The Effect of Tarragon (*Artemisia dracunculus* L.) on Hepatotoxicity in Rats

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ABSTRACT

This study aimed to evaluate the effect of *Artemisia dracunculus* L. (tarragon) leaves powder (TLP) and its aqueous extract (TLAE) on CCL4- induced hepatotoxicity in rats. Thirty-six rats were separated into two groups. The 1st group, rats (n=6) were fed on basal diet and kept as negative control group, 2st group: hepatotoxic group, rats (n=30), were injected with CCl_4 at 1ml/kg b.wt. After 24 h from injection for 3 days, a rat from each group was taken to measure liver function to be sure that all rats had liver injury. After liver injury, rats were divided as follows: subgroup 1 served as the control positive group and 4 treated rat subgroups were fed on a diet supplemented with the Tarragon leaves powder and its aqueous extract concentration (1% or 2% per kg diet, or 1mL, 2mL of TLAE as one injection gavage, respectively). Results revealed that supplementation with different levels of tarragon leaves powder and its aqueous extract had improved body weight and liver weight accompanied by a significant decrease in levels of liver functions (ALT, AST, ALP and total bilirubin), as well as in lipid profile, while a significant increase in high-density lipoprotein cholesterol (HDL-C) was recorded. In addition, malondialdehyde (MDA) and serum cytokines interleukin-1 beta were significantly reduced, while GSH was significantly ($P<0.05$) increased. In conclusion, tarragon leaves powder and its aqueous extract could introduce a potential natural therapy against hepatotoxicity.

Keywords: *Artemisia dracunculus*, Tarragon, Hepatotoxicity**,** Liver Disease, Rats.

INTRODUCTION

Chronic liver disease is a condition in which the liver slowly deteriorates and malfunctions due to chronic injury. Scar tissue replaces healthy liver tissue, partially blocking the flow of blood through the liver. Fibrosis begins with a long-lasting rather asymptomatic period **(Pinter et al., 2016)**. It can lead to cirrhosis, hepatocellular carcinoma if left untreated and liver failure **(Rajathi and Jiji, 2019)**. People are interested in using herbal medicine because the side

effects of chemical drugs. Plants are complementary and alternative medicine due to their ability to produce secondary metabolites such as proteins, flavonoids, alkaloids, steroids, and phenolic compounds which are used to recover health **(Moradi and Esfahani, 2016)**.

Tarragon *(Artemisia dracunculus L.*) is a perennial herb belonging to the *Asteraceae* family with a long history in culinary tradition and medicine; it also possesses a wide range of health benefits **(Rabinicky *et al*., 2014)**. Its taste is herbaceous with anise-like notes **(Obolskiy *et al*., 2011)**. Leaves smooth green and grown in warm, dry areas, they grow in Egypt in the Middle Sinai region **(El-Sayed *et al*., 2009)**. Tarragon has a long history in the food industry (flavoring of meat, sauces and vinegar) and cosmetics industry as well as medicinal use **(Ekiert *et al*., 2021)**.

It contains antioxidants including monoterpenoids, sesquiterpenoids and isocoumarins, flavonoids, coumarin and alkamides **(Eisenman *et al*., 2011)**. The extract of tarragon has anti-parasitic, anti-fungal, sedative, anti-cough activity, immunomodulating and anti-tumour activities **(Wang *et al*., 2011)**. Flavonoids have gained great interest as potential therapeutic agents against a wide variety of diseases. The most common flavonoids present in medicinal plants include quercetin, kaempferol, luteolin and apigenin **(Duric *et al*., 2015)**.

Ibrahem, (2017) found that the methanolic extract of dried aerial parts of tarragon contains glycosides, volatile oils, alkaloids, terpenoids, phenolic compounds and flavonoids. **Kafshboran *et al*., (2011)** showed that Flavonoids are a class of secondary plant phenolic, which act as pharmacological active compounds in many medicinal plants with their powerful antioxidant properties. They could provide strong antioxidant activities associated with their capacity to scavenge free radical and terminate radical chain. Therefore, this study aimed to evaluate the effect of tarragon herb *(Artemisia dracunculus L.)* and its aqueous on CCL_4- induced hepatotoxicity in rats.

MATERIALS AND METHODS

MATERIALS:

1- **Plant**: Tarragon leaves were purchased from El-Zohrya Botanical Garden, Giza, Egypt.

2- **Chemicals**: Casein, vitamins, minerals, cellulose, and CCl_4 were purchased from El-Gomhoria Company, Cairo, Egypt.

3- **Kits** for blood analysis were purchased from Alkan Company for Biodiagnostic Reagents, Dokki, Cairo, Egypt.

4- **Rats**: Thirty-six adult male rats **(**Sprague Dawley strain), weighing about 180±10 g b.wt. were obtained from the Laboratory Animal Colony, Helwan, Egypt. They were housed at constant conditions of room temperature and 55 ± 5% humidity under 12-hr light/12-hr dark cycles. All rats have continuous access to feed and water and will acclimate to laboratory conditions for 1 week.

METHODS:

Preparation of Tarragon Leaves Powder (TLP) and its Aqueous Extract (TLAE)

Tarragon leaves were washed separately with water and dried in the shade. The dried leaves were powdered mechanically. Fine powder is then stored in a dry place in the dark for extraction.

Aqueous Extract (TLAE):

Extraction was performed by mixing 10 g of powder in 100 ml of distilled water for 2 h at 40°C. The prepared extract was filtered through a gauze cloth followed by filtration through a normal filter paper. The product was a dark brown aqueous extract afterward sustained in an appropriate low temperature **(*Cala et al*., 2014 and Reza *et al*., 2015).**

Induction of hepatotoxicity in rats:

Carbon tetrachloride (CCl_4) – induced acute hepatotoxicity in rats **(Jayasekhar *et al*., 1997)**. Intraperitoneal injection of male albino rats with CCl_4 (1 mL/kg), a 1:1 mixture with corn oil for 3 days increased serum alanine transaminase, aspartate transaminase, and alkaline phosphatase activity as well as total bilirubin, triglycerides and total cholesterol levels.

Experimental Design

The experiment was carried out at the Post Post Graduate Lab of the Home Economics Faculty, Helwan University. Animals were housed in well aerated cages under hygienic conditions and fed a basal diet for one week for adaptation. After the adaptation period, rats were divided into two main groups, as follows:

• **First group:** Negative control group, rats (n=6) were fed on basal diet only during the experimental period.

• **Second group:** Rats (n=30), were injected with CCl_4 for 3 days (2 injections/week) at 1ml/kg b.wt. diluted with liquid paraffin oil (1:1, V:V) caused hepatotoxicity for rats **(Jayasekhar *et al*., 1997)**, then the animals were divided as follows:

Subgroup (1):	Rats (served as a positive control group) were fed on a basal diet only.
Subgroup (2):	Rats were fed a diet supplemented with 1% TLP per kg of diet.
Subgroup (3):	Rats were fed a diet supplemented with 2% TLP per kg of diet.
Subgroup (4):	Rats received a basal diet and a single oral dose of 1 mL TLAE by gavage.
Subgroup (5):	Rats received a basal diet and a single oral dose of 2 mL TLAE by gavage.

Nutritional evaluation:

The biological evaluation of the diet was carried out by determination of feed intake, body weight gain percent (BWG %) and feed efficiency ratio (FER) according to **Chapman, (1959)** using the following equation:

$$\textbf{BWG } \% = \frac{\text{Final body weight} - \text{Initial body weight}}{\text{Initial body weight}} \times 100$$

FER = Weight gain (g) / Feed intake (g)

At the end of the experimental period (4 weeks), rats were fasted overnight, then the blood was collected under slight ether anesthesia. Serum was separated by centrifugation at 3000 rpm for 15 min. The obtained serum was used immediately for routine laboratory investigation.

Biochemical Analysis:

Liver Function:

Serum aspartate aminotransferase (AST) and alanine aminotransferase (ALT) were measured according to (**Bergmeyer *et al*. (1978),** and alkaline phosphatase (ALP) was determined according to **Belfield and Goldberg (1971)**. Serum Bilirubin were measured **Weissman *et al*., (1950).**

Serum Lipid Profile:

Serum total cholesterol (TC) **(Richmond, 1973)**, triglycerides (TG) **(Wahlefeld, 1974)**, and high-density lipoprotein (HDL) **(Albers *et al*., 1983)** were determined. Meanwhile, low density lipoprotein (LDL) and very low density lipoprotein (VLDL) were calculated according to **Fridewald *et al*., (1972)**.

LDL-c = TC-[HDL-c + (TG/5)] **VLDL-c = TG/5**

Antioxidant Enzymes

The plasma level of malondialdehyde (MDA) was calculated to measure lipid peroxidation and was determined according to **Draper and Hadley (1990).** Glutathione (GSH) was measured by methods by **Moin, (1986).**

Statistical analysis:

Statistical analysis was performed using SPSS computer program (GraphPad) software Inc, San Diego, CA, USA). One-way analysis of variance (ANOVA) followed Duncan's multiple tests were done $P \leq 0.05$ were significant **(Armitage and Berry, 1987)**.

RESULTS AND DISCUSSION

Recorded results in **Table (1)** interpreted the effect of Tarragon Leaves Powder (TLP) and its Aqueous Extract (TLAE) on (IBW), (FBW), (BWG), (FI), (FER) and liver weight of hepatotoxicity rats. It shows that the injected rats with CCl_4 (+ve group) had a significant reduction ($P<0.05$) in FBW, BWG%, FI, FER, and liver weight compared to the normal rat (-ve group). This finding was consistent with a study by **Hassan *et al*., (2025)** showed that the injected rats with CCl4 (+ve group) had a significant reduction ($P<0.05$) in BWG%, FI, FER, and liver weight compared to the normal rat (-ve group).

In contrast, rats that were fed Tarragon Leaves Powder (TLP) and its Aqueous Extract (TLAE), had a significant increase ($P<0.05$) in BWG%, FI, FER, and liver weight as compared to the positive control group. The best mean values of FBW, BWG% and FER increase were observed in the group fed 2ML of TLAE.

Table (1): Effect of Tarragon Leaves Powder (TLP) and its Aqueous Extract (TLAE) on Initial body weight (IBW), Final body weight (FBW), body weight gain (BWG%), food intake (FI), food efficiency ratio (FER) and liver weight of Hepatotoxicity rats

Parameters / Groups	IBW g	FBW g	FI g/d/ rat	BWG %	FER	Liver weight g
Control (-Ve)	187.40±0.74a	240.40±0.67a	18	28.28±0.23a	0.105±0.001a	7.45±0.09a
Control (+Ve)	188.20±0.66a	207.60±0.92d	13	10.30±0.36d	0.053±0.001d	3.44±0.05e
1 % TLP/Kg diet	187.40±0.87a	217.20±1.06c	14	15.91±0.57c	0.076±0.001c	5.03±0.11d
2 % TLP/Kg diet	187.60±0.67a	221.40±1.28c	16	18.01±0.39c	0.075±0.001c	5.57±0.44cd
1mL/rat/day TLAE	186.20±1.06a	227.00±0.31b	15	21.92±0.74b	0.097±0.002ab	6.27±0.11bc
2 mL/rat/day TLAE	187.80±0.80a	231.20±0.86b	17	23.11±0.35b	0.091±0.002b	6.84±0.13ab

Results are expressed as mean ± SE.
Values in each column which have different letters are significantly different at ($P<0.05$).

The tabulated results in **Table (2)** explained that rats with liver toxicity by CCl_4 injection had a significant increase ($p<0.05$) in the serum activity of AST, ALT, ALP and Total Bilirubin compared to normal rates (-ve control group). Serum AST, ALT, and ALP activity levels were significantly higher in CCl4-treated rats than in the control group. This finding was consistent with a study by **Negm and Aljarari, (2023); Hassan *et al*., (2025)**.

CCl_4 is a poisonous substance that damages the liver. According to the investigation, exposure to CCl4 alters normal physiological aspects by upsetting the normal levels of bilirubin, AST, ALT, and ALP. CCl4 is a potent hepatotoxin known for inducing hepatotoxicity features in animals that are similar to those of acute hepatitis in humans **(Li et al., 2015)**. Significant rises in the blood marker enzymes (AST, ALT, and ALP) are linked to acute liver injury. Liver enzyme levels and serum biomarker concentrations are helpful indicators for monitoring liver disease. Higher AST and ALT values suggest liver damage, whereas lower AST and ALT values indicate a reasonably healthy liver status **(Hassan *et al*., 2025)**. Research has shown that CCl_4 has a major impact on serum levels of ALT and AST. These liver enzymes' elevation is explained by the acute hepatocyte damage brought on by CCl_4 **(Negm, 2023a; Munir & Khan, 2023)**.

While the treatment of liver toxicity in rats by feeding on Tarragon Leaves Powder (TLP) and its Aqueous Extract (TLAE) significantly ($P<0.05$) reduced serum activity of AST, ALT, and ALP enzymes compared to the (+ve group). The rats administered with the highest ratio 2ML of TLAE showed the greatest improvement in results. This finding was consistent with a study by **Zarezade et al., (2018)** indicated oral treatment with the hydro-alcoholic extract of tarragon (HEAD) at doses of 50, 100, or 200 mg/kg exhibited a

significant decrease in the levels of AST, ALT, ALP, and total bilirubin in CCl4-induced hepatic damage in rats. The extract showed a good concentration-dependent reducing power and suggested that these effects may be produced by reducing oxidative stress. At different doses offered hepatoprotection, but 200 mg/kg of HEAD was more effective than the other doses, which was consistent with the findings of **Rajabian et al., (2016)**. Also, **Ismail et al., (2021)** showed that oral tarragon extract (100 and 200mg /kg) in chronic liver disease rats groups had decreased AST, ALT and ALP.

Table (2): Effect of Tarragon Leaves Powder (TLP) and its Aqueous Extract (TLAE) on liver function of Hepatotoxicity rats

Parameters / Groups	AST (µ/L)	ALT (µ/L)	ALP mg/dL	Total Bilirubin µmol/L
Control (-Ve)	19.27±0.24e	34.25±0.15f	104.80±0.36f	0.74±0.008f
Control (+Ve)	41.78±0.52a	74.95±0.52a	170.09±0.36a	1.84±0.032a
1 % TLP/Kg diet	36.94±0.50b	71.63±0.34b	162.37±0.65b	1.55±0.08b
2 % TLP/Kg diet	33.25±0.37c	62.33±0.45d	155.04±0.44c	1.22±0.007c
12mL/rat/day TLAE	34.98±0.24bc	66.78±0.83c	145.17±0.39d	1.07±0.013d
2 mL/rat/day TLAE	29.40±0.30d	59.07±0.18e	131.26±0.42e	0.96±0.021e

Results are expressed as mean ± SE.
Values in each column which have different letters are significantly different at ($P<0.05$).

As shown in **Table (3)** the effect of Tarragon Leaves Powder (TLP) and its Aqueous Extract (TLAE) on TC, TG, HDL-C, LDL-C, and VLDL-C in rats with liver toxicity. The positive control group showed significant increases ($P<0.05$) in mean levels of TC, TG, VLDL-C, and LDL-C, while HDL-C declined significantly compared to the negative control group. Abnormalities in lipid and lipoprotein levels are frequently associated with liver diseases **(Negm,**

2023; Taha et al., 2022; Negm and El-Soadaa, 2020).

Induced group rats which had Tarragon Leaves Powder (TLP) and its Aqueous Extract (TLAE) at different levels showed a significant decrease at levels ($P<0.05$) of lipid profile compared to the control positive group, while the HDL-C was significantly increased. Moreover, there was a significant difference at ($P<0.05$) in the mean values of TC, TG, VLDL-C, and HDL-C for those feeds supplemented with Tarragon Leaves Powder (TLP) and its Aqueous Extract (TLAE). The group that supplemented with Tarragon Leaves Aqueous Extract at 2ML showed the greatest improvement in lipid profile. This finding was consistent with a study by **Haghighian et al., (2021)** indicates that 1.5 g/d tarragon supplementation for 8 weeks significantly improves FBG levels and lipid profiles in patients with type 2 diabetes, which is consistent with the study of **Parsaei et al., (2016)** who established the efficacy of tarragon powder in reducing TG levels in diabetic rats.

Table (3): Effect of Tarragon Leaves Powder (TLP) and its Aqueous Extract (TLAE) on lipid profile of Hepatotoxicity rats

Parameters / Groups	TC mg/dl	TG mg/dl	HDL mg/dl	LDL mg/dl	VLDL mg/dl
Control (-Ve)	174.62±0.60e	84.85±0.41e	35.33±0.38a	95.31±0.40e	16.97±0.08e
Control (+Ve)	180.47±0.37a	134.79±0.44a	24.23±0.31e	129.19±0.57a	26.95±0.08a
1 % TLP/Kg diet	169.77±1.35b	122.38±0.95b	25.93±0.22de	119.36±1.17b	24.47±0.39b
2 % TLP/Kg diet	165.75±0.77c	110.62±0.35c	27.84±0.54cd	115.78±0.39c	22.12±0.06c
12mL/rat/day TLAE	152.63±0.40d	108.72±0.52c	29.23±0.23c	101.65±0.42d	21.74±0.10c
2 mL/rat/day TLAE	148.88±0.48de	91.20±0.65d	32.77±0.54b	97.86±0.57e	18.24±0.13d

Results are expressed as mean ± SE.
Values in each column which have different letters are significantly different at ($P<0.05$).

Table (4) shows lipid peroxidation as measured by serum MDA levels and GSH activity in normal rats injected with CCl_4 and supplemented with Tarragon Leaves Powder (TLP) and its Aqueous Extract (TLAE). Injection of CCl_4 results in a considerable rise ($P<0.05$) in serum MDA levels and decreased activity of GSH enzymes compared to normal rats. This finding was consistent with a study by **Hassan et al., (2025)** which showed that that the injection of CCl4 results in a considerable rise ($P<0.05$) in serum MDA levels and decreased activity of GSH enzymes compared to normal rats.

Lipid peroxidation is a major index of oxidative stress. Elevated levels of liver MDA induced by CCl_4 imply enhanced lipid peroxidation which leads to hepatocellular damage and failure of natural antioxidant defense system to prevent overproduction of free radicals **(Pareek et al., 2013)**. One of the important antioxidant mechanisms is free radical scavenging activity that interferes with the chain reaction of lipid peroxidation **(Kepekçi et al., 2013)**. It has been presumed that one of the main underlying mechanisms of CCl_4-induced liver damage is the formation of lipid peroxides by free radicals produced by CCl_4. Hence, the antioxidant activity or the prohibition of the production of free radicals is important in the defense against CCl_4-induced hepatotoxicity **(Zeashan et al., 2008)**.

In hepatotoxicity induced by CCl_4, the balance between ROS formation and these antioxidant defenses may vanish and oxidative stress occurs; oxidative stress during a series of events, disturbs the cellular functions leading to hepatic damage. Concerning non-enzymatic antioxidants, GSH is a crucial determinant of tissue proneness to oxidative damage and the depletion of hepatic GSH has been shown to be related with an enhanced toxicity to

chemicals, including CCl_4 **(Jiang et al., 2015)**. **Zarezade et al., (2018)** showed that a decrease in liver tissue GSH level was observed in CCl_4-treated groups.

On the other hand, rats were fed Tarragon Leaves Powder (TLP) and its Aqueous Extract (TLAE) plus injected with CCl4, serum MDA levels and GSH enzyme activity improved significantly when compared to the positive control group. The treaded group demonstrated a superior result in serum MDA concentration and antioxidant enzyme activity due to higher levels 2 ML of Tarragon Leaves Aqueous Extract. The hepatoprotective effect of *Artemisia dracunculus* may be due to decreased lipid peroxidation and ameliorated defense of the hepatocytes against ROS. These results agree with **Zarezade et al., (2018)** observed that treatment with 100 and 200 mg/kg of HEAD reduced lipid peroxidation by diminishing MDA levels, exhibiting the free radical scavenging activity of tarragon under in vivo conditions. In addition, the increase in hepatic GSH level in the animals treated with 50, 100 and 200 mg/kg of hydro-alcoholic extract of aerial parts of *Artemisia dracunculus* (HAAD) may be due to de novo GSH synthesis or GSH regeneration.

Also, **Bolandian et al., (2019)** showed that the extract was capable of resolving inflammatory mediators as demonstrated by the decreased MDA. The aquase extract of Tarragon contains, presented substantial antioxidant properties through their ability to hinder reactive oxygen or nitrogen compounds. The anti-inflammatory and antioxidative activities of the tarragon compounds have also been advantageous **(Zhao et al., 2012)**. **Haghighian et al., (2021)** indicate that supplementation with 1500 mg/day of tarragon leads to significant improvements in blood antioxidant parameters of individuals with type 2

diabetes; GPx, and SOD increased significantly after adjuvant therapy with tarragon.

Table (4): Effect of Tarragon Leaves Powder (TLP) and its Aqueous Extract (TLAE) on Antioxidant Enzymes of Hepatotoxicity rats

Parameters / Groups	MDA ng/mL	GSH nmol/mg
Control (-Ve)	119.63±0.40e	135.24±0.45a
Control (+Ve)	297.60±1.60a	82.58±0.42d
1 % TLP/Kg diet	293.81±0.189a	94.76±0.35c
2 % TLP/Kg diet	262.85±1.04b	100.91±0.52c
12mL/rat/day TLAE	254.02±0.89c	115.34±0.57b
2 mL/rat/day TLAE	211.13±1.07d	121.18±0.63b

Results are expressed as mean ± SE.
Values in each column which have different letters are significantly different at ($P<0.05$).

Table (5) show cytokines Interleukin-1 beta in normal rats injected with CCl_4 and supplemented with Tarragon Leaves Powder (TLP) and its Aqueous Extract (TLAE). Injection of CCl_4 results in a considerable increase ($P<0.05$) in serum cytokines Interleukin-1 beta compared to normal rats. On the other hand, rats were fed Tarragon Leaves Powder (TLP) and its Aqueous Extract (TLAE) decreased significantly of serum cytokines Interleukin-1 beta when compared to the positive control group. This finding was consistent with a study by **Majdan et al., (2020)** observed that the application of aqueous extract of tarragon produced a decrement of the release of IL-8 (by 4.0 and 4.8%) and TNFα (by 7.8 and 5.2%).

Table (5): Effect of Tarragon Leaves Powder (TLP) and its Aqueous Extract (TLAE) on cytokines Interleukin-1 beta of Hepatotoxicity rats

Parameters / Groups	IL 1ß pg/mL
Control (-Ve)	8.12±0.29e
Control (+Ve)	16.17±0.27a
1 % TLP/Kg diet	15.07±0.09ab
2 % TLP/Kg diet	13.29±0.38c
1mL/rat/day TLAE	14.18±0.21bc
2 mL/rat/day TLAE	11.69±0.24d

Results are expressed as mean ± SE.
Values in each column which have different letters are significantly different at ($P<0.05$).

Conclusion:

The present study sheds light on the effect of *Artemisia dracunculus* (tarragon leaves powder and its aqueous extract) on hepatotoxicity by CCl_4 in rats. The CCl_4 toxicity produced radical oxygen species prompting oxidative stress. Our finding suggested that tarragon leaves powder and its aqueous extract restored the increased serum enzyme levels, diminished liver antioxidant markers, and exerted effective antioxidant activity under in vitro conditions suggesting that it has hepatoprotective and antioxidant capacities in CCl4-intoxicated rats. More studies are needed to know the underlying mechanism of the hepatoprotective effect of tarragon leaves powder and its aqueous extract because it is a mixture of bioactive compounds present and there may be more than one mechanism involved in it.

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تأثير الطرخون على تسمم الكبد فى الفئران

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الملخص العربي

هدفت هذه الدراسة إلى تقييم تأثير مسحوق اوراق الداجرون ومستخلصه المائى على السمية الكبدية التي يسببها CCL4 في الفئران. تم تقسيم ستة وثلاثين فأرًا إلى مجموعتين. تم تغذية المجموعة الأولى وعددها ٦ فئران على نظام غذائي أساسي وتم الاحتفاظ بها كمجموعة ضابطة سلبية، المجموعة الثانية: مجموعة تسمم الكبد، تم حقن الفئران (عددها = ٣٠) بـ CCl4 بمعدل ١ مل / كجم من وزن الجسم. بعد ٢٤ ساعة من الحقن لمدة ٣ أيام، تم أخذ الفئران من كل مجموعة لقياس وظائف الكبد للتأكد من أن جميع الفئران تعاني من إصابة الكبد. بعد التأكد من إصابة الكبد تم تقسيم الفئران على النحو التالي: المجموعة الفرعية ١ بمثابة المجموعة الضابطة الموجبة وتم تغذية الاربع مجموعات الفرعية الأخرى من الفئران المعالجة على نظام غذائي أساسي مكمل من مسحوق اوراق الداجرون بتركيزات (٢،١ %) لكل كجم من النظام الغذائي الأساسي، مستخلصه المائى جرعة واحدة بالانبوب بتركيز ١، ٢ ملى على التوالى. أظهرت النتائج أن التدعيم بمكملات من مسحوق اوراق الداجرون ومستخلصه المائى بمستويات مختلفة قد أدى إلى تحسن في وزن الجسم ووزن الكبد، مصحوبًا بانخفاض ملحوظ في مستويات وظائف الكبد (ALT، AST، ALP، والبيليروبين الكلي)، وكذلك في مستوى الدهون، في حين سُجلت زيادة ملحوظة في كوليسترول البروتين الدهني عالي الكثافة (HDL–C). بالإضافة إلى ذلك، انخفض بشكل ملحوظ مستوى مالونديالديهايد (MDA)، وسيتوكينات إنترلوكين–١ بيتا بينما ارتفع مستوى GSH بشكل ملحوظ ($P < 0.05$). الخلاصة: يمكن أن يعتبر مسحوق اوراق الداجرون ومستخلصه المائى علاجًا طبيعيًا محتملًا لتسمم الكبد.

الكلمات المفتاحية: الطرخون، السمية الكبدية، أمراض الكبد، الفئران.