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Utilization of Pomegranate Peel Waste in Reducing the Risk of Hepatotoxic Rats by Ccl4

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Abstract:
Carbon tetrachloride (CCl4) is a toxic substance linked to liver damage and oxidative stress. So, the current study investigated the influence of pomegranate peel waste on minimizing the risk of CCl4 hepatotoxicity in rats. Thirty male albino rats were divided into two main groups. The first group) was the negative control group (6 rats), fed on a basal diet for all experimental periods. The second group (hepatotoxic rats) (n=24 rats)was divided into four subgroups (6 per each group) .subgroup one served as the positive control group .subgroup 2, 3, and 4 were fed on 1.5, 3, and 4.5% of pomegranate peel powder respectively for 30 days. Subcutaneous injection of CCl4 produced a marked elevation ($P < 0.05$) in the serum levels of aspartate transaminase (AST), alanine transaminase (ALT), and alkaline phosphatase (ALP), malondialdehyde (MDA), total cholesterol (TC), triglycerides (TG), low-density lipoprotein (LDLc) and very low-density lipoprotein(VLDL). Treatments of 4.5% of pomegranate peel improved liver function, antioxidant status in liver tissues, and lipid profile compared to the positive control group. In conclusion, our results suggest that pomegranate peel has antihepatotoxicity and antioxidant properties in hepatotoxic rats by CCl4.

***Keywords**: Pomegranate Peel, Hepatotoxic Rats, CCl4, Liver Function, Antioxidant*

Introduction

The liver is a vital organ of the human body that regulates various important activities of the body, including biotransformation and detoxification of foreign and endogenous chemicals [1]. It responds to oxidative stress by activating antioxidant systems that neutralize reactive oxygen and nitrogen free (RONS) radicals. [2]. Carbon tetrachloride (CCl4) is an organic compound having the formula CCl4. CCl4 is also well known for its liver toxicity. It causes immediate liver injury in the form of necrosis and steatosis. This impact is caused by the generation of free radicals, specifically trichloromethyl (CCl3) and peroxy trichloromethyl

(OOCCL3) radicals. These free radicals can cause lipid peroxidation, which can damage cell membranes, changes in enzyme activity, and, finally, liver injury and necrosis. [3]. CCl4 acted as a major chemical in tissue injury. Several research were conducted, and various theories were advanced. As a result, several significant basic mechanisms of tissue injury, such as metabolic activation, reactive free radical metabolites, lipid peroxidation, covalent bonding, and disruption of calcium homeostasis, have emerged [4].

Fruit byproducts are rich in bioactive chemicals that have the potential to be used as antioxidants in food [5]. Food waste is one of humanity's most serious problems [6]. Pomegranate (Punica granatum L.) is a tropical and subtropical fruit that contains numerous bioactive chemicals. When producing juice and preserves from pomegranates, large numbers of byproducts are produced [7]. Pomegranate peel is obtained after the processing of pomegranate juice, which is an inedible portion. Tannins, flavonoids, and other phenolic substances are abundant in pomegranate skin[8]. It contains polyphenolic antioxidants like as flavonoids and tannin [9]. Antioxidant activity has been found to be important in a variety of pharmacological pathways such as anti-aging, anti-atherosclerosis, and anti-inflammatory activity. Antioxidant supplementation has become an appealing therapeutic option for decreasing disease risk by inhibiting free radical produced damage. Free radicals initiate oxidative stress. The peel of pomegranate has been shown to protect against sepsis-induced acute liver damage. The study also demonstrated that the fruit phenolics' free radical scavenging properties and anti-inflammatory activities are the primary mechanisms by which pomegranate phenolics reduce and mitigate the risks of acute liver injury. The phenolics in pomegranate peel aid in the modification of inflammatory pathways [10]. Therefore, this study was carried out to encourage the utilization of pomegranate peel as a waste which remain from food factories to promote the health by reducing the risk of hepatotoxic rats by CCl4.

Materials and methods

Materials

Chemicals: Cellulose, casein, mineral mixture, vitamin mixture, corn oil and corn starch were obtained from Morgahn Co., Menoufia, Egypt, Carbon tetra chloride (CCL4) was obtained from Memphis Co. from pharm. Chem. Ind, Cairo, Egypt. Pomegranate peel: was obtained from Edfina company for food preservation, Alexandria, Egypt. Kits: for estimation biochemical analysis were obtained from Alkan medical company, St. El-Dokki, Cairo, Egypt. Rats: Thirty male Sprague-Dawley albino rats 200± 5g were purchased from Conjunctivitis Eye Institute Giza, Egypt. Cupcake ingredients: Wheat flour (72% extract) , powdered sugar ,baking powder ,margarine butter ,fresh whole eggs , skimmed milk and vanillin flavor were obtained from the local market , Menoufia , Egypt.

Methods:

Preparation of pomegranate peel:

Pomegranate peel was washed several times with tap water , then dried for 5 days at 50°C in a " Plue Pardng oven, Taiwan.T. S100 ". These dried wastes were crushed to pass through 60 mesh sieves and stored in tight glass jars at -10°C until used .

Chemical analysis:

Determination of chemical composition and bioactive compounds of pomegranate peel:

Moisture, fat, protein, fiber and ash contents of pomegranate peels were determined according to the methods of [11]. The carbohydrate was calculated by difference [12]. Determination of total phenols, total flavonoids, anthocyanin and antioxidant activity (DPPH) according to [13], [14] and [15] respectively.

Experimental design:

The Research Ethics Committee from the Faculty of Science, Menoufia University, Egypt was approved on the strategy of this experiment (Approval No SNFS 623). The rats were housed in well aerated cages individually under hygienic laboratory condition at Faculty of Home Economics, Menoufia University and fed standard diet according to AIN-93 guidelines [16] for 7 days as an adaptation period.

The rats (n=30) were randomly divided into two main groups according to the following: Group I: (n=6) negative control group was fed basal diet. Group II: hepatotoxic groups (n =24). Hepatotoxic groups were treated with orally a single dose of 1 mg/kg body weight carbon tetrachloride (was dissolved in sunflower oil 1:1) according to[17], then divided into four subgroups (6 rats each) according to the following: subgroup 1 positive control group. Subgroup 2 , 3 and 4 were fed 1.5, 3 and 4.5% of pomegranate peel powder respectively for 30 days. After the end of experimental period (30 day), animals were anesthetized with xylazine hydrochloride and ketamine hydrochloride [18] after fasting for 12h and blood samples were collected from the hepatic portal vein, for used to the biochemical assays. Livers of the rats were taken directly to determine the antioxidant activity in liver tissues.

Biochemical assays:

Alanine aminotransferase (ALT) and aspartate aminotransferase (AST) were determined according to the methods described by [19]. Alkaline phosphatase (ALP) was determined according to [20], Gamma-Glutamyl Transferase (GGT) was determined according to the methods described by [21]. Total protein (TP), albumin and globulin were determined according to [22]and [23]. Globulin and albumin to globulin ratio (A/G ratio) was calculated according to[24].Total bilirubin (TB)was determined according to the methods described by [25]. Malondialdehyde (MDA) was determined according to [26],superoxide dismutase (SOD) was also assayed using commercial kits according to [27], total antioxidant capacity in liver tissues (TAC) was determined according to [28].Total cholesterol (TC),triglycerides (TG) and high density lipoprotein cholesterol (HDLc) were determined according to [29]. Very low density lipoproteins (VLDL-c) and low density lipoproteins (LDL-c) were determined according to [30] as the following equations: LDL-c (mg / dl) = total cholesterol –(HDL-c + VLDL-c). VLDL-c (mg / dl) =triglycerides / 5.

Technological methods

Preparation of cupcake ingredients:

Control cupcake was prepared according to the following formula [31] as shown in Table (A). Cupcake butter and sieved sugar were creamed together in the mixer (HMS-Fresh-Egypt) for 5 minutes until light in color, as stated by [32].Eggs were added and combined for 5 minutes before adding vanillin, wheat flour, skimmed milk, baking powder, and water to the moisture

and blending for 1 minute. Butter was placed in pans with internal dimensions of 18.5 x 9.5 x 5 and baked at 220°C in an electric oven (8605 Universal-Egypt) for 45 minutes. The cake was left at room temperature (25°C) overnight and wrapped in aluminum foil until the panel test. As a "fat replacer," 3 and 4.5% of pomegranate peel flour was replaced with the butter

Table (A): Ingredients of control cupcake and cupcakes which replacing fat with 3 and 4.5% of pomegranate peel

Ingredients(g)	Control	Pomegranate Peel powder	
	0%	3%	4.5%
Wheat flour	30.07	30.07	30.07
Sugar	28.68	28.68	28.68
Butter	10.79	10.47	10.3
Eggs	14.71	14.71	14.71
Skimmed milk	15.02	15.02	15.02
Backing powder	0.05	0.05	0.05
Vanillin	0.68	0.68	0.68
Pomegranate peel powder	0	0.32	0.49
Total	100	100	100

Sensory evaluation of cupcakes:

The sensory properties (Taste , color , flavor ,texture , appearance and over-all acceptability) of cupcakes were evaluated by the method recommended by [33] using a hedonic rating test. Panelists were chosen based on their interest, and samples were served to fifteen of staff members and post graduate students in the Department of Nutrition and Food Science. They were asked to rate the acceptability of the cupcakes on a 1-9 point scale, ranging from the like extreme (9) to the dislike extreme (1), as described by [34].Cupcakes were tested 24 hours after backing. After cooling, the cupcakes were cut into 15 cm radial portions, sealed in plastic bags, and kept at room temperature (25°C) until sensory analysis. On white plates, randomly coded samples were served one at a time to them .Panelists were served samples in a room with separators between each seat and overhead fluorescent lighting. Before beginning and between sample evaluations, panelists were told to rinse their mice with tap water.

Statistical Analysis:

The data were recorded as a mean ±SD. Using a statistical analysis method, the experimental data were subjected to an analysis of variance (ANOVA) for a completely randomized design [35]. Duncan's multiple range tests were performed to determine mean differences at the 5% level.

Results and Discussion

Table (1) showed the proximate chemical composition and bioactive compound of dried pomegranate peel. The pomegranate peel had 13.46g/100g moisture, 66.58 g/100 g total carbohydrates, 12.13 g/100 g fiber, 3.11 g/100 g ash, 1.54g/100g fat and 3.18 g/100 g protein. The energy content was 292.9 Kcal/100 mg. This result is in accordance with those found by Spilmont et al.[36] who reported that pomegranate peel had 14,70, 12.61, 6.8, 2.4

and 5.1 g/100g for moisture, carbohydrates, fiber, ash, fat and protein respectively. In the same table, total phenols total flavonoids, anthocyanin and antioxidant activity in pomegranate peel powder were 171.18 mg/g, 43.84 mg/g, 71.18 mg/100g and 86.11% respectively. These findings are supported by Morea et al. [37] which reported that pomegranate peel powder has high levels of total flavonoids 18.6 mg/g, total phenols 410mg/g (as gallic acid) and anthocyanins 33.31 mg/100g and has a high potency as an antioxidant.

Table (1): Proximate chemical composition and bioactive compound of pomegranate peel (on the dry weight basis %).

Parameters	Pomegranate peel powder
Moisture (g/100g)	13.46 ± 0.04
Crude protein (g/100g)	3.18 ± 0.02
Crude fat (g/100g)	1.54 ± 0.04
Fiber (g/100g)	12.13 ± 0.02
Ash (g/100g)	3.11 ± 0.02
Carbohydrates (g/100g)	66.58 ± 0.02
Energy(kcal)	292.9 ±0.01
Total phenols (mg/g)	171.18 ± 0.01
Total flavonoids (mg/g)	43.84 ± 0.01
Anthocyanin (mg/100g)	71.18 ± 0.02
Antioxidant activity (DPPH) %	86.11±0.01

Each value in the table is the mean ± standard deviation of three replicates

The effect of pomegranate peels on serum biochemical hepatic markers of normal and hepatotoxic rats is presented in Table (2). The obtained results showed that serum ALT, AST, ALP and GGT in CCL4 group which received a normal diet (positive control group) had significantly ($P \leq 0.05$) elevated levels compared to a normal control group and other treated hepatotoxic groups. These findings are in agreement with Oriakhi and Uadia,[38] who reported that CCl4-induced liver injury may be directly related to increased serum levels of these markers indicating loss of hepatocyte membrane integrity. On the other side, a reduction of ALT, AST, ALP and GGT in hepatotoxic rats after treated with 4.5 and 3 % of pomegranate peels respectively and the treatment of 4.5% was more effective. These obtained results were consistent with those reported by Toklu et al. [39] who showed that ingesting pomegranate peel reduced bile duct binding, which led to restoration of liver function, and modification of liver enzymes. Moreover, people with liver disease can use pomegranate peel powder as a food ingredient that is rich in phenolic compounds as it protects against oxidative stress. [40]. The mean values of T.B, D.B and ID.B of serum in the hepatotoxic group which received normal diet (positive control group) had significantly ($P \leq 0.05$) elevated levels compared to the negative control group and other treated hepatotoxic groups. Ingesting rats with diet replaced by 4.5% of pomegranate peels had the best in reduction of T.B , D.B and ID.B compared to other treated groups. These results are consistent with Salwe et al.[41] who indicated that pomegranate peel decreased the activity of total bilirubin, direct and indirect. Our results also showed that T.P, ALB, and G in the

positive control group had significantly (P ≤ 0.05) lower levels than normal control group and other treated hepatotoxic groups. While A/G ratio had elevated levels. On the other side, this study showed elevated levels of serum T.P, ALB , and G and reduce A/G ratio in hepatotoxic rats after being treated with 4.5and 3 % of pomegranate peels respectively. These results are in line with Vidal et al. [42] who indicated that the presence of active compounds such as flavonoids, phenols, and triterpenes, which are considered antioxidants, play an essential role in stimulating the process of protein synthesis in their various locations in the body, which is attributed to these effects. These increases in serum proteins are due to the role of antioxidants in reducing oxidative stress, which works to inhibit the secretion of cortisone from the adrenal cortex, which improves or increases the level of proteins in the circulation [43] .

Table (2): Effect of pomegranate peels on serum biochemical hepatic markers of normal and hepatotoxic rats.

Parameters	Normal group	Hepatotoxic groups			
		Positive group	1.5% Peel	3% Peel	4.5% Peel
ALT (U/L)	89.79e ± 0.43	314.20a±0.31	241.17b±0.41	154.83c±0.41	141.08d±0.20
AST (U/L)	90.94e±0.26	250.10a±0.49	241.67b±0.52	157.83c±0.41	122.75d±14.34
ALP (U/L)	98.07e±0.24	381.47a±0.39	278b±0.01	169.50c±0.55	160.50d±0.55
GGT (U/L)	1.10d±0.09	6.38a±0.42	4.80b±0.24	3.90c±0.09	3.68c±0.34
T.B (U/L)	1.10e±0.42	4.11a±0.01	4.04b±0.01	3.22c±0.01	2.97d±0.01
D.B (U/L)	0.43e±0.01	2.55a±0 .01	2.50b±0.01	1.85c±0.01	1.65d±0.01
ID.B (U/L)	0.68e±0.01	1.56a±0.01	1.54b±0.01	1.37c±0.01	1.33d±0.01
T.P (U/L)	9a±0.01	4.39e±0.01	5.23d±0.01	6.80c±0.01	6.35b±0.01
ALB (U/L)	5.45a±0.01	3.31e±0.01	3.68d±0.01	4.42c±0.01	4.69b±0.01
G (U/L)	3.55a±0.01	1.09e±0.01	1.56d±0.01	2.39c±0.01	2.67b±0.01
A/G ratio (%)	1.54e±0.01	3.05a±0.01	2.36b±0.01	1.85c±0.01	1.75d±0.01

Data are expressed as mean ±SD. Values within in a row having different superscripts are significantly different (p≤0.05).

Data showed in Table (3) reflected the effect of pomegranate peels on antioxidant status in the liver tissues of normal and hepatotoxic rats. The obtained results showed that MDA had significantly (p ≤ 0.05) elevated levels, while SOD and TAC had low levels in positive control group compared to negative control group. These results were similar to the results obtained by Yang et al.[44] who reported that CCl4 toxicity depleted SOD from hepatocytes resulting in rapid, easier, and long-lasting liver damage. This study showed a gradual improvement of antioxidant serum levels in the liver tissues of hepatotoxic rats which fed on 4.5% of pomegranate peels followed by 3%. This effect may due to very high total antioxidant activity in pomegranate peel because it has large amounts of total "flavonoids and polyphenolic" compounds. Ellagic and Gallic acids present in pomegranate peel act as powerful free radical scavengers, resulting in restoring the activity of hepatic enzymes (peroxidase, superoxide dismutaseas and catalase) and inhibiting lipid peroxidation process[45]. Also, some parts of pomegranate peel as polysaccharides have free radical scavenging property [46].

Table (3): Effect of pomegranate peel on antioxidant status in the liver of normal and hepatotoxic rats.

Parameters	Normal Groups	Hepatotoxic groups			
		Positive Group	1.5% Peel	3% Peel	4.5% Peel
MDA (nmol)	0.38e±0.01	13.55a±1.08	10.18b±10.18	3.70c±0.19	2.76d±0.22
SOD (mg/dl)	252.53a±0.45	42.23e±0.24	61.90d±0.39	110.83c±0.41	121b±0.01
TAC (µM/g tissue)	13.85a±0.38	0.33e±0.03	0.93d±0.06	3.02c±0.26	3.76b±0.20

Data are expressed as mean ±SD. Values within in a row having different superscripts are significantly different (p≤0.05). MDA: Malondialdehyde, SOD: Superoxide Dismutase, TAC: Total Antioxidant Capacity.

Effect of pomegranate peels on lipid profile is presented in Table (4). Hepatotoxic group which received basal diet (positive control group) had the highest (P ≤ 0.05) values of TC, TG, LDL and VLDL compared to negative control group and pomegranate peel groups while, HDL had opposite trend. These data were in partial harmony with Venkatanarayana et al. [47] who found that elevated serum TC, TG, LDLc, and VLDLc levels and elevated cholesterol synthesis are biomarkers of liver damage due to CCL4 toxicity. In the same table the TC, TG, LDL and VLDL levels were significantly (P≤0.05) decreased by increasing the replacement level of pomegranate peels. Better improvement of TC, TG, LDL, HDL and VLDL levels in serum were observed in rats feeding 4.5% of pomegranate peels. This may be due to high contents of total phenols total flavonoids and anthocyanin in this group. These results in agreement with Aviram et al. [48]who reported that these effects of pomegranate peels are due to its strong antioxidant that leads to a decrease in the rate of lipid oxidation and may also help reduce the effect of high cholesterol production in the serum [49] .

Table (4): Effect of pomegranate peel on lipid profile of normal and hepatotoxic rats

Parameters	Normal Groups	Hepatotoxic groups			
		Positive Group	1.5% Peel	3% Peel	4.5% Peel
TC(mg/dl)	100.50e ±0.55	245.50a ± 0.55	230.50b ± 0.55	207.50c ± 0.55	199.70d ± 0.55
TG(mg/dl)	70.33e ± 0.82	178.30a ± 0.11	158.67b ± 0.52	122.50c ± 0.55	108.50d ±0.55
HDLc(mg/dl)	45.50a ± 055	31.50e ± 0.55	33.50d ± 0.55	37.67c ± 0.52	39.67b ± 0.52
LDLc(mg/dl)	40.90e ± 0.11	178.30a ± 0.11	165.27b ± 1.17	145.27c ± 1.16	138.13d± 0.37
VLDLc(mg/dl)	14.10e ± 0.11	35.60a ± 0.31	31.73b ± 0.10	24.50c ± 0.11	21.70d ± 0.11

Data are expressed as mean SD Values within in a row having different superscripts are significantly different (p≤0.05). TC: Total Cholesterol, TG: Triglyceride, HDL: High Density Lipoprotein, LDL: Low Density Lipoprotein , VLDL: Very Low Density Lipoprotein.

Data recorded in Table (5) showed the sensory evaluation of control cupcake and cupcakes which replacing fat with 3 and 4.5% of pomegranate peel powder. Cakes have enjoyed the relatively constant position in our diets for a long time and its beautiful taste has encouraged the development of newer and more attractive items that are available in the market today. It is usually a dessert choice for meals at a ceremonial event especially wedding anniversaries and birthdays [50]. The obtained results indicated that the control cupcake (0% pomegranate peel powder) is more acceptable one than the cupcake which replacing fat with 3 and 4.5% of pomegranate peel powder respectively in all sensory properties. These results are in line with Lotfy and Barakat,[51] who reported that when, the amount of pomegranate peel powder was increased, it led to a decrease in taste score which may be due to the mild

bitterness of tannin and phenolic compounds. Also agreed with Izonfuo et al. [52] who showed that the high amount of pomegranate peel powder that added led to a slight decrease in the taste score due to the bitter taste of the phenolic compounds present in the pomegranate peel powder. Also, our results noticed that the control cupcake is the most acceptable one in the color score followed by the one which contains 3 and 4.5% of pomegranate peel respectively. This is similar to the finding of Ahenkora et al.[53] and Abdel-Rahim et al.[54] who reported that the color of the cupcake decreased with the addition of pomegranate peel powder, and this is due to the dark brown color of the pomegranate peel powder that contains phenolic compounds such as tannins. Also the current results is similar to Greiby, Siddiq, Dolan, Kelkar,[55] who stated that the decrease in crust color values have been linked to anthocyanin deterioration during baking and may be due to Maillard reactions. Moreover in crumb color measurements, a statistically increase in a values was observed when pomegranate peel powder was lower. Also, the obtained result indicated that the control cupcake is the most acceptable one in the texture score followed by the one which contains 3 and 4.5% of pomegranate peel respectively. This was described by Ismail et al. [56] who noticed that a moderate and gradual increase in the amount of fiber in pomegranate peel powder led to the textural hardness property of the cookie product, which led to a decrease in the sensory degree of it. The higher the pomegranate peel supplementation levels, the increases in the hardness values of the muffins. This can be explained by the higher dietary fiber concentrations of pomegranate peel. These effects may due to the ability of dietary fibers to hold water is strongly due to the source of the dietary fiber [57]. According to the results of this study, the control cupcake is the most acceptable one in the flavor score followed by the one which contains 3 and 4.5% of pomegranate peel respectively.

Table (5): Sensory evaluation of control cupcake and cupcakes which replacing fat with 3 and 4.5% of pomegranate peel.

Parameters	Cupcake Samples		
	0 % Pomegranate peel powder (control)	3% Pomegranate peel powder	4.5% Pomegranate peel powder
Taste	8.50a b ±0.53	8.80 a ± 0.42	8.30 b ± 0.48
Color			
Crust	8.00a±0.67	7.00b±0.05	6.00c±0.05
Crumb	8.00a±0.67	7.00b±0.05	6.05c±0.16
Texture	8.40a ± 0.52	8.20a ± 0.79	8.00a ± 0.67
Flavor			
Taste	8.97a±0.05	8.50b±0.53	8.05c±0.60
Odor	8.69a±0.65	8.60a±52	8.39a±0.69
Appearance	8.99a ±0.03	7.55b ±0.60	7.00c ±0.05
Overall acceptable	8.99a ±0.03	8.09b ±0.73	8.05b ±0.50

Values within a row having different superscripts are significantly different ($p \leq 0.05$).

Similarly, Oboh et al. [58] who reported that sensory attributes of foods such as flavor are significantly affected by phenolic compounds, also the same results were recorded in odor, this effect may be that pomegranate peel have strong tannins aroma which reduce the score

of odors by adding pomegranate peel. The obtained result indicated that the control cupcake is the most acceptable one in appearance score, this result is line with Lotfy and Barakat,[51]who reported that in all sensory attributes the control sample was better than the treated cakes. The obtained result also indicated that the control cupcake is the most acceptable one in overall acceptable score followed by the one which contains 3 and 4.5% of pomegranate peel respectively. This result is in agreement with Bourekoua et al.[59] who showed that adding pomegranate peel decreases the overall impression after eating. This may be due to the acids in the pomegranate peel which lead to the mild sour taste. Finally, our study concluded that the best treatment of pomegranate peel powder was 3%.

Conclusion

This study demonstrated that pomegranate peel plays a vital role in controlling and reducing the dangerous effects of liver disease. Our study revealed that 4.5% of pomegranate peel was the most effective treatment due to its phenolics with high antioxidant fraction and beneficial impact on human health. Also, sensory evaluation of cupcake samples showed that the best concentration of pomegranate peel was 3%. So, this study recommended adding pomegranate peel to the diet of hepatic patients to keep them healthy.

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الاستفادة من مخلفات قشور الرمان فى تقليل خطر السمية الكبدية فى الفئران بواسطة رابع كلوريد الكربون

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الملخص العربي:

رابع كلوريد الكربون مادة ســـامة و مرتبطة بتدمير الكبد و الإجهاد التأكســـدى ؛ ولهذا أجريت هذه الدراســـة الحالية للتحقق من تأثير مخلفات قشـــور الرمان فى تقليل خطر الســـمية الكبدية لرابع كلوريد الكربون فى الفئران . 30 فأر من ذكور الألبينو تم تقسيمها إلى مجموعتين أساسيتين :المجموعة الأولى (المجموعة الضابطة السالبة)(عددها =6) تم تغذيتها على الوجبة الأساسية طوال فترة التجربة . المجموعة الثانية (الفئران المصابة بالسمية الكبدية) (عددها =24 فأر) تم تقســـيمها إلى 4 مجموعات فرعية (6 لكل مجموعة) . المجموعة الفرعية الأولى قدمت كمجموعة ضـــابطة موجبة ، المجموعة الفرعية الثانية و الثالثة و الرابعة تم تغذيتها على 1.5 و 3 و 4.5% من مسحوق قشـور الرمان على التوالى لمدة 30 يوم .أحدث الحقن تحت الوريد برابع كلوريد الكربون إرتفاعاً ملحوظاً (بمســـتوى معنوية أقل من 5.,.) فى مســـتويات ســـيرم (الإســـبارتات ترانس أمينيز) ، (الألانين ترانســـفيريز) ، (الألكالين فوســـفاتيز) ، (المالونديالدهيد) ، (الكوليستيرول الكلى)، (الدهون الثلاثية)،(الكوليستيرول الضار) و(الكوليستيرول الضار جداً) .المعاملات ب 4.5% من قشـور الرمان حسـنت وظائف الكبد ، حالة مضـادات الأكسـدة فى أنسـجة الكبد ، و صـورة دهون الدم بالمقارنة بالمجموعة الضـابطة الموجبة . الخلاصـة : تقترح نتائجنا أن قشـور الرمان لها تأثير مضـاد لسـمية الكبد و خصـائص مضادة للأكسدة فى الفئران المصابة بالسمية الكبدية بواسطة رابع كلوريد الكربون.

الكلمات المفتاحية : قشـــور الرمان ، الفئران المصـــابة بالســـمية الكبدية ، رابع كلوريد الكربون ، وظائف الكبد ، حالة مضادات الأكسدة .