The Effect of Doum (Hyphaene thebaica) Powder on Lipid Profile and Quality Characteristics of Cake

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Abstract

The effect of doum powder on lipid profile and the quality characteristics of doum supplemented cake were studied. Doum powder was subjected to chemical composition analysis and the biological study used five groups (6/ each) male Sprague Dawly. One group was fed on basal as negative control group. The second group was fed on fat diet as positive control group.The rest three groups were fed on fat diet supplemented with different percentages of doum powder (5, 10 and 15%) for 4 weeks. Blood samples were used to determine lipid profile, liver function and some minerals (iron, sodium and potassium). Shortening and spongy cakes were prepared by doum powder at (5, 10 and 15%) and the fortified cakes were subjected to sensory and objective evaluation. The results showed that, Doum powder contain high amounts of fiber, calcium and potassium, there was a significant decrease in cholesterol, triglyceride, very low density lipoprotein and atherogenic index in groups fed on 10 and 15% doum powder and a significant decrease in sodium level at ($P< 0.05$) and significant increase in potassium at 15% doum powder. Height, volume and index to volume in fortified

shortening cake with 15 % doum were significantly increased to the control. But sensory evaluation results showed that there was a significant decrease in taste and odor scores in the shortening and spongy cakes fortified with 10 and 15% doum powder. It can be concluded that doum powder at 15 % gave better results in lowering lipid profile. But, the two types of cake at 5 % showed better quality characteristics. Flavor enhancers should be added to enhance cakes characteristics at high percentage of doum.

Introduction

Doum palm known as Hyphaene thebaica, L., found in many African countries such as Egypt, Senegal, Central Africa, Nigeria, Tanzania and Mauritania ***(Walter, 1971).*** Doum fruit is an oval, shiny has pericap and outer coat of the endocarp are inedible, the mesocarp and Kernel flesh are edible, ***(Loukuruka, 1990).*** It was considered sacred by the ancient Egyptians, the seed was found in many pharaoh's tombs and play an important role in the treatment of bilharzasis, also has an anti-inflammatory, antipyretic and antiepileptic effect ***(Amin and Mahmoud, 1999).*** Also, ***Irobi and Adeday, (1999)*** stated that, doum aqueous extract has antihypertensive activity and antifungal effect. ***Abdel-moniem et al., (2015)*** reported that doum fruits showed hypolepidemic, and antidiabetic and antihypertensive activities. ***Umaru, et al., (2007)*** demonstrated that Hyphaene thebaica Egyptian doum palm contain antinutritional components such as oxalate (13.5 %), phytate (1.18 %), saponin (8.25 %) and tannin (6.39 %). Despite the fact that many natural foods consumed with lack of sufficient information on its content and its effect on some diseases. The Doum may play a role in regulating blood pressure, has a cooling and soothing effect on the

digestive system and antioxidant properties which help flush toxins from the body ***(Orwa et al., 2009).*** Doum palm fruit is also a source of potent antioxidants ***Hsu et al., (2006), Aremu and Fadele (2011); Al Amer and Rashwan (2012).*** Research on the fruit pulp have shown that it contains 4.91% proteins, 5.26% fat, 4.5% ash and 85.33% total carbohydrate fatty acids, in particular the nutritionally essential linoleic acid ***(Eissa et al., 2008).*** The high fiber content of doum fruit is suggesting as a potential to be used in the formulation of bakery products such as bread, biscuits, cookies, cakes and pan cakes to satisfy consumer needs for increased fiber intake without sacrificing sensory attributes and enrich their texture, flavor and nutritional value ***Dubois, (1978) and Fondroy, et al., (1989).*** Bakery products constitute one of the most consumed foods in the world. Among them, cakes are popular and are associated in the consumer's mind with a delicious sponge product with desired organoleptic characteristics ***Matsakidou, et al., (2010).***

Therefore, this study was undertaken to study the effect of doum on lipid profile and quality characteristics of different kinds of cake.

Materials and Methods

Doum fruit was obtained from Isis Company for manufacturing foods then cleaned from foreign materials. Edible part was milled to obtain powder. **Chemical analysis:** (Protein, carbohydrate, lipids, fiber, ash, moisture and minerals (iron, sodium, potassium, calcium and zinc) was performed according to ***(AOAC, 2005).***

Biological experiment:

Thirty male Sprague Dawly rats of average weight 110±10 gm, were obtained from Vaccine and Immunity Organization, Helwan, Cairo. Rats were kept in stainless steel cages under hygienic conditions for one week on basal diet for adaptation according to ***(Reeves, et al. 1993)***. Rats were divided into 5 groups, six in each group. All groups fed on hypercholesterolemic diet according to ***(Shinnick, et al., 1990)*** for 2 weeks except the negative control group (group A). After this period, the second group of rats maintained on basal diet + cholesterol, (group B) positive control group. The rest groups C, D and E fed on basal diet + cholesterol + doum powder at different levels 5, 10 and 15% respectively, for 4 weeks.

After this period, rats were fasted for 12 hours, then bloods samples were taken from internal canthus near the lacrymal glands in the eyes of the rats with heparinized capillary tubes and kept in heparinzed test tubes then centrifuged to separate plasma that was used in the determination of total cholesterol (Ch), triglyceride (TG), and high density lipoprotein cholesterol (HDL-c)according to the method of ***Rachel and Janine (1993)*** and low density lipoprotein cholesterol (LDL-c), very low density lipoprotein cholesterol (VLDL-c) according to the method of ***Wamick (2000)*** and minerals (iron, sodium and potassium) according to the ***method of AOAC, (2005) and Riely, (1966)*** and liver function; Aspartate transaminase (AST) and Alanine transaminase (ALT) were determined according to ***Henry (1974)*** and ***Yound (1975)*** and ***Tietz (1976).***

Biological Evaluation:

Rat's organs (liver, kidney and spleen) were isolated and weighed and percentage to the final body weight was calculated.

Rat's Initial body weight (IBW) was taken weekly, food intake (FI) taken daily. Feed efficiency ratio (FER) was calculated according to ***Chapman, et al., (1959).***

Preparation of products:

Doum powder was used to fortify two bakery products, spongy cake and shortening cake. Blends of wheat flour with doum powder were prepared by substituting 5, 10, 15% for both spongy cake and shortenig cake. Spongy cake was prepared according to ***Bennion and Bamford, (1997)***, the ingredients used for preparation of spongy cake are shown in table (1). Whole fresh egg, sugar and vanilla were whipped for six minutes at room temperature, and then dried ingredients (flour, doum powder and baking powder) were mixed together and beaten for three minutes using the mixing machine. The spongy cake batter was weighed at 350 g., in baking pans and baked in hot oven at 180^{o}C for 30 minutes, then weighed after cooling.

Shortening cake was prepared according to ***AACC (2002),*** the ingredients used was shown in table (2). All dried ingredients (flour, doum powder, sugar, salt, baking powder) were mixed together. Shortening, egg and milk were poured into the dried ingredients then stried well; the cake batter was put into tefal pan (19x9x6 cm) weighed at 350g., and baked in hot oven at 200^{o}C.

Objective measurements:

Objective evaluations were done on the products after cooling. The products were removed from the pan and cooled on a wire rack for at least two hours. Weight before and after baking, changes in baked weight was represented as a percentage by using the following equation:

$$\text{Percent change} = \frac{\text{Weight before baking (g.) – Weight after baking (g.).}}{\text{Weight before baking (g.)}} \times 100$$

Volume, height, index to volume and specific gravity were calculated according to the method of ***(Penfield and Campbell, 1990).***

Sensory evaluation:

Sensory evaluation was done to detect color (interior and exterior), cell (size and uniformity), appea-rance, tenderness, taste, odor and general acceptability. Organoleptic evaluation was carried out on 20 well trained panelists using a score sheet ***(Coultate, 1996).*** All characteristics were evaluated from 1-5 degree (1 represents very poor and 5 represents very good) ***(Penfield and Campbell, 1990).***

Statistical Analysis:

Data were statistically analyzed using ANOVA according to the method of ***Sendecore and Cochran (1967),*** and the significant difference among means was evaluated by least significant difference at level $P<0.05$.

Results and Discussion

First Part:

Chemical composition of doum:

Chemical composition of doum powder per 100 (gm.) was shown in table (3). It was found that doum contain 7.35 g protein, 3.52 fat and 70.00 carbohydrate, 10.46 g fiber and minerals (calcium , potassium, sodium, iron and zinc, (111.5, 542.25, 138.75, 8.25 and 1.5 mg., respectively). The results were in agreement with ***Auwal, et***

al., (2013) who stated that doum contain high amounts of calcium, sodium and potassium. Also**, *Aboshora, et al., (2014)*** reported that doum fruit contained substantial amounts of essential minerals as follows: sodium 364.7 mg/100 g, calcium 284 mg/100 g and iron 12.18 mg/100 g in the epicarp while the flesh part of the doum fruit contain potassium 2947.6 mg/100 g, magnesium 185.62 mg/100 g and phosphorus 154.6 mg/100 g.

Also, ***Aboshora, et al., (2014)*** stated that doum fruit provides essential nutrients and possesses important functional properties which if well exploited can help to address many food related problems like diabetic and hypertensive patients.

Percent change in body weight, body weight gain food intake and feed efficiency ratio in the investigated groups of rats were illustrated in table (4). There was a decrease in body weight in the treated groups with different percent of doum as compared with the positive control group. The reduction in body weight gain may be due to the fiber content of doum. The group which was fed on 15 % doum showed a significant decrease in body weight gain. It was found that food efficiency was decreased in all treated groups with (5, 10 and 15 percent) in comparison with the positive control group. The results were in agreement with ***Holloway & Grieg, (1984)*** who demonstrated that the decrease in the body weight gain could be attributable to a reduced metabolizable energy of the diets containing doum fruit flour (DFF), due to its high fiber content (12.42 g./100 g. DFF) resulting in lower mean values of FER. Also, the water holding capacity (WHC) of dietary fiber is thought to be an important determinant of faecal bulking and intestinal transit times with influence on gastrointestinal disease.

Mean of organs weight as percentage of body weight of rats fed on doum supplemented diet was shown on table (5). The treated group with 15% doum powder showed a significant decrease in heart as compared with the positive control group. Liver in both treated groups with 10 and 15 % doum powder were decreased sign-ificantly as compared with the positive control group. Kidney and spleen in all treated groups were showed slight increase in all treated groups with different percent of doum powder as compared with the positive control group.

Mean of blood lipids profile and liver function in the rats fed doum supplemented diet were demonstrated in table (6). It was found that cholesterol, triglyceride and VLDL were significantly decreased in the groups which were fed on 10 and 15 % doum powder respectively. Also the group which was fed on 5 % doum powder showed a decrease in cholesterol and triglyceride but not significant as compared to the positive control group. On the other hand, HDL was significantly increased in all treated groups with different percent of doum powder (5, 10 and 15 %) in comparison with the positive control group. LDL, AI, AII, AIII and TG/HDL were significantly decreased in all treated groups in comparison with the positive control groups. These results were in agreement with ***El-Gendy, et al , (2008)*** illustrated that supplementation with doum caused a significant decrease in total cholesterol, triglyceride and LDL-C in treated patients compared to non treated ones, while they reported an increase of the HDL-C. ***Bayad (2016)*** stated that the doum fruit may be improving lipid profile. ***Elhaj and El Bagir (2016)*** reported that**,** feeding Hyphaene thebaica may protect from the increase of the bad cholesterol, even a high fat diet is consumed. AST was decreased significantly in the groups which were fed on 10 and 15%

in comparison with the positive control group. ALT was also decreased in all treated groups as compared with positive control group but not significant. These results in agreement with those of ***Al-amer and Rashwan (2012)*** who demonstrated that administration of doum can improve liver functions.

Table (7) showed the mean of hemoglobin and minerals (iron, sodium and potassium) in the investigated groups of rats. It was found that there was a significant decrease in hemoglobin level in the group which was fed on 15 % of doum respectively as compared with positive control group. There was a significant decrease in iron in the groups which were fed on 10 and 15 % doum powder as compared with the positive control group. The decrease in hemoglobin level and iron level may be related to the fiber content of doum. These results disagree with ***Auwal, et al, (2013)*** who stated that Hyphaene thebeica can improve the hematological parameters and has the ability to improve immune system related disease and can be used in the management of anemia and immune disease. There was a significant decrease in sodium level in group fed on 15% doum powder in comparsion with the positive control group. On the other hand there was a significant increase in potassium level in the group which was fed on 15 % doum as compared with the positive control group. The results showed an increase in potassium level may be due to the high content of potassium in doum and also doum is used as hypotensive so that it will decrease the level of sodium which is related to the hypertension**.** ***El-Gendy, et al., (2008)*** stated that doum lowering blood pressure in hypertensive patients and changing blood lipids and lipoproteins in a manner that decreases the risk on the cardiovascular system.

Second Part:

Chemical composition of Products:

Chemical composition of fortified shortening cake and spongy cake with different percent of doum powder per 100 g. was shown in table (8). Shortening cake fortified with different percentages of doum (5, 10 and 15%) contain 5.57, 5.50 and 5.48 % moisture, protein (7.35, 7.7 and 8.54 g.), fiber (2.32, 2.53 and 3.39 g.) respectively. It was observed that, fiber content increased by increasing the amount of doum powder in shortening cake in comparison with the control (2.11g.). The fortified shortening cake contain high amounts of potassium as compared with the control. This increase related to the high amount of potassium in doum powder. Spongy cake fortified with different percentages of doum powder 5, 10 and 15 % contained 11.06, 12.6, and 13.30g. protein, respectively. Also, the amount of fiber increased by increasing the percentages (5, 10 and 15%) of doum powder (1.99, 2.11 and 2.28 g.) respectively. The fortified spongy cake was contained high amount of potassium, and this amount increased by increasing the percentage of doum powder. Increasing the amount of potassium in both types of cake may be useful in treating hypertension. These results are in agreement with ***Seleem, (2015)*** who reported that increasing the levels of substitution doum increased the total fat, crude fiber and ash contents in produced cake compared with control. Also, minerals of the produced cake showed an increment in potassium and magnesium, while slightly increment in calcium, iron and zinc with increasing the level of substitution.

Mean of selected measurements for shortening cake and spongy cake fortified with different levels of doum powder was illustrated in table (9). The results showed that there was a significant increase in shortening cake fortified with 15% of doum powder in

height, volume and index to volume as compared with the unfortified shortening cake. On other hand the spongy cake fortified with 15 % doum powder has significant decrease in height, volume and index to volume as compared with the unfortified spongy cake.

Mean of sensory characteristics for shortening cake and spongy cake fortified with different levels of doum was shown in table (10). The results showed that there was significant decrease in the scores of both types of cake (shortening and spongy) in the interior and exterior color, cell size, cell uniformity and tenderness fortified with 15% of doum powder as compared with the control. Sensory evaluation results showed that, there were significant decrease in taste and odor scores in the shortening and spongy cakes fortified with 10 and 15%. These results are in agreement with ***Seleem, (2015)*** who reported that, there was a significant decrease in the acceptability by increasing the doum powder substitution as comparing with the control.

It was concluded that feeding rats with doum at 15 % gave better results in lowering lipid profile. But, the two types of cakes at 5 % showed better quality characteristics. Doum powder may be used added to enhance cakes characteristics.

Table (1): Ingredients of spongy cake fortified with different levels of doum powder.

Ingredients	Products			
	Control	Doum powder (%)		
		5	10	15

Wheat flour (g.).	100	95	90	85
Doum flour (g.).	-	5	10	15
Whole fresh egg (g.).	125	125	125	125
Sugar (g.).	75	75	75	75
Salt (g.)	1	1	1	1
Vanilla (g.).	2	2	2	2

Table (2): Ingredients of shortening cake fortified with different levels of doum powder.

Ingredients	Products			
	Control	Doum powder (%)		
		5	10	15
Wheat flour (g.).	100	95	90	85
Doum flour (g.).	-	5	10	15
Whole fresh egg (g.).	50	50	50	50
Sugar (g.).	50	50	50	50
Baking powder (g.).	9	9	9	9
Shortening (g.).	50	50	50	50
Vanilla (g.).	2	2	2	2
Salt (g.).	1.6	1.6	1.6	1.6
Milk (ml.).	110	110	110	110

Table (3): Chemical composition of doum per 100 gm.

Chemical composition	Amount
Protein (g.)	7.35
Fat (g.)	3.52

Carbohydrate (g.)	70.00
Fiber (g.)	10.46
Ash (g.)	3.09
Moisture (g.)	5.57
Minerals	
Calcium (mg.)	111.5
Potassium (mg.)	542.25
Sodium (mg.)	138.75
Iron (mg.)	8.25
Zinc (mg.)	1.5

Table (4): Mean of Initial body weight (IBW), final body weight (FBW), body weight gain (BW), percent change in body weight , food intake (FI) and feed efficiency ratio (FER) in the investigated groups of rats during the study period.

Parameters	Groups				
	A	B	Treated groups with Doum powder		
			C	D	E
IBW (g.)	109.80± 0.44 [a]	109.88± 0.44 [a]	108.8± 1.30 [a]	105.4± 3.84 [a]	104.20±3 .89 [a]
FBW (g.)	130.20± 5.16 [cb]	141.80± 7.73 [a]	134.40±5. 63 [ab]	129.40± 5.12 [cb]	125.4± 4.72 [c]
BW G (g.)	20.40± 3.84[b]	31.92± 0.09 [a]	25.60± 6.10 [ab]	24.00± 6.44 [ab]	21.20± 4.54[b]
%BWt	18.58± 4.81 [b]	28.24± 7.46 [a]	23.55± 5.69 [ab]	22.90± 6.67 [ab]	20.41± 4.59 [ab]
FI (g./day)	8.78± 0.45 [b]	12.47± 1.37 [a]	10.23± 1.00[b]	10.07± 1.86[b]	9.11± 1.61[b]
FER	0.082± 0.56 [a]	0.099± 0.49 [a]	0.089± 0.72 [a]	0.085± 0.98 [a]	0.083± 0.28 [a]

A: Negative control. B: Positive Control. C: 5% Doum D: 10% Doum. E: 15% Doum.

Means in same row which does not share the same letter have significant difference at P<0.05.

Table (5): Mean of organs weight as percentage of body weight of rats fed on doum supplemented diet.

Organs	Groups		
	A	B	Treated groups with Doum

			C	D	E
Heart	0.85.00± 0.105[b]	1.108± 0.07[a]	0.99± 0.14 [ab]	0.95± 0.19 [ab]	0.88± 0.16 [b]
Liver	3.51± 0.55 [ab]	4.12± 0.93 [a]	3.41± 0.14 [ab]	3.23± 0.23 [b]	3.03± 0.37 [b]
Kidney	0.75± 0.13 [a]	0.77 ±0.07 [a]	0.80± 0.09 [a]	0.81± 0.04 [a]	0.73± 0.07 [a]
Spleen	0.72± 0.08 [a]	0.60± 0.12 [a]	0.65± 0.07 [a]	0.66± 0.14 [a]	0.65± 0.16 [a]

A: Negative control. B: Positive Control. C: 5% Doum D: 10% Doum. E: 15% Doum.

Means in same row which does not share the same letter have significant difference at P<0.05.

Table (6): Mean of blood lipids profile and liver function in rats fed on doum supplemented diet.

Parameters	Groups				
	A	B	Treated groups with Doum		
			C	D	E

Blood lipids (mg. /dl.) Ch	145.40± 11.76^{bc}	167.80± 6.05^{a}	153.40± 27.54^{ba}	148.00± 7.71^{bc}	130.60± 6.65^{c}
TG	65.20± 12.04^{bc}	87.00± 11.76^{a}	75.80± 13.53^{ba}	66.20± 8.70^{bc}	58.00± 12.04^{c}
HDL-c	77.00± 10.27^{a}	39.20± 8.84^{b}	79.20± 9.25^{a}	84.00± 7.41^{a}	84.00± 8.21^{a}
LDL-c	55.36± 16.58^{bc}	111.12± 10.71^{a}	59.04± 30.05^{b}	50.76± 10.45^{bc}	35.00± 8.00^{c}
VLDL-c	13.04± 2.40^{bc}	17.40± 2.35^{a}	15.16± 2.70^{ab}	13.24± 1.74^{bc}	11.60± 2.40^{c}
AI	0.91± 0.29^{b}	3.52± 1.41^{a}	0.96± 0.43^{b}	0.76± 0.16^{b}	0.55± 0.13^{b}
AII	0.73± 0.29^{b}	3.05± 1.23^{a}	0.76± 0.41^{b}	0.61± 0.16^{b}	0.42± 0.11^{b}
AII	1.91± 0.29^{b}	4.52± 1.41^{a}	1.96± 0.43^{b}	1.76± 0.16^{b}	1.55± 0.13^{b}
TG/HDL	0.85± 0.19^{b}	2.36± 0.92^{a}	0.95± 0.14^{b}	0.78± 0.05^{b}	0.69± 0.19^{b}
Liver Function (µ/l.)					
AST	120.80± 13.16^{b}	148.40± 12.66^{a}	139.20± 18.79^{ab}	137.60± 25.99^{ab}	124.80± 28.22^{ba}
ALT	26.00± 4.30^{a}	31.60± 6.87^{a}	29.00± 7.87^{a}	28.00± 2.00^{a}	27.40± 4.50^{a}

A: Negative control. B: Positive Control. C: 5% Doum D: 10% Doum. E: 15% Doum. AI: Atherogenic index-I, AII: Atherogenic index–II and AIII: Atherogenic index-III.
Means in same rows which does not share the same letter have significant difference at P<0.05.

Table (7): Mean of hemoglobin and minerals (iron, sodium and potassium) in the investigated groups of rats.

Parameters	Groups		
	A	B	Treated groups with Doum

			C	D	E
HB (g./dl.)	13.32± 1.87^{b}	15.20± 0.95^{a}	14.72± 0.74^{ba}	13.98± 1.53^{ba}	13.28± 0.75^{b}
Fe (µg./dl.)	24.580± 45.92^{a}	25.60± 35.30^{a}	22.90± 66.20^{a}	15.40± 92.03^{b}	14.52± 5.58^{b}
Na (mEq./l.)	12.64± 18.60^{ab}	12.92 ± 8.67^{a}	11.80± 11.57^{ab}	11.52± 5.97^{ab}	11.30± 9.97^{b}
K (mEq./l.)	5.92± 1.87^{c}	5.70± 0.63^{bc}	6.42± 0.51^{ba}	6.52± 0.45^{ab}	6.64± 0.12^{a}

A: Negative control. B: Positive Control. C: 5% Doum D: 10% Doum. E: 15% Doum. C: 5% Doum D: 10% Doum. E: 15% Doum. Iron (Fe). Sodium (Na). Potassium (K).

Means in same rows which does not share the same letter have significant difference at P<0.05.

Table (8): Chemical composition of fortified shortening cake and spongy cake with different percent of doum powder per 100 g.

Chemical Composition	Shortening Cake		Spongy Cake	
	Cont	Fortified (products)	Control	Fortified (products)

	rol	5%	10%	15%		5%	10%	15%
Moisture (%)	5.63	5.57	5.50	5.48	4.64	4.90	4.92	6.53
Protein (g.)	8.4	7.35	7.7	8.54	10.15	11.06	12.6	13.3
Fat (g.)	29.75	30.52	30.72	31.63	12.55	12.55	14.10	14.19
Carbohydrate (g.)	50.88	50.08	50.05	48.23	62.69	64.18	68.69	68.96
Fiber (g.)	2.11	2.32	2.53	3.39	1.20	1.99	2.11	2.28
Ash (g.)	3.23	3.09	3.5	3.59	1.41	1.53	1.61	1.88
Calcium (mg.)	109	111	114	116	47.25	52.75	56.50	56.75
Iron (mg.)	8.25	12	13	14	5.75	6.25	13.25	15.25
Zinc (mg.)	1	1	3.25	3.5	4.25	4.5	1.25	1.5
Sodium (mg.)	138.57	136.18	495.75	471.5	471.5	467.25	136.17	136.16
Potassium (mg)	246.5	320.25	542.25	566.75	369.5	443.75	566.75	640.75

Table (9): Mean of selected measurements for shorte- ning cake and spongy cake fortified with different levels of doum powder after baking.

Cake Products	Parameters						
	Wt After (g.)	% Change	Height (cm.)	Volume (cm^3)	Index to volume	Specific volume	Density ($g./cm^3$)

		Wt.			(cm.)	(cm^3/g.)	
Shortening cake							
Control	200 ± 30.00[a]	33.33± 10.00[a]	3.56± 0.01[c]	270.00± 50.00[b]	6.23± 0.01[d]	1.34± 0.05[a]	0.74± 0.03[b]
Fortified Products							
5 %	225 ± 34.64[a]	24.99± 11.54[a]	3.37± 0.01[d]	360± 85.00[ab]	6.58± 0.01[b]	1.62± 0.44[a]	0.65± 0.20[a]
10 %	230± 10.00[a]	23.33± 3.33[a]	3.64± 0.01[b]	430± 100.00[ab]	6.33± 0.01[c]	1.87± 0.51[a]	0.55± 0.15[a]
15 %	240± 10.00[a]	19.99± 3.33[a]	4.37± 0.01[a]	450 ± 110.00[a]	6.76± 0.01[a]	1.86± 0.38[a]	0.54± 0.11[a]
Spongy cake							
Control	250± 32.78[a]	28.57± 9.36[a]	3.20± 0.10[a]	1200± 300.00[a]	14.34± 0.01[a]	4.78± 0.95[a]	0.21± 0.03[a]
Fortified products							
5 %	263.33± 70.23[a]	24.75± 20.06[a]	2.98± 0.01[b]	1000± 500[a]	13.32± 0.01[ba]	3.73± 1.58[ab]	0.29± 0.10[a]
10 %	290 ± 40.00[a]	17.14± 11.43[a]	2.87± 0.01[c]	800 ± 200.00[a]	13.04± 0.01[cb]	2.85± 1.09[ab]	0.38± 0.15[a]
15 %	296.66± 25.16[a]	15.23± 7.18[a]	2.67± 0.01[d]	600± 400.00[a]	13.02± 0.01[db]	1.95± 1.19[b]	0.72± 0.55[a]

Means in same columns which does not share the same letter have significant difference at P<0.05.

Table (10): Mean of sensory characteristics for shortening cake and spongy cake fortified with different levels of doum

Characteristics	Types of cake							
	Shortening cake				Spongy cake			
	Control	Fortified cake			Control	Fortified cake		
		5%	10%	15%		5%	10%	15%
Apperance	4.10± 1.07[a]	3.80± 1.00[ab]	3.00± 1.62[bc]	2.90± 1.29[c]	4.05± 1.27[a]	3.95± 1.05[a]	3.40± 1.27 ab	3.00± 1.33[b]

Interior color	4.05± 0.94 a	3.60± 1.31 ab	2.90± 1.65 bc	2.60± 1.46 c	3.85± 1.34 a	3.75± 1.37 a	3.15± 1.42 ab	2.85± 1.34 b
Exterior color	4.20± 1.00 a	3.30± 1.45 b	2.80± 1.57 b	2.65± 1.46b	3.95± 1.35 a	3.70± 1.34 ab	3.20± 1.50 ab	2.95± 1.50 b
Cell size	4.10± 1.02 a	3.40± 1.50 ab	2.80± 1.47 bc	2.30± 1.21 c	4.05± 1.09 a	3.90± 1.02 a	3.10± 1.33 b	3.50± 1.10 ab
Cell uniformity	4.55± 0.60 a	3.90± 1.55 ab	3.35± 1.69 bc	2.85± 1.49 c	4.25± 1.25 a	4.25± 1.06 a	3.85± 1.42 ab	3.40± 1.42 b
Tenderness	4.30± 0.86 a	4.05± 1.14 a	2.85± 1.56 b	2.20± 1.47 b	4.05± 1.05 a	4.05± 0.99 a	3.70± 1.21a	3.35± 1.26 a
Taste	4.70± 0.47 a	4.00± 1.25 ab	3.65± 1.56 bc	3.00± 1.55 c	4.15± 1.18a	4.20± 1.00a	3.65± 1.53a	3.20± 1.60a
Odor	4.45± 0.60 a	4.10± 1.07 ab	3.65± 1.53 b	2.85± 1.30 c	4.40± 0.68 a	4.30± 1.08 ab	4.00± 0.85 ab	3.70± 1.45 b
General acceptability	4.05± 0.88 a	4.05± 1.60 a	3.10± 1.44 b	2.85± 1.59 b	4.60± 0.75 a	3.75± 1.71 ab	3.10± 1.68b	2.85± 1.53b

Means in same rows which does not share the same letter have significant difference at P<0.05.

References

AACC (2002):

Approved Methods of the American Association of Cereal Chemistry. American Association of Cereal Chemists, Inc, St. Paul.

Abdel-moniem M, Mustafa H. N. , Megahed H. A., Agaibyi, M. H., Hegazy, G. A. and El-Dabaa M. A. (2015):

The ameliorative potential of Hyphaene thebaica on streptozotocin-induced diabetic nephropathy. Folia Morphol. 74 (4):447- 457.

Aboshora, W., Lianfu, Z., Dahir, M., Gasmalla, M., Musa, A., Omer, E., and Thapa, M. (2014):

Physicochemical, Nutritional and Functional Properties of the Epicarp, Flesh and Pitted Sample of Doum Fruit (Hyphaene Thebaica). Journal of Food and Nutrition Research, 2(4): 180-186.

Al-Amer, H. A. and Rashwan, N. M., (2012):

Effects of dietary supplementation with doum and selenium on liver injury in experimental rats. Journal of Applied Sciences Research, 8(4): 2018-2023.

Amin, A. and Mahmoud, S. (1999):

Evaluation of some pharmacological activities of Hyphane thebaica. Arab. J. Lab Med. 25: 355- 365.

AOAC, (2005):

Official Methods of Analysis of AOAC Intern- ational. 18th Edition, AOAC, Washington DC.

Aremu, A. K. and Fadele, O. K. (2011):

Some Physical Properties of Doum Palm Fruit (Hyphaene thebaica Mart.). J New York Science, 4(3): 63-69.

Auwal, M. S. , Sanda, K. A., Mairiga, I. A, Lawan, A. A., Mutah, A. N. , Tiggani, A., Shuaibu, A. Ibrahim, A., Njobdi, A. B. and Thaluvwa, A. B. (2013):
The phytochemical , elemental and hemotologic evaluation of crude mesocarp extract of Hyphaene thebacia (doum palm) in wistar albino rats. Asian Journal of Biochem., 8: 14-23.

Bayad, A. E. (2016):
Influences of doum fruit (Hyphaene thebaica) extract on the reproductive parameters, blood picture , lipid profile and hepato-renal functions in rats. Merit Research Journal of Medicine and Medical Sciences (ISSN: 2354-323X) Vol. 4(8) PP. 384-391.
http://www.meritresearchjournals.org/mms/index.htm.

Bennion, E. B. and Bamford, G. S. T. (1997):
In: A. J. Bent (ed.) The Technology of Cake Making, 6th edn. Blackie Academic and Professional, London

Chapman, D. G., Gastilla, R. and Campbell, J. A. (1959):
Evaluation of protein efficency ratio. Can. J. Biochem. Physiol., 37: 647-686.

Coultate, T. P. (1996):
Food: the chemistry of its components 3rd ed. The Royal Society of Chemistry. British. P. 178.

Dubois, C. (1978):

The Practical Application of Fiber Materials in Bread Production. Baker‘s Digest, 52, 30-33.

Eissa, H. A., Ramadan, M. T., and Ali, H. S. (2008):

Effect of natural extracts from the fruits of doum palm, carob and licorice on the quality and safety of apple slices. J. Agric. Sci. Mansoura Univ., (33): 6609–6623.

El-Gendy, El-Mileegy, Ghyaty, Malek, and El-Hamid Mousa, (2008):

The Beneficial Dietary Hypotensive and Hypoli-pidemic Effects of Hyphaene thebaica. The Internet Journal of Alternative Medicine; 7(1):1-9.

Elhaj, N. A., and ElBagir, N. M. (2016):

Hypolipidemic Effect of Hyphaene thebaica (Doum-palm) in Induced Hypercholestrolemic Wistar Albino Rats. International Journal of Biochemistry and Biophysics 4(2): 11-15.

Fondroy, E. B., White, P. J. and Prusa, K. J. (1989):

Physical and Sensory Evaluation of Lean White Cakes Containing Substituted Fluffy Cellulose. Cereal Chemistry, 66, 402-404.

Henry, R.J. (1974):

Clinical Chemist: Principles and techniques, 2nd ed., Hagerstown (MD) Harper and Row P. 525-882.

Holloway, W.D., and Grieg R., (1984):

Water holding capacity of hemicelluloses from fruits, vegetables and wheat bran. Food Sci., , 49, 1632–1633.

Hsu B., Coupar, I. M., and Ng, K. (2006):
Antioxidant Activity of Hot Water Extract from the Fruit of the Doum Palm, Hyphaene thebaica. Food Chem., Elsevier Science Direct. 98: 317–328

Irobi, O.N. and Adeday, O. (1999):
Antifungal activity of aqueous extract of dormant fruits of Hyphaene thebaica palmae. Pharm. Biol., 37: 114-117.

Lokuruka, M. N. I. (1990):
The chemical and nutritional characteristics of the fruit of Hyphaene coriacea (the turkana Doum-palm) and implications of its consumption on health. M. Sc. Thesis. Dept. of Food Science, University of Reading U.K.

Matsakidou, A., Blekas, G. and Paraskevopoulou, A. (2010):
Aroma and Physical Characteristics of Cakes Prepared by Replacing Margarine with Extra Virgin Olive Oil. LWT-Food Science and Technology, 43, 949-957.http://dx.doi.org/10.1016/j.lwt.2010.02.002

Orwa, C., A. Mutua, R. Kindt, R. Jamnadass and Anthony S. (2009):
Agro-Forest Tree Data Base: A Tree Reference and Selection version 4.0.

Penifeld, M. and Campbell, A. M. (1990):

Experimental food science, 3rd ed. (ed.) Academic press, Inc. London P. 33-34.

Rashel, B. S. and Janine, D. (1993):

Microplate method for determination of serum cholesterol, high density, lipoprotein cholesterol, triglyceride and apolipoprotein. Lipids J., 28: 151-155.

Reeves, P., Nielsen, F. and Fahmy, G. (1993):

Report of the The American Institute of Nutrition adhoc writing committee on the reformulation of the AIN – 76, Rodent diet. J. Nutr., 123: 1939-1951.

Riely, C. (1966):

Flame photometry, A comparative test of fifteen instrument. Assoc. Clin. Bioch., 381.

Seleem, H. A. (2015):

Effect of Blending Doum (Hyphaene thebaica) Powder with Wheat Flour on the Nutritional Value and Quality of Cake. Food and Nutrition Sciences 6, 622-632

Sendecor, G. W. and Cochran, W. G. (1967):

Statistical methods. The Lowa State University Press, Ames, USA 6th ed.

Shinnick, F., L., Ink, S. L. and Marlett, J. A. (1990):

Dose response to a dietary oat bran fraction in cholesterol fed rats. J. Nutr., 120: 561-568.

Tietz, N. W. (1976):
Fundamentals of clinical chemistry W. B. Sanu ders, Philadephia.

Umaru, H. A., Adamu, R., Dahiru, D. and Nadro, M. S. (2007):
Levels of antinutritional factors in some wild edible fruits of Northern Nigeria. African J. Biotech., 6: 1935-1938.

Walter, H. (1971):
General features of vegetables of sub-tropical and tropical regions. In Ecology of tropical and sub-tropical vegetables. Oliver and Boyd, Edinburgh. P.226-298.

Wamick, G. R. (2000):
Measurement of cholesterol and other lipoprotein constituents in the clinical laboratory. Clin. And Lab. Med., 38: 287-300.

Yound, D. S. (1975):
Determination of Got. Clin. Chem., 22: 21-31.

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قسم التغذية و علوم الاطعمة – كلية الاقتصاد المنزلي –جامعة حلوان

الملخص العربي

يهدف هذا البحث إلى دراسة تأثير مطحون الدوم على صورة الدهون في الدم وجودة خصائص الكيك المضاف إليه الدوم. تم تقدير المحتوى الكيميائي للدوم وتضمنت الدراسة البيولوجية خمس مجموعات من الفئران (6/ مجموعة) من ذكور الفئران من النوع Sprague Dawly. المجموعة الاولى غذيت على الغذاء الاساسي (مجموعة ضابطة سالبة) ، و المجوعة الثانية غذيت على غذاء يحتوى على دهون لتصبح (مجموعة ضابطة موجبة). اما باقي المجموعات الثلاث فقد غذيت على نسب مختلفة من الدوم المطحون (5، 10، 15 %) لمدة أربعة اسابيع. تم تجميع عينات الدم لتقدير صورة الدهون ، ووظائف الكبد و بعض الاملاح المعدنية (الحديد، الصوديوم، والبوتاسيوم) . تم إعداد أنواع مختلفة من الكيك (الدسم والاسفنجي) بنسب (5، 10، 15 %) من الدوم المطحون. اجريت تقييمات حسية و موضوعية على الكيك المدعم . أشارت النتائج ان الدوم المطحون مرتفع في محتواه من الالياف والكالسيوم والبوتاسيوم ، وهناك انخفاض معنوي ذات دلالة إحصائية في مستوى الكوليسترول، و الجلسريدات الثلاثية والليبوبروتينات منخفضة الكثافة جدا و معدل التصلب في كل من المجموعتين اللتين غذيتا على 10 و 15% دوم مطحون وإنخفاض معنوي ذات دلالة إحصائية في مستوى الصوديوم في المجموعة التى غذيت على 15% دوم مطحون وارتفاع معنوي في مستوى البوتاسيوم في هذه المجموعة ايضاً. هناك ارتفاع معنوي ذات دلالة إحصائية في الارتفاع، والحجم ،والحجم بالنسبة للإرتفاع في الكيك الدسم المدعم بنسبة 15%مقارنة بالعينة الضابطة. أشارت نتائج التقييم الحسي الى ان هناك انخفاض معنوي في الطعم و الرائحة في كل من الكيك الدسم والاسفنجي المدعم بنسب المطحون (10و15%) من الدوم المطحون . نستخلص من الدراسة إلى أن الدوم المطحون بنسبة 15% من أعطى افضل النتائج في انخفاض مستوى الدهون في الدم ، العينات المدعمة بنسبة 5% من الدوم المطحون في كل من الكيك الدسم و الاسفنجي أظهرت أفضل النتائج من حيث خصائص جودة الكيك. لذا يجب إضافة محسنات النكهة لتحسين خصائص الكيك في النسب المرتفعة من الدوم .