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Aziza H. Abd El zahir, Amira A. Hamouda and Mona M. Farouk.
Nutrition & Food Science Dept.,
Faculty of Home Economics,
Menoufia Univ., Egypt

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ABSTRACT:

Xenobiotics are continuously exposed to the liver, which can cause several significant liver diseases. To determine if they are suitable for treating chemically induced liver injuries in experimental animals, various plant products have been examined for their potential hepatoprotective properties. The effect of different heart of palm date powder concentrations 2.5, 5.0, and 7.5% on the biological and biochemical alterations in the livers of rats were evaluated. Twenty-five white male albino rats weighing 140±10g each were placed into 5 groups with 5 animals each. Rats infected with hepatic by injecting carbon tetra chloride (CCl_4) 0.2 ml/100 g body weight of 40 ml/l CCl_4 dissolved in paraffin oil. After being starved for one day, rats were slaughtered, and blood was collected and processed to separate the serum. Serum liver functions (ALT, AST, and ALP) and oxidative enzymes such as glutathione peroxidase (GPX), superoxide dismutase (SOD) and catalase (CAT) activity, serum lipid profile (T.G., T.C., LDL-c, HDL-c, VIDL-c), and renal functions (uric acid, urea, and creatinine), were also determined. The HPLC technique was also used to identify phenolic compounds. The HPLC results showed that the heart of palm contained many bioactive compounds. The obtained results of hepatic rats indicated that heart of palm powder improve serum liver functions, kidney functions, lipid profile and oxidative enzymes in rats especially 7.5% levels. As conclusion, heart of palm powder could be used in our beverages and daily dishes, besides the fact that it has so many health benefits.

Key words: Date by-products, Rats, Hepatoprotective, Biochemical analysis.

Introduction

The liver, which is situated on the upper right side of the stomach, is the primary and most crucial metabolic organ of the human body. It is the starting point of many metabolic processes that take place inside the body **(Ghany and Hoofnagle, 2005)**. The liver is engaged in the breakdown and clearance of toxins like pharmaceuticals and other foreign chemical substances because it is the first place that toxins from the intestinal system travel after leaving the digestive tract. The body's liver performs the various tasks listed below **(Abhilash *et al.*, 2014)**. Numerous

compounds, including iron, vitamins, minerals, and glycogen, are kept in the liver for storage. The liver converts glycogen that has been stored into glucose if the body's blood sugar levels drop and it becomes necessary for it to produce energy **(Rane *et al.*, 2016)**. There are various mechanisms of liver that can cause immunological responses, depending on the type of underlying liver injury. Hepatic fibrosis is caused by persistent immunological responses. It is vitally necessary to comprehend the mechanisms of inflammation and fibrosis to develop treatments for chronic liver disorders **(Koyama and Brenner, 2017)**. One of the most popular hepatotoxins applied in the experimental research of liver disorders is CCl_4. The accumulation of trichloromethyl radical, CCl_4's active metabolite, in the liver is the primary cause of the substance's hepatotoxic effects **(Tapper *et al.*, 2017)**. The plant-based hepatoprotective agents or drugs contains diversity of major active constituents such as phenols, coumarins, lignans, terpenoids, carotenoids, glycosides, flavonoids, organic acids, alkaloids and xanthenes. Several Phyto-molecules have been reported as having potent hepatoprotective principles. So, an investigation into the lead molecules, that may produce better therapeutic effects, is required to overcome the pharmaceutical imbalance between remedies that protect the liver and drugs that induce hepatotoxicity **(Ahmed *et al.*, 2008)**.

Heart-of-palm is extracted from several palm genera and species. The heart of palm is composed of the apical meristem of the palm plus part of the young or immature leaves emerging from the meristem. This edible meristem is frequently consumed in salads, soups, and other gourmet dishes. Saudis consume this product in its fresh form immediately after its extraction from the tree **(Tabora *et al.*, 1993)**. The palmito, also known as the "heart of the palm," is a plant that thrives in a variety of habitats and is the heart or center of various wild species of palm trees. It is regarded as a superior source of energy and contains vitamins, several minerals, including phosphorus, iron, potassium, and a sizeable amount of calcium **(Rose, 2019)**. The hearts of palm are relatively rich in protein and amino acids, especially essential amino acids. It is also an excellent source of dietary fiber. They are moderate sources of minerals such as Ca, Fe, K, Na, P, and Zn. However, they are low in fat and sugars **(Soto *et al.*, 2005)**. According to data collected over the past 40 years, dates may have several health benefits, including actions that are antihyperlipidemic, anticancer, gastroprotective, nephroprotective, anti-inflammatory, and hepatoprotective. It is also used to treat edema, gonorrhea, cystitis, sore throats, and alcohol intoxication **(Clinical Practice Guidelines, 2018)**. The heart of palm can protect hepatic tissue against the toxicity induced by CCl_4 revealed through

significant reduction of serum activities of liver enzymes and in the concentrations of TSB, DB and total lipid, and with a significant increase of serum concentrations of total protein and albumin. In conclusion, the heart of palm can be proposed to protect the liver tissue against CCl_4-induced liver damage in rats **(Al-Abachi and Al-Gorany, 2015)**. According to **Attia *et al.*, (2016),** it was suggested that date fruit extract (DFE) or date pits extract (DPE) can prevent liver fibrosis by suppressing genotoxicity and nuclear factor-κB inflammatory pathway and by promoting collagen degradation. Both DFE and DPE significantly attenuated CCl_4-induced oxidative damage as indicated by reducing lipid, protein, and DNA oxidation in addition to increasing the levels of hepatic catalase activity. Both extracts blocked the accumulation of collagen I in the liver and ameliorated the increased expression of collagen III and α-smooth muscle action suggesting suppression of profibrotic response induced by CCl_4. The heart of palm extract stimulated the regeneration of hepatic tissue which increases protein synthesis in damaged liver and improves the functional status of the liver cells **(Thangakrishnakumari *et al.*, 2012)**.

The present study was designed to elevate the possible hepatoprotective effect of various levels of the heart of palm against carbon tetrachloride induced liver damage in experimental rats

Material and Methods:

Materials:

Heart of palm was obtained from local market, Alex Governorate, Egypt.

Casein, cellulose, choline chloride, and DL-Methionine

Casein, cellulose, choline chloride powder, and DL- methionine powder, were obtained from Morgan Co. Cairo, Egypt.

Experimental animals

A total of 25 adult normal male albino rats Sprague Dawley strain weighing 140±10 g was obtained from Vaccine and Immunity Organization, Ministry of Health, Helwan Farm, Cairo, Egypt.

The chemical kits

Chemical kits used for determination the (TC, TG, HDL-c, ALT, AST, urea, uric acid, and creatinine) were obtained from Al-Gomhoria Company for Chemical, Medical and Instruments, Cairo, Egypt.

Methods:

Preparations of heart of palm

To prepare the dried heart of palm which was obtained from local farmer. The heart of palm was washed thoroughly under running tap water, then shaded and dried in an air oven at 50°C, and ground to obtain fine powder using an air mill.

The induction of experimental hepatic rats

Rats were injected subcutaneously at a dose of 0.2 ml/100 g body weight of 40 ml/l CCl_4 dissolved in paraffin oil **(Diao *et al.*, 2011)**. Carbon tetrachloride was injected three times per week for 4 consecutive weeks. Liver fibrosis was determined at the end of experimental by killing rats with histopathological examination.

Experimental design

Twenty-five adult male white albino rats, Sprague Dawley Strain, 10 weeks age, weighing (140±10g) were used in this experiment. All rats were fed on basal diet (casein diet) prepared according to **AIN, (1993)** for 7 consecutive days. After this adaptation period, rats are divided into 5 groups, each group which consists of five rats as follows: group (I): Rats fed on basal diet as negative control. Group (2): Rats inflicted with hepatic and fed on the basil diet and used as a positive control group (control+1). Group (3): Rats inflicted with hepatic and fed on heart of palm as powder by 2.5% of the weight of the diet. Group (4): Rats inflicted with hepatic and fed on heart of palm as powder by 5% of the weight of the diet. Group (5): Rats inflicted with hepatic and fed on heart of palm as powder by 7.5% of the weight of the diet.

During the experimental period, the body weight and feed intake were estimated weekly, and the general behavior of rats was observed.

Blood sampling:

After fasting for 12 hours, blood samples in initial times were obtained from retro orbital vein. Blood samples were collected into a dry clean centrifuge glass tubes and left to clot in water bath (37°C) for 30 minutes, then centrifuged for 10 minutes at 4000 rpm to separate the serum, which were carefully aspirated and transferred into clean cuvette tube and stored frozen in deep freezer till analysis according to method described by **Schermer (1967)**.

Biochemical analysis:

Determination of serum alanine amino transferase (ALT), serum aspartate amino transferase (AST) was carried out according to the method of **Hafkenscheid (1979), Clinica Chimica Acta (1980)**, **and Moss (1982**), respectively. SOD activity was measured using quercetin as the substrate after suitable dilution method as described by **Kostyuk *et al.*, (1990)**. CAT activity was assayed according to the method of **Korolyuk *et al.*, (1988)**. The activity of GPx in the tissue homogenates was measured spectrophotometrically as described by **Moin (1986)**. Serum total cholesterol was determined according to the colorimetric method described by **Thomas (1992)**. Serum triglyceride was determined by enzymatic methods using kits according to the **Young, (1975) and Fossati & Principle (1982)**. HDL-c was determined according to the

method described by **Friedewaid (1972) and Grodon and Amer (1977)**. VLDL-c was calculated in mg/dl according to **Lee and Nieman (1996)** using the following formula: VLDL-c (mg/dl) = Triglycerides / 5. While LDL-c was calculated in mg/dl according to **Lee and Nieman (1996)** as follows: LDL-c (mg/dl) = Total cholesterol – HDL-c – VLDL-c. Serum urea was determined according to the enzymatic method of **Patton and Crouch, (1977)**. Serum uric acid was determined calorimetrically according to the method of **Barham and Trinder (1972)**. Creatinine was determined according to the kinetic method of **Henry, (1974)**.

Statistical analysis:

The data were analyzed using a completely randomized factorial design **(SAS, 1988)** when a significant main effect was detected; the means were separated with the Student-Newman-Keuls Test. Differences between treatments of ($P \leq 0.05$) were considered significant using Costat Program. One Way ANOVA analyzed biological results.

RESULTS AND DISCUSSION

Identification of phenolic compounds in heart of palm

The identification of phenolic compounds in the heart of palm is demonstrated by the data in Table (1). It is obvious to see that catechin and caffeic acid are among the greatest phenolic compounds found in the heart of palm. The values were 47.24 and 10.59 mg/100 g, respectively. On the other hand, syringic acid and kaempferol had the lowest levels of phenolic compounds in the heart of palm. The values were 1.78 and 2.18 mg/100 g respectively. These findings support the claims made by **Trabzuni *et al.* (2014)** that polyphenols are secondary metabolites of plants, many of which have antioxidant properties. The food, feed, and pharmaceutical industries could benefit from using the heart of the palm as a source of polyphenols.

Table (1): Identification of phenolic compounds in heart of palm

Phenolic compounds	Concentrations mg/100g DW
Gallic acid	3.11
Dihydroxybenzoic acid	4.05
Chlorogenic acid	3.43
Caffeic acid	10.59
Syringic acid	1.78
Catechin	47.24
Quercetin	3.72
Kaempferol	2.18
Protocatechuic acid	ND

Effect of heart of palm on liver functions level of hepatic rats

The effects of heart of palm on the liver functions (AST and ALT) of rats with hepatic are shown by the data provided in Table (2). The data collected showed that, when compared to the negative control group, the liver enzyme AST in the positive control group of rats recorded the highest value with significant difference (P≤0.05). In contrast, the treatment group fed 7.5% heart of palm had the lowest value for the AST liver enzyme, while the group fed 2.5% heart of palm had the highest value with significant difference (P≤0.05).

Regarding the liver enzyme ALT, there was a significant difference (P≤0.05) between the values recorded by the positive and negative control groups. With a significant difference (P≤0.05), the group fed 7.5% of the heart of palm had the lowest value of the treatment group's ALT liver enzyme while the group fed 2.5% of the heart of palm had the highest value. These findings concur with those of **Frank *et al.* (2012)**, who discovered that the blood ALT, AST, and ALP levels decreased when compared to group treatment. Therefore, the decrease in enzyme activity brought on by heart of palm suggests that the serum membrane has stabilized and that the hepatic tissue has recovered from the damage brought on by CCl_4. transaminase levels in the serum, which aid in the diagnosis of hepatocellular illness and function as sensitive indicators of liver cell degeneration. As hepatic parenchyma and hepatocytes recover, these enzymes return to normal. Low levels of hepatic enzyme activity may be caused by date palm fruit's potent antioxidant compounds.

Table (2): Effect of heart of palm on liver functions level of hepatic rats

Treatment/Parameter	AST (U/L)	ALT (U/L)
Control group (-)	112.50^{d} ±1.80	34.01^{e} ±0.74
Control group (+)	242.50^{a}±2.01	$98.\ 0^{a}$±0.58
Hepatic rats with 2.5% heart of palm	129.52^{b} ±0.82	53.50^{b} ±0.24
Hepatic rats with 5% heart of palm	119.6^{c} ±1.20	39.50^{c} ±1.70
Hepatic rats with 7.5% heart of palm	116.0^{c} ±1.36	36.50^{d} ±0.61
LSD (P≤0.05)	**3.816**	**1.930**

Each value represents the mean ± SD of three replicates.
Means in the same column with different letters are significantly different (P≤0.05).

Effect of heart of palm on oxidative enzymes in hepatic rats

The effect of various doses of heart of palm powder on glutathione peroxidase (GPx), catalase (CAT), and superoxide dismutase (SOD) levels in hepatic rats was demonstrated by data reported in Table 3. It was noticeable that the control (+) group's mean value for the GPX

enzyme (ng/ml) level was higher than the control (-) group's; these values were 7.66 and 1.95 ng/ml, respectively, with an a statistically significant difference. In comparison to the control (+) group, all hepatic rats fed varying amounts of heart of palm diets displayed significant changes in mean values. 3.74, 5.35, and 7.14 ng/ml were the respective values. A considerable disparity between groups 3, 4, and 5 was observed in their values. Group 5 (hepatic) had the best treatment when taking GPX enzyme (ng/ml) into consideration.

The mean enzyme level in the control (+) group for the CAT (mmol/l) enzyme was greater than that in the control (-) group; they were 652.23 and 401.20 mmol/l, respectively, with an a statistically significant difference. In comparison to the control (+) group, all hepatic rats fed varying amounts of heart of palm diets displayed significant changes in mean values. The values were, respectively, 510.73, 459.75, and 410.73 mmol/l. Groups 3, 4, and 5 had values that significantly differed from one another. When compared to the control (+) group, group 5 (hepatic rats fed on 7.5% heart of palm) showed the best results in terms of CAT (mmol/l) enzyme treatment.

However, the control (+) group's mean SOD (u/l) enzyme level was higher than the control (-) group's; it was 129.37 and 54.37 u/l, respectively, with a statistically significant difference. The mean values of all the hepatic rats fed on varying heart of palm diet concentrations differed significantly from those of the control (+) group. The values were, correspondingly, 58.54, 66.13, and 60.20 u/l. Values comparing groups 3, 4, and 5 revealed a significant difference between them. When compared to the control (+) group, group 5 (hepatic rats fed on 7.5% heart of palm) received the most effective treatment. These findings support **Saryono *et al.* (2017)**, who claimed that dates have high levels of flavonoids and phenolics, which can boost the activity of endogenous antioxidants like glutathione peroxidase (GPx), catalase, and superoxide dismutase (SOD), as well as reduce the formation of free radical oxidation products. An abundance of antioxidants can lessen oxidative stress and, as a result, lessen cell damage, particularly in pancreatic cells.

Table (3): Effect of different levels of date palm pith powders on GPX, CAT and SOD level of hepatic rats

Parameters / Groups	GPX (ng/ml)	CAT (mmol/l)	SOD (u/l)
Control group (-)	7.66^{a}±0.04	401.20^{e} ±0.30	54.37^{e} ±0.12
Control group (+)	1.95^{d}±0.01	652.23^{a} ±2.40	129.36^{a} ±0.26
Hepatic rats with 2.5% heart of palm	3.74^{c}±0.06	51٠.73^{b} ±2.30	78.54^{b} ±0.14

Hepatic rats with 5% heart of palm	5.35^{b}±0.03	459.75^{c} ±2.50	66.13^{c} ±0.13
Hepatic rats with 7.5% heart of palm	7.14^{a}±0.06	41.73^{d} ±2.30	60.20^{d} ±0.11
LSD (P≤0.05)	**1.213**	**4.325**	**2.572**

Each value represents the mean ± SD of three replicates.
Means in the same column with different letters are significantly different (P≤0.05).

Effect of heart of palm on total cholesterol and triglyceride of hepatic rats

Table (4) displays the impact of heart of palm on the blood total cholesterol and triglycerides of rats with liver damage. The findings demonstrated that the positive control group's total cholesterol levels had the highest value and a significant difference (P≤0.05) when compared to the negative control group. While 2.5% of the hearts of palm had the highest cholesterol levels, the hepatic group that consumed 7.5% of the hearts of palm had the lowest total cholesterol levels significant difference (P≤0.05).

The positive control group's triglyceride level recorded the highest value with a significant difference in comparison to the negative control group (P≤0.05). The lowest triglyceride levels were found in the group that received 7.5% heart of palm, whereas the highest levels were found in the 2.5% heart of palm group with a significant difference (P≤0.05). These findings are consistent with those made by **Oluba and Oyeneke (2008)**, who noted a decrease in total cholesterol (TC) and triglyceride (TG) plasmatic concentrations in adult rats given parts of the heart of palm when they were nursing.

Table (4): Effect of heart of palm on serum total cholesterol and triglycerides of hepatic rats

Treatment/Parameter	Total cholesterol (mg /dl)	Triglycerides (mg /dl)
Control group (-)	94.00±1.5^{c}	61.60±2.07^{e}
Control group (+)	136.0±1.5^{a}	134.60±0.58^{a}
Hepatic rats with 2.5% heart of palm	103.80±1.24^{b}	83.50±0.79^{b}
Hepatic rats with 5% heart of palm	96.70±.96^{c}	70.80±1.2^{c}
Hepatic rats with 7.5% heart of palm	80.50±1.7^{d}	65.50±1.8^{d}
LSD (P≤0.05)	**2.851**	**2.583**

Each value represents the mean ± SD of three replicates.
Means in the same column with different letters are significantly different (P≤0.05).

Effect of heart of palm on lipid profile level of hepatic rats

The effect of heart of palm on serum lipid profile (HDL-c, LDL-c and VLDL-c) level of hepatic rats was shown in table (5). When compared to the positive control group, the results showed that the HDL-c of the negative control rat group had the greatest value with significant difference (P≤0.05) which were 4.00 and 21.80 mg/dl, respectively. However, the hepatic group fed on 7.5% heart of palm had recorded the highest HDL-c of the treatment group, while the group fed on 2.5% heart of palm had the lowest value with significant difference (P<0.05) which were 41.50 and 33.80 mg/dl, respectively.

Comparatively the LDL-c and VLDL-c of the positive control rat group had the highest value compared with negative control with significant difference (P≤0.05). The mean values were (87.28 &35.68) and (26.92& 12.32) mg/dl, respectively. While the hepatic group's LDL-c and VLDL-c were the highest in the 2.5% heart of palm group, the 7.5% heart of palm group had the lowest value with significant difference (P≤0.05). The mean values were (53.30& 25.90) and (16.70&13.10) mg/dl, respectively. According to **Chaira *et al.* (2007)**, the heart of palm (palmito) can scavenge free radicals; therefore, the significant effect of heart of palm extract on blood total lipid levels after two weeks may be attributable to the compound's antioxidant characteristics.

Current data support the findings of **Saafi *et al.* (2010)** and suggest that the effect of palmito extract on total lipid content in rats may also be explained by its capacity to reduce oxidative stress.

Table (5): Effect of heart of palm on lipid profile of hepatic rats

Treatment/Parameter	(HDL-c) (mg/dl)	(LDL-c) (mg/dl)	(VLDL-c) (mg/dl)
Control group (-)	46.00±0.7^{a}	35.68±0.87^{d}	12.32±0.43^{cd}
Control group (+)	21.80±1. 3^{d}	87. 28±0.74^{a}	26.92±0.42^{a}
Hepatic rats with 2.5% heart of palm	33.80±1.30^{c}	53.30±0.84^{b}	16.70±0.37^{b}
Hepatic rats with 5% heart of palm	36.52±0.8^{c}	46.02±1.14^{c}	14.16±0.52^{c}
Hepatic rats with 7.5% heart of palm	41.50±0.8^{b}	25.90±0.68^{e}	13.10±0.49^{c}
LSD (P≤0.05)	**2.751**	**3.401**	**1.736**

Each value represents the mean ± SD of three replicates.
Means in the same column with different letters are significantly different (P≤0.05).

Effect of heart of palm on kidney functions level of hepatic rats

Data presented in table (6) show the effect of heart of palm on the kidney functions (uric acid, urea, and creatinine) level of hepatotoxicity

rats. The acquired results showed that, when compared to the negative control group, the creatinine level in the group of positive control rats recorded the highest value with significant difference (P≤0.05), which were 2.30 and 0.83 mg/dl, respectively. While the treatment group's highest creatinine level was found in the 2.5% heart of palm group, the lowest value was found in the 7.5% heart of palm group with significant difference (P≤0.05), which were 1.50 and 0.93 mg/dl, respectively.

As for urea level, the positive control group of rats had the greatest amount of urea compared with the negative control group, with significant difference (P≤0.05), which were 21.13 and 20.70 mg/dl, respectively. While the treatment group's urea level was greatest for the group fed on 2.5% heart of palm, the lowest result was for the group fed on 7.5% heart of palm with significant difference (P<0.05), which were 24.54 and 21.88 mg/dl, respectively.

The level of uric acid in the group of positive control rats was the greatest when compared to the negative control group, with significant difference (P≤0.05). The mean values were 3.10 and 1.50 mg/dl, respectively. While the group fed on 2.5% heart of palm had the highest uric acid levels among the treatment groups, the group fed on 7.5% heart of palm had the lowest values with significant difference (P≤0.05). The mean values were 1.80 and 1.65 mg/dl, respectively. These findings concur with those of **January *et al.* (2015)**, who discovered that heart of palm had a normal impact on blood urea, creatinine, and uric acid as well as CCl_4-induced liver damage in rats. While the value of heart of palm in these groups was significantly lower than that of the CCl_4-induced hepatic damage group, the uric acid, urea, and creatinine concentrations in the experimental groups that received heart of palm treatment were significantly higher than those of the control group (P≤0.05).

Table (6): Effect of heart of palm on uric acid, urea and creatinine of hepatic rats

Treatment/Parameter	Creatinine (mg/dl)	Urea (mg/dl)	Uric acid (mg/dl)
Control group (-)	0.83 ± 0.13^{c}	20.70 ± 0.48^{c}	1.50 ± 0.84^{c}
Control group (+)	2.30 ± 0.26^{a}	31.13 ± 0.94^{a}	3.10 ± 0.16^{a}
Hepatic rats with 2.5% heart of palm	1.5 ± 0.19^{b}	24.54 ± 0.50^{b}	1.80 ± 0.04^{b}
Hepatic rats with 5% heart of palm	1.3 ± 0.13^{b}	23.95 ± 0.84^{b}	1.70 ± 0.14^{b}
Hepatic rats with 7.5% heart of palm	$0.93\pm.57^{b}$	21.88 ± 0.59^{c}	1.65 ± 1.05^{b}
LSD (P≤0.05)	**0.730**	**2.250**	**1.143**

Each value represents the mean ± SD of three replicates.

Means in the same column with different letter are significantly different ($P<0.05$).

Conclusion:

The findings of this study suggest that heart of palm powder improves serum liver functions, kidney functions, lipid profile and oxidative enzymes in rats especially 7.5% levels. Heart of palm powder could be used in our beverages and daily dishes, besides the fact that it has so many health benefits.

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التأثيرات المتوقعة لجمار النخيل في الفئران المصابة بسمية في الكبد المستحث برابع كلوريد الكربون

الملخص العربي:

يتعرض الكبد للأجسام الغريبة باستمرار، مما قد يسبب العديد من أمراض الكبد الخطيرة. لتحديد ما إذا كانت مناسبة لعلاج إصابات الكبد التي تحدث كيميائيًا في حيوانات التجارب، تم دراسة العديد من المنتجات النباتية لخصائصها المحتملة في حماية الكبد. تم تقييم تأثير تركيزات مختلفة من مسحوق جمار النخيل ٢,٥، ٥,٠، ٧,٥٪ على التغيرات البيولوجية والكيميائية الحيوية في كبد الفئران. تم وضع خمسة وعشرين من ذكور الفئران البيضاء التي يبلغ وزن كل منها ١٤٠ ± ١٠ جرامًا في ٥ مجموعات كل منها ٥ حيوانات. تم اصابة الفئران بخلل في الكبد عن طريق حقن بواسطة رابع كلوريد الكربون بجرعة ٠,٢مل / ١٠٠ جم من وزن الجسم مذاب في زيت البارافين ٤٠ مل / لتر. بعد الصيام لمدة يوم طوال من التجربة، تم ذبح الفئران، وتم جمع الدم ومعالجته لفصل السيرم. وتقدير وظائف الكبد في السيرم (ALT، AST) والإنزيمات المؤكسدة مثل الجلوتاثيون بيروكسيديز ، سوبر أوكسيد ديسميوتاز ونشاط الكتاليز ، صورة دهون الدم مثل (T.G.، T.C، LDL–c، HDL– c، VIDL–c) ، ووظائف الكلى (حمض البوليك ، واليوريا ، والكرياتينين). تم استخدام تقنية HPLC أيضًا لتقدير المركبات الفينولية. أظهرت نتائج جهاز الكروماتوجرافى الغازي عالي الدقة أن جمار النخيل يحتوي على العديد من المركبات النشطة بيولوجيا. أظهرت النتائج التي تم الحصول عليها من الفئران المصابة بخلل في الكبد أن مسحوق جمار النخيل يحسن وظائف الكبد في السيرم، ووظائف الكلى ، صورة دهون الدم والإنزيمات المؤكسدة في الفئران خاصة بنسبة ٧,٥٪ . في الختام، يمكن استخدام مسحوق جمار النخيل في مشروباتنا وأطباقنا اليومية، إلى جانب حقيقة أنه يحتوي على العديد من الفوائد الصحية.

الكلمات الافتتاحية: المنتجات الثانوية للنخيل– الفئران– التأثير الحافظ للكبد– التحاليل الكيميائية الحيوية.