The Potential Effects of Cake Fortified with Date Seeds against Aflatoxin B1-Induced Liver Toxicity in Rats

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ABSTRACT

The goal of the current study is to evaluate the potential Effects of cake fortified with date seeds (CDS) against Aflatoxin B1-induced liver toxicity in rats. Thirty-five rats were separated into two main groups of seven each. The 1st main group was fed on basal diet and kept as negative control group, while the other rats were injected with Aflatoxin B1 at dosages of 2 mg/kg b.w. for 7 days, to induced liver toxicity. Then, rats reclassified into 4 equal subgroups as following: subgroup 1 served as the control positive group and 3 treated rat subgroups were fed basal diets plus cake supplemented with (5,10,15) % of Date Seeds, respectively. Hepatotoxic rats fed on an enriched diet with the three different levels of CDS had a significant decrease ($P<0.05$) in the activities of liver and kidney functions as well as in lipid profile, while serum high density lipoproteins, Albumin, Total Protein and the antioxidants enzymes glutathione peroxidase were significantly ($P<0.05$) improved while, significantly reduced Malondialdehyde compared to untreated hepatotoxic ats feed on the basal diet alone. In conclusion, it can be recommended that the necessity consumption of cake fortified with date seeds in the diets of liver diseases patients because of their antioxidants properties, and that play important role of health status.

Keywords: Date seeds – Aflatoxin B_1 – Liver function – Liver Toxicity - Antioxidant.

INTRODUCTION

Mycotoxins known as aflatoxins are created when Aspergillus species of fungi contaminate wheat and other staple food products that have not been properly kept **(Marin *et al*., 2013).** Currently, the mycotoxin species in use, is aflatoxin B1 (AFB_1) is the most common and dangerous **(Rushing and Selim, 2019).** It mostly affects the liver, though it also affects other organs like the kidneys **(El-Mekkawy *et al*., 2020).** AFB_1 potential for toxicity is thought to be caused by an imbalance between pro-oxidants and antioxidants, or free radicals and other reactive species **(Marin and Taranu, 2012).** Consequently, natural substances that could balance redox status offer a viable means of lessening mycotoxin's detrimental impacts on health. By expressing antioxidant enzymes and biotransformation enzymes against AFB_1-induced toxicity, bioactive substances such curcumin, quercetin, and lycopene have been shown to decrease the toxicity caused by AFB1 **(Karaca *et al*., 2019).**

The World Agency for Research on Cancer has categorized aflatoxins (AFs) as category I carcinogens **(Zhang *et al*., 2020)**. Adverse reactions of AFs intoxication on different organs include immunosuppression, carcinogenesis, teratogenicity, mutagenesis, and geno- toxicity **(Wang *et al*., 2022)**. Numerous studies have demonstrated that exposure to AFs can cause oxidative stress, which is characterized by the exhaustion of intracellular antioxidant enzymes **(Li *et al*., 2022)**. Because of their significant therapeutic value, natural antioxidants have recently attracted attention from all around the world and are being used extensively as replacement medications **(Jin *et al*., 2021).**

Among these are the date seeds (*Phoenix dactylifera* L.), which make up between (10 and 15) % of the fruit's total weight **Hribesh, (2020),** it ranks among the most common dates fruit trash. Numerous nutritional and functional components, including as dietary fiber, protein, carbs, minerals, and phenolic compounds (tocopherols and phytosterols), are present in date seeds **(Mrabet *et al*., 2020).** When rats were given date seed extract as a dietary supplement, their levels of tissue oxidation significantly decreased, and their antioxidant status subsequently strengthened **(Platat *et al.*, 2015).** Even a single dosage of date seed products, and date seed supplemented Arabic pita bread, increased antioxidant activity, according to a human investigation **(Platat *et al*., 2019)**. The polyphenol profile of DS showed that the most abundant category was flavan-3-ols, particularly epicatechins and catechins **(Hilary *et al*., 2019).**

Numerous polyphenols contain anti-inflammatory and antioxidant qualities that may help prevent and treat non-communicable diseases like cancer, obesity, and neurological and cardiovascular conditions, according to research on animals, people, and epidemiology. As a result, DS are a potentially useful source of bioactive substances that may be used to treat or prevent chronic illnesses **(Mitra *et al*., 2022)**.

Aim of the study

The goal of the current study is to prepare cakes with various date seed powder levels of (5, 10 and 15%). The biological effects of these compounds were then investigated to evaluate their potential to protect rats from liver damage caused by aflatoxin AFB_1.

Materials and methods

Materials

Chemicals: Casein, vitamins, minerals, cellulose, minerals were purchased from El-Gomhoria Company, Cairo, Egypt. Purified AFB1 from *Aspergillus flavus* was purchased from Sigma Company, Cairo, Egypt. **Kits** for blood analysis were purchased from Alkan Company for Biodiagnostic Reagents, Dokki, Cairo, Egypt. **Date** (*Phoenix dactylifera* L.), was purchased from the agriculture Research Center. **Ingredients** for preparing Cake was purchased from the local market. **Animals**: Thirty-five adult male rats (Sprague Dawley strain) were purchased from National Research Center, Dokki, Egypt.

Methods:

Experimental studies were conducted according to the guidelines of Animal Care and Ethics Committee of the NRC as well as the biochemical analysis at the Postgraduate Lab of Home Economics Faculty – Helwan University.

Preparation of Date seeds:

Date seeds was separated from fruits, and washed by distilled water several times, then they were completely dried in the sun on wooden trays. The dried seeds were thereafter grounded into a fine powder. The powdered seeds were kept in glass containers at 4°C in refrigerator until processing and analyses.

Chemical analysis of Date seed:

The gross chemical composition and phytochemical screening of Date seed were carried out at the National Research Center by standard methods. Moisture, protein fat, ash and crude fiber were analyzed according to **A.O.A.C, (2020)**. Total carbohydrate was calculated by the following equation: Total carbohydrate = 100 – (moisture%+ protein% + fat% +ash% +fiber).

Total phenolic and total flavonoid content were expressed as mg of gallic acid equivalent (GAE) per g of sample determined according to the procedure of **(Zilic *et al*., 2012)**. The total flavonoid content of date seed was determined by the method of **Kim *et al*., (2003).** Scavenging Radical activity of date seed against stable DPPH was assessed as described by **Blois, (1958)** method.

Preparation of fortified cake:

Cake formulated using wheat flour were given in Table (A). Wheat flour substitute with different levels (5,10 and 15%) of date seeds to produce cake according to the method of **(Figoni, 2008)**. Sugar and oil were mixed for ten minutes to prepare the batter. Eggs were then added and blended. Thereafter, dry ingredients were added (Vanilla and flour, baking powder, Milk powder). At the end, batter and water were added and blended for five min. All cakes have been manufactured on equal terms. An amount of 1500 g of cake batter was prepared. Then, the cakes batter was baked at 180-190°C for 20-25 minutes.

Table (A): Recipe of cake supplemented with Date seed (Grams based on the weight of cake flour).

Ingredient	Control *	Date seeds 5%	Date seeds 10%	Date seeds 15%
Flour	1000	950	900	850
Date Seed (g)	0	50	100	150
Oil (g)	200	200	200	200
Sugar (g)	250	250	250	250
Eggs (g)	250	250	250	250
Baking Powder (g)	25	25	25	25
Milk powder (g)	40	40	40	40
Vanilla (g)	2	2	2	2
Water (ml)	150	150	150	150

Experimental Design: The experimental animal was done using (n=35) male rats, with body weight (180 ±10) g. The rats were housed in cages under hygienic conditions, at temperature-controlled room 25°C. Basal diet was semi-synthetic and nutritionally adequate (AIN-93 M), vitamins mixture and minerals mixture were prepared as described by **Reeves *et al*., (1993).** The animals were randomly divided into two main groups as follows**:** The first main group (n= 7) was fed on basal diet. The second main group (n= 28) was fed on basal diet, intoxicated with Aflatoxin, (Aflatoxin B1) though intragastrically route at concentrations 2 mg /kg b.w., for 7 days according to **(Wójtowicz-chomicz *et al*., 2011)**. Random blood samples were taken for determination of liver and kidney functions. Then these rats were divided into 4 subgroups as follow**:** Subgroup (1) was fed on basal diet only**.** Subgroups (2 :4) were fed on basal diet with Cake that fortified with date seeds at 5, 10 and 15%, respectively.

Biological evaluation: The diet consumed was recorded every day and body weight was recorded every week during the experimental period (42 days). The body weight gain (BWG, %), feed intake (FI), and feed efficiency ratio (FER) were determined according to **Chapman *et al*., (1959)** using the following equations:

BWG % = ((Initial body weight – final body weight)/Initial body weight) × 100.

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

Blood sampling: At the end of the experimental period, rats were fasted overnight, then the blood was collected under slight ether anesthesia. Serum was separated by centrifugation at 3000 rpm for15

min. The obtained serum was used immediately for routine laboratory investigation.

Biochemical Analysis: Serum Aspartate amino transferase (AST) and alanine amino transferase (ALT) **(Bergmeyer *et al*., 1978),** serum alkaline phosphates (ALP) (**Belfield and Goldberg, 1971)** were determined. Serum urea **(Kaplan, 1984)**, uric acid **(Patton and Crouch, 1977)** and creatinine were measured according to **Bonsens and Taussky, (1984)**. Serum Malondialdehyde was measured as described by **Buege and Aust, (1978)**. Glutathione peroxidase (GPX) activities were measured as mentioned by **Splittgerber and Tappel, (1979)**. Serum total cholesterol (TC), triglycerides (TG), high density lipoprotein cholesterol (HDL-c) were determined according to the standard methods descried by **Fossati and Prenape, (1982), Richmond, (1973) and Albers *et al*., (1983),** respectively**.** Low density lipoprotein cholesterol (LDL-c) and very low density lipoprotein cholesterol (VLDL-c) were calculated (**Schriewer *et al*., 1984),** according to equation of **LDL-c = TC-[HDL-c + (TG/5)] , VLDL-c = TG/5.**

Statistical analysis: Statistical analysis was performed using SPSS computer program (Graph pad software Inc, San Diego, CA, USA). One-way analysis of variance (ANOVA) followed Duncan's multiple tests was done. $P \leq 0.05$ will be significant **(Snedecor and Cochran, 1980)**.

Results & Discussion

The results were shown in Table (1). The chemical composition of date seed powder (DSP) includes protein, moisture, crude fibers, fats, carbohydrates, and ash, with the highest concentrations found in 100g DW. **Farid *et al*., (2024)** reported that the seed's composition in proximate analysis was 6.4% protein, 16.5% crude fibers, 9.8% crude lipids, and 55.9% carbs. Similarly, **Abd El-Salam *et al*., (2024)** showed that analysis of the contents of dates seed powder (DSP) revealed notably greater levels of fat (7.90%), ash (1.30%), and fiber (16.35%).

Table 1. Proximate composition of date seeds (g/100g dry weight basis)

Components	Moisture	Protein	Fat	Ash	Fiber	carbohydrate
Date seeds (DS)	5.75	5.90	7.05	1.30	19.50	60.5

Table 2. Total phenol, Flavonoids content and Antioxidant activity in date seeds powder (DSP)

Total phenol contents	Date seeds powder (DSP)
Total phenolic content (mg GAE/100 g DW)	3015.86
Flavonoids content (mg RE/100 g DW)	1200
Antioxidant activity DPPH (%)	215.17

The total phenols, total flavonoids content , and antioxidant activity in data seed were recorded in (Table 2). The results showed that DSP has a high content of total phenol, total flavonoid content, and antioxidant activity (DPPH). The highest level was recorded to

phenolic compound (3015.86 mg GAE/100 g), flavonoid (1200 mg RE/100 g), and antioxidant activity DPPH (215.17%) respectively. This research confirms earlier results published by **Ahfaiter *et al*., (2018)** observed that DS include phenolic compounds (3010.05 mg) and flavonoids (1210.00 mg). However, the current findings are significantly greater than those published by **Mistrello *et al*., (2014)**, who discovered that total phenol and flavonoid levels ranged from 2058 to 2983 mg GAE/100 g FW and 1271 to 1932 mg CE/100 g FW. This variance may be due to variety, growing condition, maturity, season, geographic origin, fertiliser, diseases, soil type, and storage conditions, as well as extraction technology, as seen in the results of **Ahfaiter *et al*., (2018)** showed that Siwa seeds had the highest antioxidant activity based on the DPPH assay (257.19 g/l), which is the concentration of antioxidant that decreases the free radical DPPH by around 50%.

Recorded results in Table (3) interpreted the effect of feeding fortified cake with Date seeds on final body weight (FBW), body weight gain (BWG), FI, and FER in rats with liver toxicity. It shows that the injected rat with AFB_1 (+ve group) had a significant reduction ($P<0.05$) in FI, FBW, BWG and FER, compared to the normal rat (-ve group). In contrast, rats were fed cake supplemented with DS at three different doses (5, 10, and 15%), as compared to the positive control group. Results revealed that, there were no significant difference in body weight states among the treated rats. The best mean values of BWG% and FER increase were observed in the group fed 10% DS.

Table 3. The Effect of cake fortified with Date seeds on IBW, FI, FBW, BWG and FER in rats with liver toxicity

Parameters / Groups		IBW (g)	FBW (g)	BWG (%)	FI (g/d/rat)	FER
Negative control		171.95 ± 4.75[a]	227.50 ± 2.03[a]	32.39 ± 4.33[a]	17.00	0.07 ± 0.007[a]
Positive control		174.67 ± 2.25[a]	195.72 ± 4.29[c]	12.04 ± 1.45[c]	12.30	0.03 ± 0.004[c]
Treated groups with DSs	**5%**	175.29 ± 1.66[a]	211.56 ± 3.86[b]	20.69 ± 2.42[b]	13.50	0.06 ± 0.006[b]
	10%	174.37 ± 2.60[a]	218.14 ± 5.06[b]	25.10 ± 2.71[b]	13.80	0.07 ± 0.007[ab]
	15%	176.50 ± 3.75[a]	217.67 ± 4.88[b]	23.38 ± 4.39[b]	14.00	0.06 ± 0.01[ab]

Results are expressed as mean ± SD.

Means with different superscript letters in the column are significantly different at ($P<0.05$).

The obtained results were also in line with **Abd El-Rahman and El-Shall, (2019)** discovered that the best mean values of body weight increase (BWG) were 10% and 15% date seed powder. On the other hand, **Bouhlali *et al*., (2020) and Farid *et al*., (2024)** found that using date seed extract supplements was a useful way to avoid gaining weight. Comparable outcomes were attained by **Mahmoud *et al*., (2021)** found that palm date seed extract significantly increased weight gain in rats, despite lower feed consumption, suggesting a high feed efficiency ratio. The implications for these benefits could be attributed to the protein content, primarily lysine, which has the effect of sparing protein in a number of cereals.

The tabulated results in Table (4) explained that treated rats with liver toxicity by AFB_1 injection had a significant increase ($p<0.05$) in the serum activity of AST, ALT, and ALP enzymes compared to normal rates (-ve control group). AFB1 can harm hepatocytes' mitochondrial membranes and cell membrane permeability, resulting in liver damage **(Hatipoglu *et al*., 2022)**.

While the treatment of liver toxicity rats by feeding on cake fortified with DS at the three different levels (5, 10, 15%) significantly (P<0.05) reduced serum activity of AST, ALT, and ALP enzymes compared to the (+ve group). The rats administered with the highest amount (15%) of DS showed the greatest improvement in results. The results indicated that there was a significant difference in serum ALT among the 3 treated groups. According to ALP, it was observed that there was a significant decrease in serum ALP for the group fed on 10% as compared to the group fed on 5% of DS. While, there was no significant changes in the level of ALP between the groups fed either 10% or 15% of DS.

Table 4. The Effect of cake fortified with Date seeds on liver function in rats with liver toxicity

Parameters / Groups		AST	ALT	ALP
		(µ/L)		
Negative control		78.26 ± 2.27^{d}	36.45 ± 2.81^{e}	69.51 ± 4.56^{d}
Positive control		128.76 ± 2.23^{a}	90.21 ± 3.39^{a}	117.80 ± 2.71^{a}
Treated groups with DSs	**5%**	112.39 ± 5.98^{b}	81.67 ± 4.21^{b}	95.62 ± 4.44^{b}
	10%	108.74 ± 6.69^{b}	66.84 ± 5.69^{c}	80.80 ± 1.94^{c}
	15%	96.12 ± 4.35^{c}	56.78 ± 2.81^{d}	77.19 ± 3.09^{c}

Results are expressed as mean ± SD.

Means with different superscript letters in the column are significantly different at (P<0.05).

Higher AST and ALT values suggest liver damage, whereas lower AST and ALT values indicate a reasonably healthy liver status **(Lala *et al*., 2022)**. In addition, ALP levels were symptomatic of infiltrative hepatic disorders or intrahepatic cholestasis. All of these enzymes were confined inside hepatocytes by the plasma membrane. They leaked into the blood in cases of hepatic degenerative diseases

(Elgawish *et al*., 2019). The current study found a significant reduction in ALT, AST, and ALP activity in palm seed groups. These findings point to the hepatoprotective properties of palm date seeds, which could be mediated via their antioxidant activity. The antioxidant action of palm date seeds extract could stabilise the hepatocytes' cell membrane, preventing later enzyme leakage into circulation **(Eldeeb *et al*., 2020)**.

The obtained results are consistent with those of **Abd El. Rahman and El. Shall, (2019)** observed that (10 and 15) % of DS powder were the best for liver functions. All prior data sum up the hepatic improvement by palm date seeds via antioxidant capacity, which avoided apoptotic alterations in hepatocytes treated with such DS **(Ahmed *et al*., 2019)**. In agreement with, **Mahmoud *et al*., (2021)** showed that Palm date seed extract increased liver and kidney serum biomarkers, and it appeared to be safe after chronic treatment, with favourable effects on the liver. The positive effects of palm date seed extract appeared to be owing to its antioxidant action. Similarly, **Ali Zarie *et al*., (2023)** showed that date seeds significantly decreased liver function levels compared to the control group. Our preliminary phytochemical investigation found that date seeds contained considerable levels of total phenolics, flavonoids, condensed tannins, as well as strong antioxidant and anti-lipid peroxidation characteristics **(Bouhlali *et al*., 2020)**.

Table (5) showed the effect of cake fortified with DS on serum concentration of urea, uric acid (UA), Creatinine (Cr), Albumin and T. protein in rats with liver toxicity. Serum UN, UA, and Cr concentrations were significantly increase ($P<0.05$) but, Albumin and T-Protein were decreased in rats treated with AFB1 and fed a basic diet (+ve control group) compared to normal rats. However, the

results demonstrated that there was a substantial drop in serum UN, UA, and CR, but increase in Albumin and T-Protein concentrations of the AFB1 treated groups given the varying amounts of DS as compared to the positive control group. DS showed the greatest improvement in blood levels of UN, UA, and CR in treated groups at a 15% level compared to the other treatments. Regarding albumin, there was no significant difference between the groups fed either 5% or 10% of DS. However, there was a significant increase ($p<0.05$) in albumin concentrations for the group fed in 15% as compared to the other two levels of DS.

In line with agreement with **Abd El-Rahman and El-Shall, (2019)** observed that 10% date seeds powder decreased serum urea. Similarly, **Mahmoud *et al*., (2021)** showed that Palm date seed extract appeared to be safe after continuous administration and had a positive effect on renal enzymes in albumin and total protein levels. These results agree with **Abbassi *et al*., (2023)** showed that DS reduced serum levels of urea, creatinine and T-protein, levels compared to the control group.

Table 5. The Effect of cake fortified with Date seeds on kidney functions in rats with liver toxicity

Parameter / Groups		Urea	Uric acid	Creatine	Albumin	Total Protein
		(mg/dl)			(g/dl)	(g/dl)
Negative control		41.82 ± 2.82^{e}	1.14 ± 0.10^{e}	0.36 ± 0.02^{e}	6.86 ± 0.27^{a}	10.17±0.91^{a}
Positive control		93.90 ± 3.45^{a}	1.85 ± 0.07^{a}	0.98 ± 0.01^{a}	2.27 ± 0.27^{d}	3.74 ± 0.48^{e}
Treated groups with DSs	5%	75.47 ± 4.44^{b}	1.71 ± 0.06^{b}	0.74 ± 0.01^{b}	4.01 ± 0.43^{c}	4.67 ± 0.49^{d}
	10%	67.12 ± 5.03^{c}	1.49 ± 0.05^{c}	0.68 ± 0.02^{c}	4.33 ± 0.52^{c}	7.79 ± 0.48^{c}
	15%	50.45 ± 5.13^{d}	1.26 ± 0.03^{d}	0.47 ± 0.04^{d}	5.70 ± 0.27^{b}	9.10 ± 0.34^{b}

Results are expressed as mean ± SD.

Means with different superscript letters in the column are significantly different at ($P<0.05$).

As shown in Table (6) the effect of cake fortified with DS at the three different levels (5, 10, 15%) 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. **Rotimi *et al*., (2021)** showed that antenatal AFB1 exposure, at both low and high levels, significantly reduced weight, decreased cholesterol, and increased triglyceride levels.

Cake fortified with DS at different levels shows significant decrease ($P<0.05$) in the mean levels of lipid profile compared to the control positive group, while the HDL-C was significantly increased. Moreover, there was significant difference at ($P<0.05$) in the mean values of TC, TG, VLDL-C, and HDL-C for those feeds supplemented with different levels of cake fortified with DS. The group that consumed cake fortified with DS at 15% showed the greatest improvement in lipid profile.

These results agree with **Abd El-Rahman and El-Shall, (2019)** observed that 10% date seeds powder decreased lipid profile while increased level of HDL. **Salama *et al*., (2019)** discovered that consuming date seeds lowers levels of T- cholesterol, triglycerides, and the main indicators of renal function in diabetic rats. DSP has also been shown to prevent secondary diabetes outcomes such as cardiovascular events **(Bikri *et al*., 2021)**. Similarly, **Jubayer *et al*., (2020)** observed an improvement in the lipid profile of hypercholesterolemic adults after consuming 200 mg of milled date seed for 90 days and recommended using it as a supplement to manage hypercholesterolemia. **Abbassi *et al*., (2023)** revealed that DSP significantly decreased serum levels of cholesterol,

triglycerides. **Ali Zarie *et al*., (2023)** observed that oral administration of date seed extracts significantly decreased serum total cholesterol, Triglycerides.

Table 6. The Effect of cake fortified with Date seeds on lipid profile in rats with liver toxicity

Parameter / Groups		TC	TG	HDL-c	LDL-c	VLDL-c
		(mg/dl)				
Negative control		108.37 ± 2.60^{e}	63.50 ± 3.93^{e}	65.57 ± 3.16^{a}	30.10 ± 4.13^{d}	12.70 ± 0.78^{e}
Positive control		182.81 ± 5.04^{a}	148.32 ± 6.09^{a}	31.85 ± 3.32^{e}	121.29 ± 7.73^{a}	29.66 ± 1.22^{a}
Treated groups with DS	**5%**	167.20 ± 5.05^{b}	114.00 ± 5.12^{b}	42.86 ± 3.13^{d}	94.67 ± 8.00^{b}	22.80 ± 1.02^{b}
	10 %	158.22 ± 6.05^{c}	105.20 ± 4.95^{c}	49.72 ± 3.30^{c}	94.32 ± 8.12^{b}	21.04 ± 0.99^{c}
	15 %	144.14 ± 7.80^{d}	96.32 ± 2.74^{d}	57.75 ± 6.36^{b}	67.12 ± 10.98^{c}	19.26 ± 0.54^{d}

Results are expressed as mean ± SD.

Means with different superscript letters in the column are significantly different at ($P<0.05$).

Table (7) show lipid peroxidation as measured by serum MDA levels and GPX activity in normal rats injected with AFB1 and supplemented with 5, 10, and 15% DS. Administration of AFB1 results in a considerable rise ($P<0.05$) in serum MDA levels and decreased activity of GPX enzymes compared to normal rats. **Hatipoglu *et al*., (2022)** showed that through producing reactive oxygen species (ROS) and lipid peroxidation, AFB1 can cause oxidative stress, MDA levels rise as a result.

Table 7. The Effect of cake fortified with Date seeds on serum concentration of MDA, and GPX in rats with liver toxicity.

Parameters / Groups		MDA	GPX
		(µ/ml)	
Negative control		3.18 ± 0.43^{e}	67.82 ± 5.84^{a}
Positive control		9.25 ± 0.80^{a}	33.73 ± 2.60^{d}
Treated groups with DS	**5%**	7.60 ± 0.64^{b}	41.07 ± 1.63^{c}
	10%	6.07 ± 0.17^{c}	45.77 ± 4.22^{c}
	15%	5.10 ± 0.45^{d}	51.94 ± 2.37^{b}

Results are expressed as mean ± SD.

Means with different superscript letters in the column are significantly different at ($P<0.05$).

On the other hand, rats were fed a meal enriched with varying levels of DS and injected with AFB1, serum MDA levels and GPX 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 (15%) of DS.

Dietary antioxidants have an important role in Aflatoxin defence. These findings are consistent with **Parvizi *et al*., (2020)** observed that Date seeds increased SOD and CAT activity in rats that had been treated to PCM-induced hepatic injury, improving liver antioxidant potency. These findings were consistent with earlier research findings indicating animals treated with date seed extract can restore liver function by lowering oxidative damage and boosting antioxidant enzymes without generating toxicity, even after large doses of date seed extract (**Bikri *et al*., 2021 and Bouhlali *et al*., 2021**).

Also, **Bouhlali *et al*., (2021)** observed that Date pits significantly increased the activity of antioxidant enzymes (SOD, CAT, and GPx), as well as the level of reduced glutathione. The observed hepatoprotective effect may be attributed to date seeds' antioxidant properties and ability to trap free radicals. **Ali Zarie *et al*., (2023)** observed that oral treatment of DS extracts greatly reduced MAD. **Farid *et al*., (2024)** showed that date seed extract (10 and 20 mg/kg body weight) reduced oxidative stress in rats.

The presence of various chemical substances within the date pits is what causes these effects. Its include antioxidants such as carotenoids, anthocyanins, and flavonoids given their high proportion of antioxidant activity **(Huchzermeyer *et al*., 2022)**. Furthermore, **Bouhlali *et al*., (2020)** demonstrated that date seed contained high levels of rutin, quercetin, p-coumaric, and caffeic acids, as well as significant antioxidant activity.

Conclusions: the obtained results showed that cake fortified with date seed powdered was success in mitigating aflatoxin's harmful effects by increasing the levels of Malondiahide and enzymatic antioxidants as well as decreased blood indicators of liver functions due to potent of date seed of antioxidant potential and capacity to boost hepatic enzymes. The traditional use of date seeds to treat liver illness and its complications may be supported by the obtained findings.

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الملخص العربى

التأثيرات المحتملة للكيك الدعم ببذور التمر ضد سمية الكبد التي يسببها الأفلاتوكسين ب ١ في الفئران

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تهدف الدراسة الحالية الى تقييم الآثار المحتملة للكيك المدعم بنواة التمر ضد تسمم الكبد المحدث بالأفلاتوكسين ب ١ في الفئران. تم تقسيم خمسة وثلاثين فأر إلى مجموعتين رئيسيتين . تم تغذية المجموعة الرئيسية الاولي على النظام الغذائي الأساسى (٧ فئران) وخصصت كمجموعة ضابطة سالبة ، في حين تم حقن المجموعة الرئيسية الثانية (٢٨ فأر) بالأفلاتوكسين ب ١ بجرعات ٢ ملجم/كجم من وزن الجسم لمدة ٧ أيام ، لاحداث سمية الكبد. تم تقسيم الفئران إلى ٤ مجموعات فرعية متساوية على النحو التالي: المجموعة الفرعية الاولي بمثابة مجموعة ضابطة موجبة و ٣ مجموعات فرعية (الفئران المعالجة) تم تغذيتهم على النظام الغذائى الاساسى بالاضافة الى الكيك المدعم بنواة التمر بمستويات ٥ ، ١٠ ، ١٥ ٪ على التوالي. تشير النتائج الي ان تغذية الفئران المصابة بالتسمم الكبدى على نظام غذائى اساسى مدعم بالجرعات مختلفة من الكيك المدعم بنواة التمر احدثت انخفاض معنوي كبير فى وظائف الكبد والكلى وتحسين صورة دهون الدم ، في حين أن الليبوبروتينات العالية الكثافة ، الألبومين ، البروتين الكلى والانزيمات المضادة للاكسدة ارتفعت بشكل معنوي في حين ، انخفض مستوى المالوندهايد بشكل معنوي مقارنة مع الفئران المصابة بالتسمم الكبدى. ويمكن التوصية بضرورة تناول الكيك المدعم ببذور التمر في الوجبات الغذائية لأمراض الكبد لما لها من خصائص مضادة للأكسدة ، والتي تلعب دورا هاما في الحالة الصحية.

الكلمات المفتاحية: نوى التمر- الأفلاتوكسين ب ١ – وظائف الكبد – تسمم الكبد – مضادات الاكسدة.