) show the mean value of serum creatinine, urea and uric acid (mg/dl) on hepatointoxicated rats fed on various diets.

It could be observed that the mean value of uric acid of control (+) group was higher than control (-) group, being 4.17±0.009 and 1.28±0.002 mg/dl respectively. Group 5 (basal diet containing 4% mix) recorded the best result as compared to control (+) group.

The same table (9) results illustrate that mean value of creatinine of control (+) group was higher than control (-) group, being 0.79±0.002 and 0.48±0.008 mg/dl respectively. In concern to creatinine the best treatment was recorded for the group 5 when compared to control (+) group.

It could be noticed that the mean value of urea of control (+) group was higher than control (-) group, being 41±1.32 and 18±1.25 mg/dl respectively. Group 5 (rats fed on basal diet +4% mix) recorded the best result as compared to control (+) group.

Arulselvan *et al.*, (2006) indicated that oral administration of ethanolic extract of *M. koenigii* at a dose of 200 mg/kg/b.w./day for a period of 30 days significantly decreased the levels of blood urea, uric acid and creatinine in diabetic treated group of rats.

Mustafa Kiyani *et al.*, (2019) showed that turmeric decreased the level of urea, uric acid and creatinine in rats as compared to diseased control group.

Table (9): Effect of turmeric, curry and mix diets on urea, creatinine and uric acid (mg/dl) on hepatointoxicated rats injected with CCl_4

Parameters / Groups	U.A (mg/dl) Mean ± SD	Creatinine (mg/dl) Mean ± SD	Urea (mg/dl) Mean ± SD
G1: Control –ve	1.28^{e}±0.002	0.48^{e}±0.008	18^{e}±1.25
G2: Control +ve	4.17^{a}±0.009	0.79^{a}±0.002	41^{a}±1.32
G3: Turmeric (4%)	3.7^{b}±0.05	0.68^{b}±0.009	38^{b}±1.14
G4: Curry (4%)	2.95^{c}±0.008	0.65^{c}±0.006	31^{c}±1.84
G5: Mix diets (4%)	2.82^{d}±0.001	0.63^{d}±0.003	22.8^{d}±1.42
LSD	0.042	0.01	2.48

Values in each column with different letters are significantly different ($P<0.05$).

Data presented in table (10) show the levels of serum antioxidants enzymes (SOD, GPX and CAT). It evident that CCl_4 injection raised all the three enzymes in serum, which were reduced due to experimental diets, specially when using the mix diet. Turmeric diet followed that of the mix diet in improving the antioxidant enzymes, provided that numerically curry diet showed also pronounced improvement, being however the last effective diet .

Patil *et al.*, (2012) reported that treatment with methanol extract of the leaves of *Murraya koenigii* (MEMK) significantly restored the levels of protective anti-oxidant enzymes i.e. SOD, CAT, GSH and inhibited LPO in forebrain region when compared with reserpine in-vivo, because curry leaves are a rich source of carbazole alkaloids which possess various biological activities such as antitumor, antioxidant and anti-inflammatory.

Meshkibaf *et al.*, (2019) found that turmeric increased the levels of enzymes such as superoxide dismutase, catalase and

glutathione peroxidase by a dose dependent manner in male rats. The increasing level of antioxidant enzymes can be due to the antioxidant effect of curcumin.

Table (10): Effect of turmeric, curry and mix diets on antioxidant enzymes superoxide dismutase (SOD), glutathione peroxidase (GPx) and catalase (CAT) on hepatointoxicated rats injected with CCl_4

Parameters / Groups	SOD (nmol/min/mg protein) Mean ±SD	GPx (nmol/min/mg protein) Mean ±SD	CAT (U/mg) Mean ±SD
G1: Control –ve	66.15^{a}±1.6	0.90^{a}±0.008	0.207^{a}±0.0001
G2: Control +ve	32.64^{e}±1.25	0.36^{e}±0.006	0.100^{e}±0.0008
G3: Turmeric (4%)	50.27^{c}±1.24	0.79^{b}±0.004	0.174^{c}±0.0005
G4: Curry (4%)	46.02^{d}±1.76	0.62^{d}±0.009	0.162^{d}±0.0006
G5: Mix diets (4%)	58.32^{b}±1.38	0.68^{c}±0.005	0.196^{b}±0.0007
LSD	2.66	0.01	0.001

Values in each column with different letters are significantly different ($P<0.05$)

Results of histopathological examination:

Microscopic examination of livers of hepatotoxic control positive rats showed congestion of the central vein, marked dilatation of the hepatic sinusoids with leukocytosis (Photo 1). Those livers showed vacuolar degeneration and necrosis of the hepatic cells with appearance of apoptotic cells, increased number of binucleated cells and markedly dilated hepatic sinusoids (Photo 2). The portal areas in those livers showed dilatation and congestion of portal vessels, mononuclear inflammatory cells infiltration and edema (Photo 3).

Concerning, the treated groups, livers of hepatotoxic positive rats which treated with (turmeric diet) showed good degree of protection of the hepatic parenchymal cells which appeared near to normal with normal central vein and portal area (Photo 4). The portal areas showed just congestion of the portal vessels and mild degenerative and necrotic changes of the hepatic cells (Photo 5).

Livers of hepatotoxic control positive rats which treated with (curry diet) showed periportal vacuolar degeneration and necrosis of the hepatic cells with mild inflammatory cells infiltrating the portal areas (Photo 6) and congestion of portal vessels in some portal areas (Photo 7).

Livers of hepatotoxic control positive rats which treated with (mix diet) showed mild hepatocellular degenerative changes and scattered necrotic cells with few inflammatory cells infiltrating the portal areas (Photos 8 & 9).

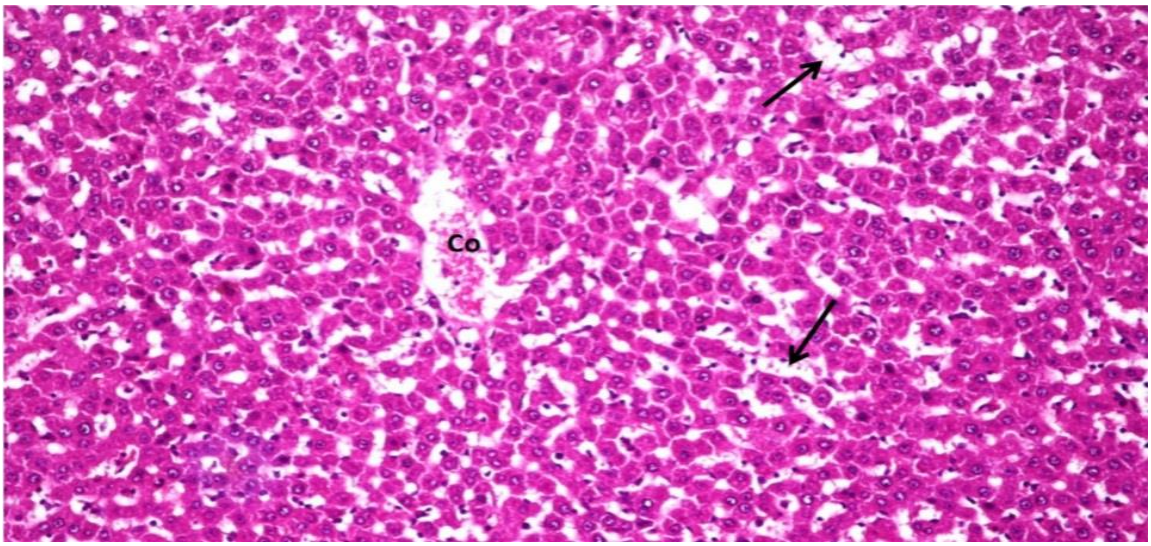

Photo 1: Liver of hepatotoxic control positive rat showing congestion of the central vein (Co), marked dilatation of the hepatic sinusoids (arrow) with leukocytosis. (H&E, X200).

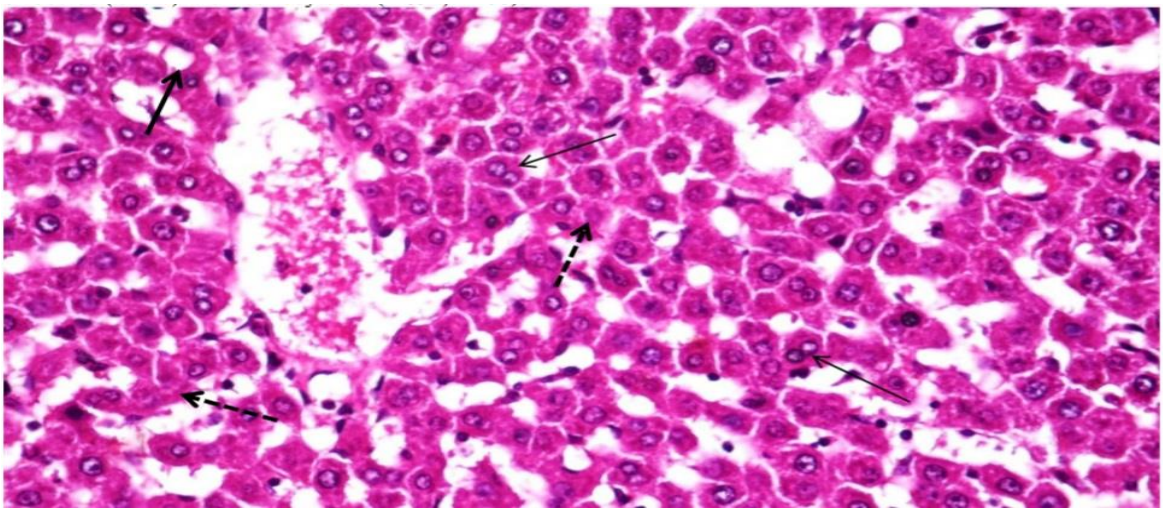

Photo 2: Higher magnification of liver of hepatotoxic control positive rat showing vacuolar degeneration (arrow) and necrosis (dashed arrow) of the hepatic cells with apoptotic cells (short arrow), increased number of binucleated cells (thin arrow). Notice the markedly dilated sinusoids. (H&E, X400).

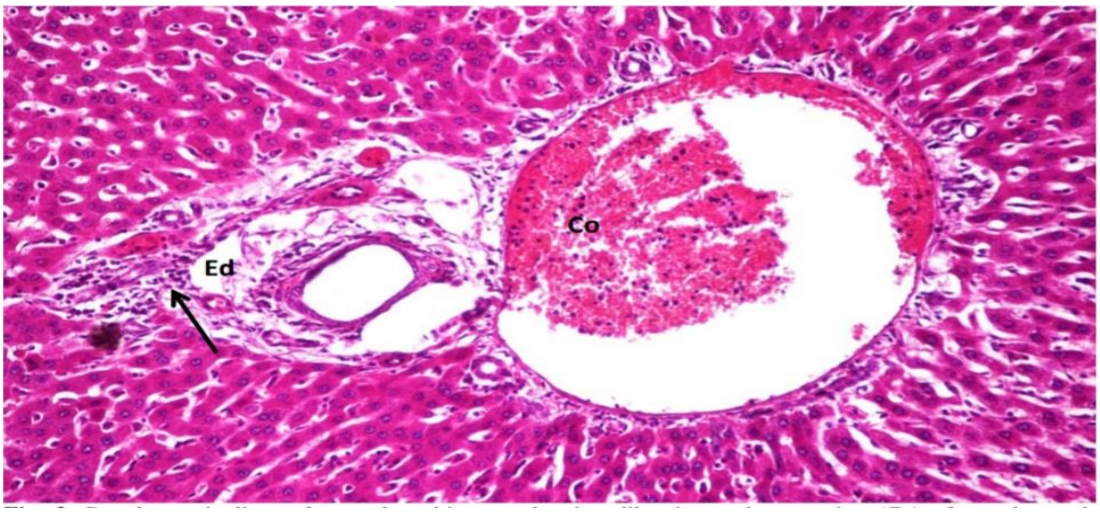

Photo 3: Portal area in liver of hepatotoxic control positive rat showing dilatation and congestion (Co) of portal vessel, mononuclear inflammatory cells infiltration (arrow) and edema (Ed). (H&E, X200).

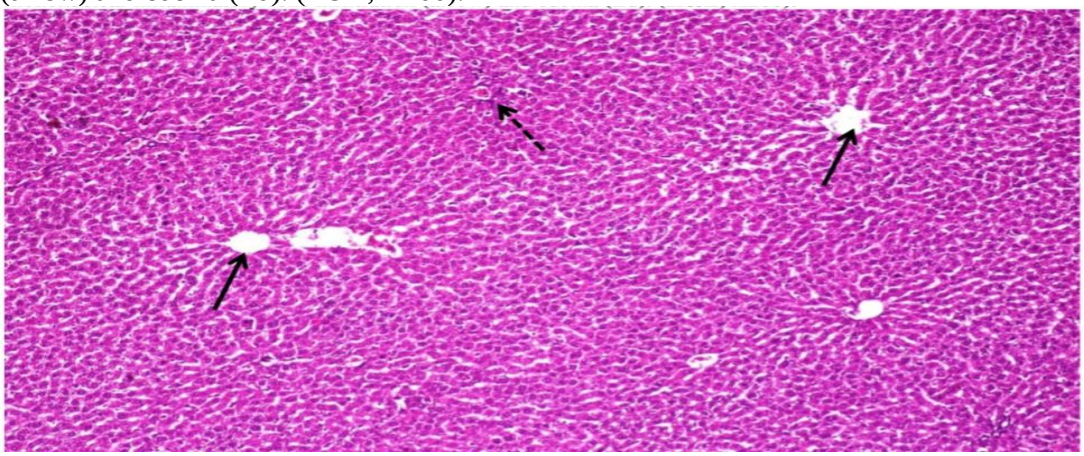

Photo 4: Liver of hepatotoxic control positive rat which treated with drug 1(turmeric diet) showing good degree of protection of the hepatic parenchymal cells (HCs) which appeared near to normal with normal central vein (arrow) and portal area (dashed arrow). (H&E, X100).

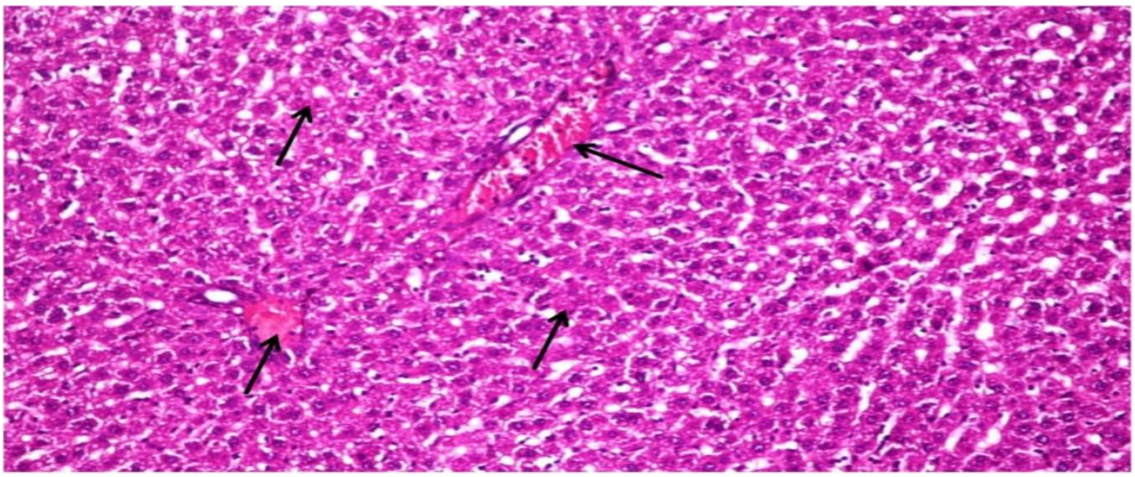

Photo 5: Liver of hepatotoxic control positive rat which treated with drug 1(turmeric diet) showing just congestion of the portal vessels (arrow) and mild degenerative and necrotic (dashed arrow) changes of the hepatic cells. (H&E, X200).

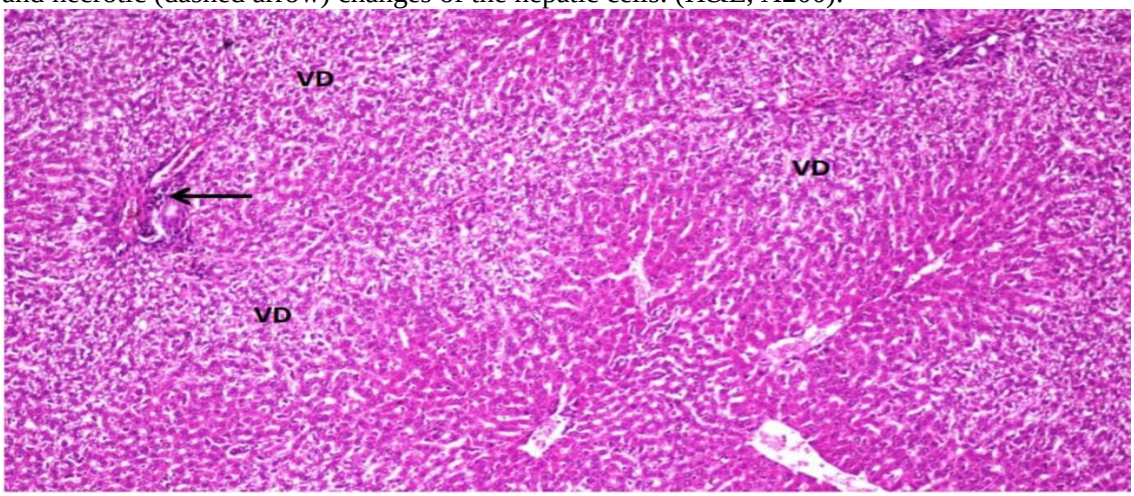

Photo 6: Liver of hepatotoxic control positive rat which treated with drug 2 (curry diet) showing periportal vacuolar degeneration (VD) and necrosis of the hepatic cells with mild inflammatory cells infiltrating (short arrow) the portal areas. (H&E, X100).

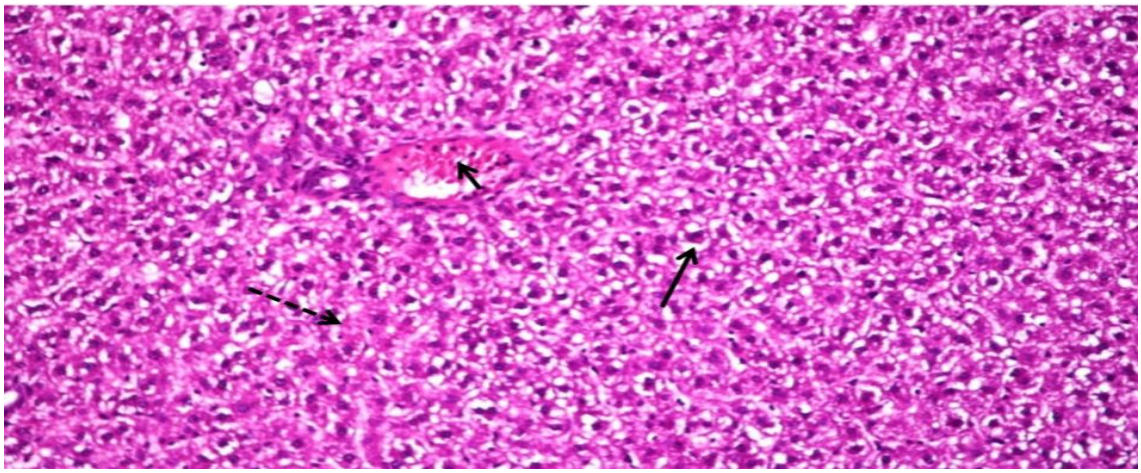

Photo 7: Liver of hepatotoxic control positive rat which treated with drug 2 (curry diet) showing periportal vacuolar degeneration (arrow) and necrosis (dashed arrow) of the hepatic cells with congestion (short arrow) of the portal vessels. (H&E, X200).

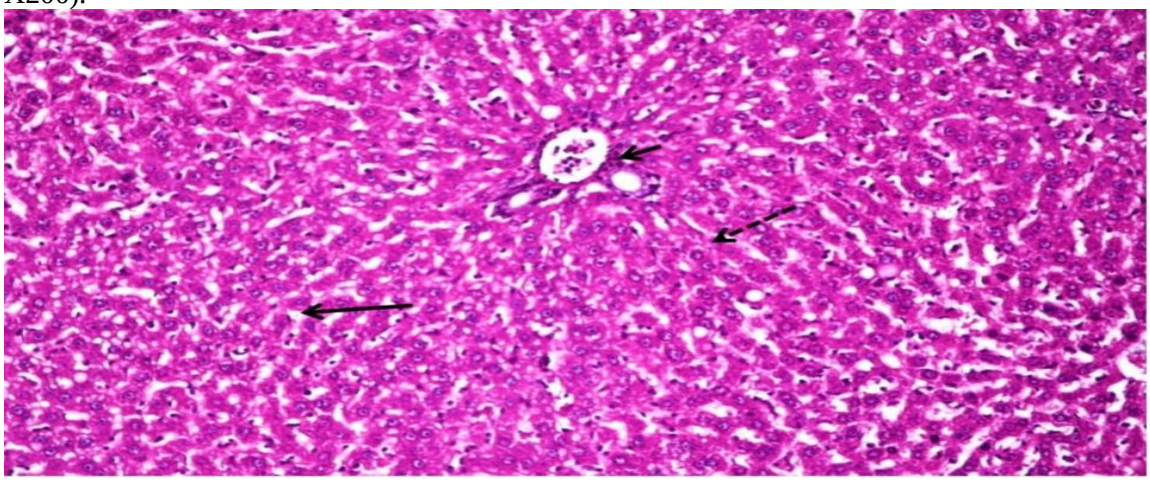

Photo 8: Liver of hepatotoxic control positive rat which treated with drug 3 (mix diet) showing mild hepatocellular degenerative changes (arrow) and scattered necrotic cells (dashed arrow) and few inflammatory cells infiltrating (short arrow) the portal areas. (H&E, X200).

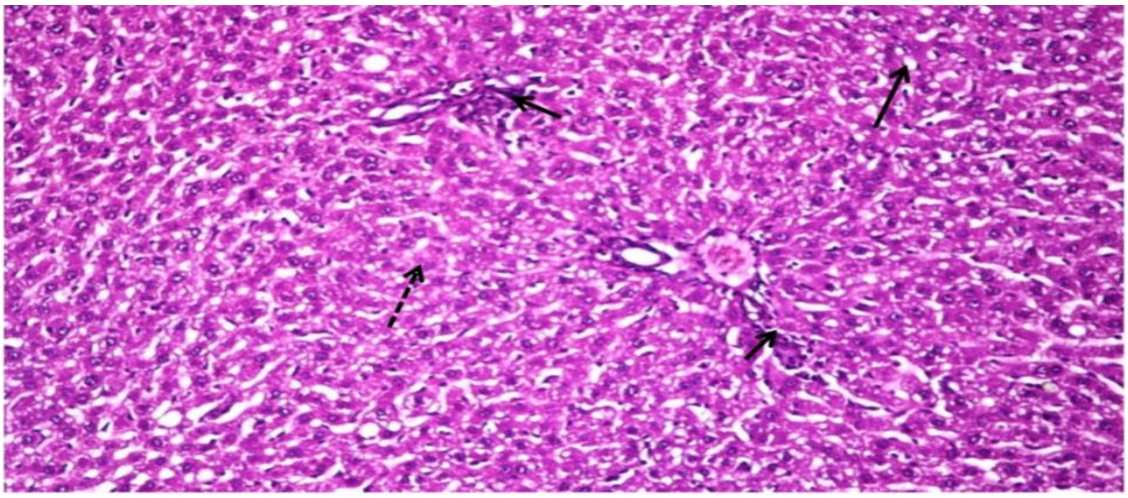

Photo 9: Liver of hepatotoxic control positive rat which treated with drug 3 (mix diet) showing mild hepatocellular degenerative changes (arrow) and scattered necrotic cells (dashed arrow) with few inflammatory cells infiltrating (short arrow) the portal areas. (H&E, X200).

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التغذية العلاجية لسمية الكبد المستحثة برابع كلوريد الكربون فى ذكور الفئران البيضاء باستخدام أغذية تحتوى على أوراق الكارى والكركم ومخلوطهما

هيفا حسين على حجازي

كلية التربية - قسم التربية الأسرية - جامعة أم القري - مكة المكرمة

الملخص العربى

يهدف هذا البحث إلى تقييم تأثير الكركم وورق الكاري والخليط منهما علي سمية كبد الفئران المحقونة برابع كلوريد الكربون. تم تقسيم ثلاثون فأر من الذكور البالغين سبراغ داولي إلى خمس مجموعات. مجموعة (1): وهي المجموعة الضابطة السالبة (-) تغذت على الوجبة الأساسية ، المجموعة (2): وهي المجموعة الضابطة الموجبة (+) وهي الفئران المحقونة برابع كلوريد الكربون في الكبد وتغذت على الوجبة الأساسية. المجموعة (3): الفئران المحقونة برابع كلوريد الكربون في الكبد التي تغذت علي عشبة الكركم بنسبة 4%. المجموعة (4): الفئران المحقونة برابع كلوريد الكربون في الكبد التي تغذت على نبات الكاري بنسبة 4 %. المجموعة (5): الفئران المحقونة برابع كلوريد الكربون في الكبد التي تغذت على الاثنين معا بتركيز 5%.. في نهاية التجربة ، بعد 28 يومًا من التغذية ، تم تقدير الاختبارات البيوكيميائية للدم. الحقن برابع كلوريد الكربون سبب انخفاض في الوزن المكتسب والمأخوذ من الغذاء وكفاءة الاستفادة من الغذاء مع ارتفاع مستويات الجلوكوز واليوريا والكرياتينين واليوريك اسيد وASTوALT وALP ومستوى الكوليسترول الكلي وجلسريدات ثلاثية والليبوبروتين منخفض الكثافة والليبوبروتين منخفض الكثافة جدا والبيليروبين الكلي والبيليروبين المباشر والغير مباشر وانخفاض مستويات الليبروتين مرتفع الكثافة والبروتين الكلي والألبيومين والجلوبيولين وإنزيمات الأكسدة وتحسنت النتائج باستخدام الأغذية المعالجة وخاصة الغذاء الخليط.

الكلمات المفتاحية : الكبد، الكركم، ورق الكاري والخليط من الاثنين معا.