Tetrachloromethane (CCl4)-induced liver deterioration in rats with effects of the phytochemical in loquat (Eriobotrya japonica) leaves

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ABSTRACT:

The fruit tree Eriobotrya japonica (EJL) performs a variety of essential functions. The current article's target was to establish the hepatoprotective effects of the phenolic and flavonoid constituents in loquat leaves (E. japonica); versus CCl4 in rats. In this study, thirty male albino rats averaging 190± 10 g were separated into two main sets: first G (-ve) was fed on a basal diet for 4 weeks and the remainder were injected by CCL_4 for induction liver injury twice weekly for 4 weeks, there are all treatment rats divided into 4 sub-groups. Second G was fed a basal diet with CCL_4 injection (2 mg /kg) (+ve) control and sets (3,4,5) fed different dried Eriobotrya japonica levels at (50,100 and 150 g/kg diet). The findings revealed that all indicators have highly significantly increased (malondialdehyde MDA, liver enzymes, lipid parameter) after CCL_4 injection, but when added EJL at different levels, all parameters were highly significantly decreased when compared with positive G, and the decreasing level was accompanied with increasing the EJL levels, this due to the phenolic and flavonoids compounds of EJL. The same effects were noticed in histological results. Bread sensory evaluation revealed the good palatability of these leaves, which could be used as ameliorating products for liver injury.

Keywords: *EJL* – flavonoids – tannin – MDA – liver function.

INTRODUCTION:

Asian trees called loquats (Eriobotrya japonica, EJL) are grown for their fruit. Its leaves have been employed in medicine for humans **(Liu *et al.*, 2016).** Additionally, loquat leaf is a crucial component of culinary applications, and in China and Japan, it has been the main component of certain wholesome and delectable herbal teas **(Hui *et al.*, 2017).**

The healthy food and drug sectors may use polysaccharides derived from loquat leaves (LLPs) when the structural characterization of polysaccharides gets more efficient **(Agsalda-Garcia *et al.*, 2020; Trang *et al.*, 2020).** However, it is yet unclear if a chemical change has an impact on the antioxidant activity of EJL.

The main bioactive substances in E. japonica leaves, according to spectrometry, are tormentic acid, oleanolic acid, ursolic acid, and corosolic acid (**Yanwei *et al.*, 2022).** A green fruit tree called Eriobotrya japonica is planted in several nations, including Iran, Spain, Turkey, Tunisia, and Egypt (**Liu *et al.*, 2016).**

Eriobotrya japonica, Tussilago farfara, and Ephedra sinica were among 56 chosen Chinese herbal remedies that **Song *et al.* (2010)** studied; the findings suggested that these plants may be excellent sources of naturally occurring antioxidants.

The leaves of E. japonica contain a range of natural substances, including tannins, triterpenes, sesquiterpenes, and flavonoids. Several of those substances have antiviral, anti-inflammatories, antihyperglycemic, and antitumor properties (**Cha *et al.*, 2011**).

The primary bioactive components of loquat leaves are polysaccharides, which account for 3.62–5.29% of the plant's total weight and have strong antioxidant, anti-tumor, anti-inflammatory, anti-obesity, and antifatigue properties **(Wu *et al.*, 2018**). Additionally, research shows that the Eriobotrya japonica plant has a variety of essential functions, including the enhancement of liver, lung, renal, and brain cells (**Yang *et al.*, 2012**).

According to **Arjun (2022),** the key organ in charge of regulating essential processes like digestion and the major detoxifying of poisons that reach the body is the liver. Because hepatic cytochrome P450 converts CCl_4 into very reactive carbon-centered trichloromethyl radicals, it is frequently employed to injure the liver. These radicals cause liver injury by triggering a series of lipid peroxidation events **(Aminjan *et al*., 2019).**

The current focus of research is on the pharmacological use of plants and natural components. Determining the hepatoprotective qualities of E. japonica (EJL) leaves and their various fractions towards CCl4-induced rat liver injury was the objective of the current work.

MATERIALS AND METHODS:

Materials:

After being collected, the leaves were cleaned to get rid of the dirt and tiny feathers that were already on them. Next, leave it in the air (room temperature) for two consecutive days. This helps to dry the leaves before they are ground into an ultrafine powder and packaged.

Formalin with carbon tetrachloride (CCl_4) at 100% concentration. was acquired from the Al-Gomhoria - Company.

Animals:

Thirty male albinos Sprague Dawley rats weighing 190±10 g each were employed in this experiment. The creatures were bought from the Helwan animal house- in Cairo. For one week of acclimatization, they were kept in cages and given unlimited amounts of food and water.

Methods:

Determination of total phenolic and flavonoids:

The actual amount of phenol in the sample was measured using the Folin-Ciocalteu micro-method **(Saeedeh and Asna, 2007).** The approach of using the total flavonoid content as a measurement **(Ordon et al., 2006).**

Preparation of toast bread

Flour blends were baked using the straight–dough method; according to (**Chauhan *et al*. 1992 and Radwan and Elmaadawy**

2022). Wheat flour was substituted by three levels of EJL powder (5, 10, and 15 %). The baking formula was composed of a 500 g flour blend, 9 g of compressed baker's yeast, 5 g of NaCl, 13 g of cane sugar, and 10 g of vegetable oil. The dough was fermented for 90 min at 28±1°C and then punched, scaled to 250 g dough pieces, proofed for 90 min at 30°C, 85% relative humidity, and baked at 250°C, for 30 min.

***Sensory evaluation**:*

The sensory qualities of toast samples were assessed. Each bread sample was given to ten participants in the form of a half-slice on disposable, odorless, white plates. Samples were graded on a scale of 1 to 10 for taste, texture, fragrance, color, and overall quality. The assessment was completed using methodology according to **(Land and Shepherd 1988).**

Design of the experiment:

A total of 30 male Sprague Dawley albino rats, weighing 180–200 g, were kept in separate cages under standard circumstances and given a week of a baseline diet to help them adjust. The rats were split into two major groups after this week, as follows: The first group (each with six rats) had a basal diet according to **Reeves *et al*., (1993)** for four weeks (negative group). Four subgroups were created from the 24 rats in the second major group. Carbon Tetra Chloride (CCl_4) 2 mg/Kg of rat body weight was administered intraperitoneally (IP) into all rats twice weekly **(Fang, *et al*., 2008)**. Rats in the third through fifth groups were fed a base meal with various EJL concentrations at (5%, 10%, and 15% /kg basal diet instead of corn starch) **(Sundaresan and Subramanian 2003)**. At the conclusion of the experiment, all rats received a mild anesthetic, and blood samples were taken from the retro-orbital arteries. To extract the serum, blood samples were separated for 15 minutes at 3000 rpm after being allowed to clot.

Biological evaluation

Weekly measurements Feed intake was taken and was an assessment of the growth rates of the rats in all groups throughout the experiment, and the growth rates for each group were as follows: Growth is the variation between the current weekly weight (g) and the previous weekly weight (g) **(Adeyemi et al., 2015).** The relative weight of the liver is determined in the final period as follows: weight liver/ final weight of rat.

Serum biochemically and antioxidant enzymes evaluation:

aspartate aminotransferase and alanine aminotransferase (AST and ALT) as stated by **Reitman and Franke (1957),** serum alkaline phosphatase (ALP) as reported by **Roy (1970**), gamma-glutamyl transferase (GGT) according to **Fischbach (2004),** bilirubin In keeping with (**Walter and Gerade 1970),** malondialdehyde (MDA) in line with **Draper *et al*.,(1993**), total cholesterol as stated by **Allain *et al*., (1974**), triglycerides consistent with **Trinder (1969**), High-Density Lipoprotein-cholesterol HDL-c in line with **Lopes-Virella *et al*., (1977)**, Low-Density Lipoprotein-cholesterol LDL-c and Very Low-Density Lipoprotein- cholesterol VLDL-c consistent with **(Friedwald *et al.*, 1972).**

Histopathological examination:

A liver organ was dried with high alcohol concentrations after being immersed in a formalin solution (10%). Each group collected five 5-mm thick slices and stained them with Masson Trichrome and eosin and hematoxylin (H&E) **(Bancroft and Gamble, 2002).**

Statistical Analysis

An examination of variation in one direction was used to establish the statistical significance of standard deviation across groups (ANOVA). In order to determine if mean differences at ($P \leq 0.05$) were significant, the Least Significant Difference (LSD) test was used. All data analysis was done using SPSS software (Version 16; SPSS Inc., Chicago., USA) **(McCormick and Salcedo 2017).**

RESULTS AND DISCUSSION:

The total phenolic, flavonoid, and tannin content of Eriobotrya japonica Leaves (EJL) were (0.175± 0.01, 0.073± 0.01, 6.94±1.11 g/100g), according to data in **table 1**. These findings were in line with research by **Pande and Akoh (2009**), who discovered that EJL contains tannins, sesquiterpenes, triterpenes, megastigmane glycosides, and flavonoids including quercetin, epicatechin, and catechin, as well as phenolic acids like p-coumaric, gallic, caffeic, and ellagic acid. The leaves of Eriobotrya japonica had a high tannin concentration, which was consistent with the findings of **Nawrot-Hadzika *et al*. (2017),** who determined that the tannin level was 7.52±1.01 g/100g. The total amount of phenolic (TPC) and flavonoid (TFC) chemicals in 100 g of EJL leave was (0.160, 0.01, and 0.064, respectively). According to **Borges *et al*. (2013**), Numerous elements, such as soil nutrients, had an effect on phenolic compounds, and their concentrations altered from one generation to the next **(Verma and Shuklla, 2015).** EJL also contains tormentic acid, in addition to ursolic and oleanolic acids. Its actions are hypoglycemic, anti-inflammatory, anti-atherogenic, and normoglycemic Tormenting acid (**Fogo *et al*., 2009; Xu and Chen 2011; Wu et al., 2015).** The portion of loquat leaves showed anti-inflammatory activity by reducing nuclear factor-B (NF-B) activation, nitric oxide (NO)synthase expression and NO production are inhibited, and down-regulating the secretion of pro-inflammatory cytokines like interleukin-6 and tumor necrosis factor (TNF). Since disturbed cellular oxidative status is linked to NF-B activation, antioxidant activity may also play a role **(Shih *et al*., 2010; Alshaker *et al*., 2011)**. Increased antioxidant enzyme activity glutathione peroxidase, catalase and superoxide dismutase (GPx, CAT, and SOD), and HO^{-1}, which protects against intracellular reactive oxygen species ROS, are associated with both anti-inflammatory and anti-oxidant actions of loquat leaf extract that is rich in flavonoid compounds such as triterpene acids **(Li *et al*., 2007; Lin and Tang 2008).** There have been several research on the terpenoid components of loquat leaf. For instance, in loquat leaves, several terpenoid compounds have been found, and flavonoid amount and activity have been linked **(Li *et al*., 2009; Li *et al*. 2015)**

From **table (2)** EJL toast at level 5% had the highest score at color, appearance, and texture across all samples in comparison with the control sample. EJL toast at levels 10% and 15 received the lowest score across all sensory evaluations, which may have been a result of containing a harsh texture due to the high quantity of dietary fibers and the darkness of the dried leaves. The present findings agree with those of **Cho and Kim (2013),** who found that values for all criteria dramatically reduced as EJL levels increased**.**

Figure 1 observed that photo (6a) represents all samples, photo (6b) represents the control wheat sample of toast, photo (6c) represents the toast sample with 5% EJL, photo (6d) represents the toast sample with 10% EJL, and photo (6e) represent toast sample with 15% EJL. From photos (6a, b, c, d, and e) it could be noticed that the toast sample of wheat flour differs in texture, volume, and pores this is due to a gluten network that traps air inside, while the three samples of toasts differ gradually in color, volume, and texture which revealed the same trend as sensory evaluation, as the best score of samples was at the toast with 5% level of EJL, this may be due to the toast color and volume. Other samples became slightly dark, which can influence the evaluation. These results were in a harmony with (**Ga et al., 2021**) who reported that according to the observations using a scanning electron microscope (SEM), the pores decreased and merged as the amount of loquat leaf powder rose, yet they grew bigger and fewer in number. The rice cake with 4.5% loquat leaf powder earned the highest grade in all of the sensory tests, according to sensory assessments. In conclusion, loquat leaf powder enhanced the antioxidant activity and quality attributes that might be used to make different foods.

The effects of EJL powder (5%, 10%, and 15%) on feed intake (FI), body weight gain (BWG), the feed efficiency ratio (FER), and liver weight (g) were shown by the data in **the table (3**). When compared to the negative group (19.14 ±1.10), feed intake in the positive group (13.88 ±0.12g) had a significant decrease. Assessing all treated groups to the positive group, a significant increase was observed ($p<0.05$). The group treated with CCL4+15% EJL was (17.47 ±1.12), which is the best value for the (-ve) group, and obtained the best performance as indicated in the table (1). The findings showed that the mean BWG in the positive control group was considerably lower than in the negative control group. In comparison to the positive control group, all EJL powder treatment groups (5%, 10%, and 15%) displayed a significant increase ($P <0.05$). The group treated with CCL4+15% EJL achieved the best results, which is a value similar to the (-ve) control group as specified in Table (1). The feed efficiency ratio in the positive control group recorded a significant decrease as compared with (-ve) and all treated with EJL (5%,10%, and 15%) powder. When compared to the negative control group, the value of liver weight was significantly higher in the positive control group. Each group that received EJL powder treatments (5%, 10%, and 15%) demonstrated a statistically significant increase (P0.05). The group that received treatment with CCL4+15% EJL has a close value to the (-ve) group as described in Table (1). These results were in a harmony with those of **Yoshioka *et al.*, *(*2018**) revealed that CCl4 administration increased liver weight, decreased body weight, and feed intake. Also, the result showed a significant increase at ($p<0.05$) in body weight in all groups treated with different levels of EJL when compared with the positive control group. It should be mentioned that body weight is rising together with the level of Eriobotrya Japonica. As opposed to the negative control group, the positive control group's body weight considerably decreased at ($p< 0.05$) when compared to the negative control group, however, it was still lower than the control negative group. In contrast to the positive control group, body weight gain was higher in all groups treated with various doses of Eriobotrya Japonica. These outcomes were comparable to those attained by **(Shafi and Tabassum 2013)**

Data in **table (4)** showed that all parameters of total cholesterol, triglycerides, high-density lipoprotein cholesterol, and low-density lipoprotein cholesterol (TC, TG, HDL-c, and LDL-c) were significantly higher in groups of rats with liver fibrosis brought on by CCl_4 injection than in the control group, with values of mg/100gm 289.6 ± 23.8, 207±5.4, 23±2.9, and 173 ± 5.03, respectively. These findings were consistent with those of **Kamalakkannan *et al.* (2005**), who reported that CCl_4 injection increased total cholesterol. The results of **Kamalakkannan *et al.* (2005**) study showed that CCl_4 also inhibits the synthesis of apo-lipoprotein, which in turn reduces the synthesis of lipoproteins, while the groups of rats fed on EJL at 5%, 10%, and 15% with CCl_4 showed a highly significant decreased in TC, TG, and LDL-c and a highly significant ($p<0.05$) increased in HDL-c. In addition, **Shih *et al*., (2010) and Shih *et al*., (2013)** displayed a result of lowering body weight growth, hepatic triacylglycerol levels, adipocyte size in visceral depots, and the weight of white adipose tissue (WAT) (containing visceral fat, mesenteric, perirenal, and epididymal WAT), flavonoids like terpenoids in (EJL) showed hypo-lipidemic action. According to certain research, lipids deposited in peripheral adipose tissue are transferred to the liver and kidney after CCl_4 poisoning and accumulate there (**Kamala-kkannan *et al*., 2005**). Additionally, loquat extractions control how lipids are metabolized and result in lower levels of triglycerides and total cholesterol **(Lu *et al*., 2009).** Treatment with CCl_4 reverses the weakening of the liver cells' capacity to metabolize lipids and convert cholesterol to bile acid for excretion, while also raising blood levels of triglycerides, low-density lipoprotein cholesterol, and cholesterol while lowering high-density lipoprotein cholesterol levels. The fractions and extract of loquat helped to mitigate these effects. (**Shahat *et al*., 2018).** In addition to decreasing sterol regulatory element binding protein-1c (SREBP-1c) mRNA levels and sterol regulatory element binding enzyme levels in the liver, loquat also altered fatty acid levels and oxidation enzymes **(Shih *et al*., 2010).** The reduction in blood fat levels, including triglycerides, total cholesterol, low-density lipoprotein cholesterol, malondialdehyde, and an increase in HDL-c, may be attributable to Eriobotrya Japonica leaves having a high concentration of total sesquiterpene glycosides compounds, according to **Jian *et al* (2017).** Loquat leaves have antioxidant properties, according to several research) **Banno *et al*., 2005; Hong *et al*., 2008),** and natural antioxidants work to prevent lipid peroxidation by inhibiting the enzyme xanthine oxidase.

The normal control group's biochemical characteristics served as the baseline for comparison. Serum levels of MDA, bilirubin, ALP, AST, ALT, and GGT were significantly higher in the CCl_4 group than in the control group. According to **tables (5, 6),** the levels of MDA, bilirubin, ALP, AST, ALT, and GGT were all significantly lower in rats fed meals with levels of (EJL) ($P<0.05$) when compared to the positive control group. This result was consistent with **Shahat et al., (2018)'s** report that fractions of EJL also significantly suppressed the CCl_4-stimulated elevated amount of malondialdehyde (MDA), which was demonstrated by a decline in histopathological injuries. With increased leaf percentage in the basal diet, the improvement of all parameters was significantly increased. Aspartate aminotransferase (AST), gamma-glutamyl transferase, alanine aminotransferase (ALT), bilirubin, and alkaline phosphatase levels in rats treated with this plant were considerably decreased at ($p<0.05$) levels when compared with positive controls, according to research (**Shahat *et al*., 2018**). The present findings demonstrated that rat serum levels of ALP and bilirubin were increased by CCl_4. Such enzymes are often found in cell cytoplasm at greater concentrations than in serum.

According to the degree of liver injury, hepatopathy induces the release of AST, ALT, and bilirubin into the circulation (**Nkosi *et al*., 2005).** According to results from another study, increased blood levels of AST, ALT, ALP, and total bilirubin in CCl_4-treated rats suggested cellular damage and loss of cell membrane function (**Zeashan *et al*., 2008).** Additionally, **Shahat *et al*. (2018**) discovered that Eriobotrya japonica leaf extracts in methanolic, ethyl acetate, aqueous, and butanol as well as their various fractions against hepatotoxicity brought about by CCL_4 resulted in a significant decrease in serum levels of liver enzymes like ALP, ALT, AST, malondialdehyde, and bilirubin.

Figure 1 shows that in rats treated with CCl_4 and given a low dosage of EJL photo (3) (50 g/kg), the hepatocytes did not return to normal. Hepatocytes were somewhat congested and had a modest degree of cellular edema in the liver slices. However, rats given CCl_4 treatment plus a high dosage (150 g/kg) of EJL supplementation had normal hepatic lobules and hepatocytes G (5). **Li *et al.* (2014)** mentioned that CCL4 is commonly used as a model toxicant to induce chronic and acute liver injuries. Acute liver injury was successfully induced by CCL4 as revealed by histopathological results and the significant increase in ALT and AST. **Haytham *et al.* (2019)** demonstrated the changes in the liver after four weeks of CCL4 administration. They observed necrotic changes in the centrilobular area with swelling of the hepatocytes and infiltration of ceroid pigment-laden macrophages were seen. Many researchers hypothesized that the anti-inflammatory effects of loquat extracts were caused by a reduction in pro-inflammatory mediators or an increase in anti-inflammatory cytokine (IL-10) discharges (**Fogo *et al*., 2009; Fang *et al*., 2008**). Inhibiting the nuclear factor-B (NF-B) and mitogen-activated protein kinase (MAPK) signaling pathways, which were connected to this regulation were those that have been suggested as key regulators of the cellular signaling pathway's generation of inflammatory mediators (**Ullah *et al*., 2018 and Cha *et al*., 2011).** Total Flavonoid (TF) extracted from Loquat Leaf, the mitigated microvascular fatty and histopathological changes in liver tissue were improved in a dose-dependent manner, and the volume and number of lipid droplets markedly decreased. TF treatment significantly ameliorated the steatosis and hepatocyte swelling, especially in the treatment of TF at a high dose of 200 mg/kg, and the morphology of the liver lobular structure recovered to nearly normal status (**Tunyu et al., 2018)**

CONCLUSION:

Since more than 500 variants of Eriobotrya plants have been identified, there is a plentiful natural supply of these plants. As a result, it is anticipated that various Eriobotrya species may display significant variations in their phytochemical composition and antioxidant activity. Understanding the antioxidant properties of different wild species might assist us in understanding their chemical characteristics and possible medicinal uses. The loquat (Eriobotrya japonica) is a significant source of physiologically active phyto-chemicals, including terpenoids, carotenoids, phenolic, flavonoids, vitamin C, and carotenoids. Traditional Chinese medicine utilizes the entire plant. Pharmacological research has revealed that several loquats extract exhibit anti-inflammatory, antioxidant, hypoglycemic or antihyperglycemic, gastro-protective, and hypolipidemic properties.

Generally, according to this study, the *Eriobotrya Japonica* leaves powder has a high content of nutritive value, *Eriobotrya japonica* leaves can be used for anti-oxidative damage and anti-hepatic damage.

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Table (1): phenolic and flavonoid compound of Eriobotrya- japonica Leaves

sample	Total phenolic g/100g	Total flavonoids g/100g	Tannins g/100g
EJL	0.175±0.01	0.073± 0 .01	6.94± 1.11

Table (2): Color, appearance, texture, taste, and overall quality of EJL Toast Bread (Tb)at different levels

samples	Color	Appearance	Texture	Taste	Overall Quality
control	**9.8**	**9.7**	**9.6**	**9.8**	**9.7**
Tb 5% EJL	**9.1**	**9.1**	**8.9**	**8.4**	**8.87**
Tb 10 % EJL	**8.5**	**8.83**	**8.4**	**7.5**	**8.31**
Tb 15 % EJL	**7.9**	**8.5**	**8.1**	**7.1**	**7.9**

Photo(6a)

photo(6b)

photo (6c)

Photo (6d)

Photo (6e)

Figure 1 all samples, represents the wheat sample of toast

Table (3) biological evaluations in administered CCI_4 rats fed meals with different levels of (EJL) (Mean ±SD).

Groups	F intake g/d	BWG%	FER	Liver weight (g)
negative control	19.14 ±1.10[a]	28.30 ± 2.6 [a]	0.10±00.04 [a]	5.30±0.20[d]
positive control	13.88 ±0.12 [c]	9.19 ±1.6 [d]	0.03 ± 0.0 [c]	8.41±0.13 [a]
CCL4+5%EJL	16.65±1.10[b]	12.61 ±1.2 [c]	0.04 ± 0.0 [c]	7.70±0.06 [b]
CCL4+10% EJL	17.42 ± 0.14 [b]	16.94 ± 1.8 [b]	0.06 ± 0.0 [b]	7.32±0.07 [b]
CCL4+15 %EJL	17.47 ±1.12 [b]	19.8±1.9 [b]	0.08 ± 0.04 [a]	6.65±0.06 [c]

This means in the same column with completely different letters is significantly different at $p<0.05$.

Table (4): Serum lipid profiles (TC, TG, HDL-c, and LDL-c) in administered CCI_4 rats fed meals with levels of (EJL) (Mean ±SD).

groups	TC mg/dl	TG mg/dl	HDL-c mg/dl	LDL-c mg/dl	VLDL-c mg/dl
Negative control	**106.2±4.92 [b]**	**86.7 ± 9.2 [b]**	**46.6 ±3.78 [b]**	**42.4±1.82**	**17.34±1.5 [b]**
Positive control	**279.6 ± 23.8 [a]**	**207.6 ±5.4 [a]**	**23.00 ±2.9 [a]**	**183.4±5.03 [a]**	**73.5±3.8 [a]**
CCL4+ 5%EJL	**208.2 ± 7.9 [a,b]**	**189.6 ±6.5 [a,b]**	**35.4±3.35 [a,b]**	**152.6 ± 3.36 [a,b]**	**37.9± 2.1 [a,b]**
CCL4+ 10% EJL	**151.8 ± 6.76 [a,b]**	**138.3±6.96 [a,b]**	**37.4 ± 2.72 [b]**	**135.4 ± 8.9 [a,b]**	**27.7±2.9 [a,b]**
CCL4+ 15 % EJL	**135.3 ± 4.95 [a,b]**	**103.8 ±4.21 [a,b]**	**46.2 ± 4.92 [b]**	**109.4± 8.62 [a,b]**	**20.76±2.3 [b]**

[a] *Significant with Negative G* [b] *Significant with positive G*

Table (5) serum MDA and Bilirubin) in administered CCI4 rats fed meals with different levels of (EJL) (Mean + S.D):

groups	MDA µmol/ l	Bilirubin g/ dl
negative control	1.77 ± 0.16 [b]	0.73 ± 0.16 [b]
positive control	9.16 ± 0.85 [a]	3.33 ± 0.37 [a]
CCL**4**+5% EJL	8.76 ± 0.92 [a]	2.77 ± 0.55 [a, b]
CCL**4**+10% EJL	3.64±0.44 [a, b]	1.65 ± 0.43 [a, b]
CCL_4+15% EJL	2.29 ± 0.27 [b]	0.75 ± 0.20 [a, b]

[a] *significant with negative G*

[b] *significant with positive G*

Table (6) Serum blood ALT, AST, ALP, and GGT (U/L) in administered CCI4-rats fed meals with levels of EJL (Mean + S.E.).

groups	AST U/L	ALT U/L	ALP U/L	GGT U/L
negative control	120.15 ± 3.76 [b]	64.15 ± 4.04 [b]	92.9 ± 4.1 [b]	0.82 ± 0.12 [b]
positive control	217.80 ± 5.44[a]	173.26 ± 4.36[a]	189.5±6.2[a]	14.74 ± 1.34[a]
CCL_4+5% EJL	179.74 ± 9.45[a, b]	159.42 ± 4.01 [a,b]	186.99 ±4.0[a]	11.71±0.99[a,b]
CCL_4+10% EJL	171.40 ± 4.55 [a,b]	125.49 ± 4.05 [a,b]	125.16 ±5.2[a,b]	9.10 ±0.8 0[a,b]
CCL_4+15% EJL	142.59 ± 3.0 3[a,b]	108.93 ±6.80 [a,b]	102.40 ±8.4[b]	6.75 ± 1.39 [a,b]

[a] *significant with negative G*

[b] *significant with positive G*

Figure 2 Microphotograph results:

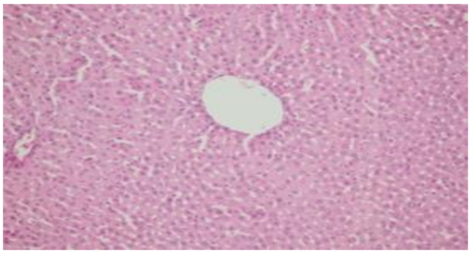

photo (1) G1 Microphotograph of rat liver section shows a normal histological pattern of hepatocytes and central vein (HE, 400x)

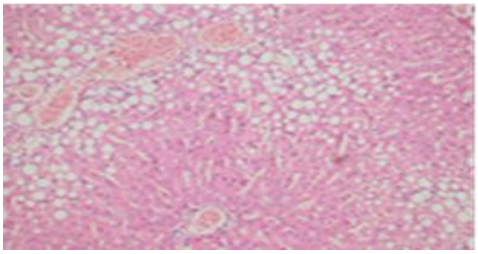

photo (2) G2 Microphotograph of liver showing severe multifocal macro-vesicular steatosis in hepatocytes and congestion of hepatic veins and well-formed fibrotic bands and abundant collagen fibers around the regenerative hepatocytes' nodules (HE, x400).

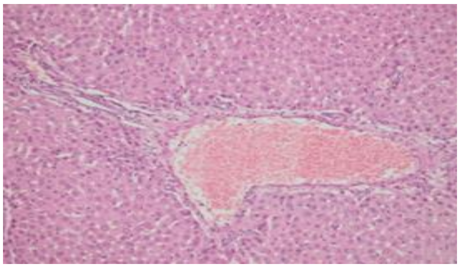

photo (3) G3 Microphotograph of rat liver section shows a normal histological pattern of hepatocytes, moderate congestion of portal veins (HE, 400x)

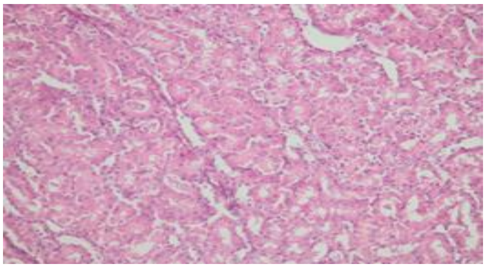

photo (4) G4 Microphotograph of liver showing normal hepatocytes and some congested hepatic veins (HE, x400)

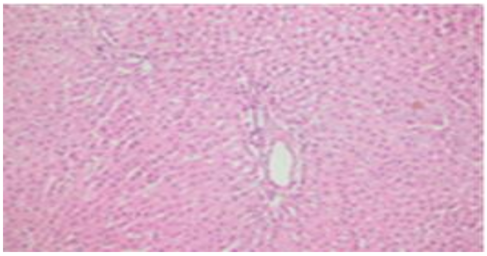

photo (5) G5 Microphotograph of liver showing normal hepatocytes and congested central veins (HE, x400).

تدهور الكبد الناجم عن رباعي كلورو الميثان (CCl4) في الجرذان مع تأثيرات المادة الكيميائية النباتية في أوراق البشملة

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المستخلص العربي

تؤدي شجرة الفاكهة Eriobotrya japonica (EJL) مجموعة متنوعة من الوظائف الأساسية. كان هدف المقالة الحالية هو تحديد التأثيرات الوقائية للكبد للمكونات الفينولية والفلافونويدية في أوراق اسكدنيا (E. japonica) ؛ ضد CCl4 في الجرذان. في هذه الدراسة ، تم فصل ثلاثين من ذكور الجرذان البيضاء بمتوسط 190 ± 10 جم إلى مجموعتين رئيسيتين: تم إطعام المجموعة أولى الضابطة السالبة على نظام غذائي أساسي لمدة 4 أسابيع وتم حقن الباقي بواسطة CCL4 لإصابة الكبد مرتين أسبوعياً لمدة 4 أسابيع ، تم تقسيم كل الجرذان المصابة إلى 4 مجموعات فرعية. تم تغذية المجموعة الثانية بنظام غذائي أساسي بعد حقن CCL4 (2 مجم / كجم) كمجموعة تحكم ضابطة موجبة ومجموعات (3،4،5) تم تغذيتها بمستويات مختلفة من Eriobotrya japonica (50،100 و 150 جم / كجم). أظهرت النتائج أن جميع المؤشرات قد زادت بشكل كبير (malondialdehyde MDA ، إنزيمات الكبد ، معامل الدهون) بعد حقن CCL4 ، بينما عند إضافة EJL بمستويات مختلفة ، انخفضت جميع المعلمات بشكل واضح عند مقارنتها بالمجموعة الإيجابية ، وكان المستوى المتناقص مصحوبًا مع زيادة مستويات EJL ، وهذا بسبب مركبات الفينول والفلافونويد فيها. لوحظت نفس التأثيرات في النتائج النسيجية. كشف التقييم الحسي للخبز عن مدى استساغة هذه الأوراق ، والتي يمكن استخدامها كمنتجات محسنة ل الكبد المصاب.

الكلمات المفتاحية: اوراق البشملة –الفلافونويد- داى مالون الدهيد – وظائف الكبد