POTENTIAL UTILIZATION AND HEALTHY EFFECTS OF *DOUM* PALM FRUITS IN ICE CREAM AND SESAME BUTTER (*TEHENA*)

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ABSTRACT

Potential utilization of *Doum* palm fruit (*Hyphaene thebaica mart*.)in its powder form was applied in some food products as a source of fiber, stabilizer and minerals as well as for its potential healthy effect. *Doum* powder was fractionated and the fraction of 0.1mm that containing hemi cellulose (12.88%), cellulose (21.37%) and lignin (1.08%), was added at levels of 1, 3, 5 and 7% in ice cream mix. Another *Doum* powder fraction (0.25 mm) containing hemi cellulose (15.60%), cellulose (14.75%) and lignin (5.95%) was used at levels of 5,10,15 and 20% in the production of sesame butter, which is commonly used in some Middle East countries as appetizing and known as *Tehena*. Changes in specific gravity, freezing point, weight of gallon, titratable acidity, protein stability of ice cream mixes as well as the overrun, melting resistance and sensory evaluation of the produced ice cream were investigated. The results confirmed the presence of a proportional relation between the added quantities of *Doum* powder and the apparent viscosity of both the produced ice cream mixes and the prepared *Tehena*. Ice cream sample containing 3% *Doum* powder was organoleptically superior followed by that of 5 % *Doum* powder. It seems evident that *Tehena* manufactured from 5 and 10% *Doum* powder (0.25mm) was acceptable and having good nutritional value for its mineral content and fiber. A preliminary experiment indicated a noticeable decrement of systolic blood pressure with values ranged between 5 and 10mmHg, after consumption of ice cream containing different levels (1-7%) of *Doum* powder (0.1mm). On the other hand, more reduction in diastolic blood pressure was observed (1.6-5.0mmHg) for the sample of people under study (age 30 to 60 years). Subsequently, utilizing *Doum* palm powder as a potential source for dietary fiber and minerals in both ice cream and *Tehena* can be achieved successfully beside its expected efficiency in reducing the risk of hypertension.

Keywords : Doum palm fruit, ice cream, sesame butter, hypertension, fiber.

INTRODUCTION

Hyphaene thebaica mart. is one of the members of family *Palmae*. It is common in Egypt, West India, several parts of Africa and known in Arabic language as *Doum* palm or gingerbread palm because the plant has the taste and the consistency of gingerbread (Bonde *et al.*, 1990). In Egypt, the *Doum* palm has been cultivated since ancient times and has long been considered as a sacred tree, symbolizing masculine strength. It was also planted in belief of Pharaohs that it protected and supplied the person with shade, water and food after death. The outer layer of the fruit is edible and can be prepared either in sliced or in a powder form, which is further dried then added to food as a flavouring agent. In Turkey and Kenya, the powder prepared from the outer covering of the fruit is added to water, milk and left to stand to make a mild alcoholic drink. In other countries, the terminal meristem is tapped for making palm wine. Roots are used in the treatment of Bilharzia, while fruit pulp is chewed to control hypertension.

Some people in Egypt use *Doum* as a medicinal plant for the treatment of several diseases and hypertension. The *Doum* palm is among the more important plant families that supplies human with dietary fibers, carbohydrates and antihypertension substances. The phytochemicals, called lignans, having apparent anticarcinogenic action in animals as mentioned by Carter (1993). Dietary fiber is defined as the remnants of vegetable cell walls, which are not hydrolyzed, by alimentary enzymes. A lower dietary fiber intake is reported to be associated with several disorders of the human body including diverticular disease and cancer colon, constipation, ischemic heart disease, diabetes and other diseases of the gastrointestinal tract (Cummings & Englyst, 1991).

Sesame seeds are rich in edible oil, protein, dietary fiber, unsaturated fatty acids, and very efficient oil-soluble antioxidants. In addition, it is devoid of most antinutritive agents that are usually associated with other seed proteins, (Rosenthal *et al.*, 2001). Sesame butter is the main ingredient for preparing an appetizing salad dish commonly used with either animal or vegetable protein foods as well as in manufacturing a well-known traditional item called *Tehena* in Arabic. Therefore, the present investigation was initiated to study the possibilities of utilizing *Doum* palm fruit powder as a potential source for dietary fiber, stabilizing agent and treatment of hypertension as well as, partially replacing the more expensive ingredients that used in the formula of ice cream and sesame seed which used in manufacturing of butter known as *Tehena*.

MATERIALS AND METHODS

Materials

Raw buffalo's milk was obtained from the herd of the Faculty of Agriculture, Ain Shams University and used as one of the main ingredients for the ice cream mixes. The *Doum* palm fruit (*Hyphaene thebaica mart.*) in a crushed form and sesame seeds were obtained from local market. Skim milk powder (SMP) made in USA was obtained from Misr for Milk and Food Co., Cairo, Egypt. Commercial grade cane sugar was purchased from Sugar and Integrated Industries Company, Giza, Cairo. Carboxymethyl cellulose (CMC/ Sigma) was used as a stabilizer. Vanilla (local market) was used to flavour the produced ice cream.

Methods

Technological methods

Preparation of Doum powder: The *Doum* palm (*Hyphaene thebaica mart.*) samples were prepared in a powder form by cleaning and milling in a blender laboratory mill type (Broun, Germany).

Preparation of Ice cream: The control of ice cream mix was standardized to contain 6% fat, 12% solids not fat (SNF), 15% sugar, 0.15% CMC and 0.01%vanilla powder. The *Doum* powder (0.1mm) was used at levels of 1, 3, 5 and 7 % in the mixes. Mixes were heat treated at 80±1°C to about 30 sec., then rapidly cooled to 5±1°C and aged at the same temperature for 4 hr. After ageing, vanilla was added and the mixes were frozen in horizontal batch freezer (Taylor Co. USA). The frozen ice cream was drawn in plastic cups (100 ml) and hardened at -26°C for 24 hr. before analysis. All the four treatments were prepared in triplicates.

Preparation of Tehena: *Tehena* was prepared by milling of dehulled roasted white sesame seeds as described by Rosenthal *et al.* (2001). The *Doum* palm powder of 0.25 mm was used to replace sesame seeds by different levels (5, 10 15 and 20%) and hom-ogenized for 5 min at 30,000 rpm in VIRTIS 23 Homogenizer. *Tehena* samples were packaged in glasses, and stored at room temperature for further analysis and sensory evaluation.

Analytical Methods

Chemical composition: The gross chemical composition including moisture, fat, protein, crude fiber and ash were analyzed according to A.O.A.C. (1995). Minerals and heavy metals of the *Doum* samples (Fe, Cu, Mn, Se, Ca, P and K) were determined using the Atomic Absorption, (Spectrophotometer IL 157) according to A.O.A.C. (1995). Total carbohydrates were determined using the phenolsluphuric acid method as described by Dubois *et al.* (1956).

Microbial analysis: Total count of mesophilic aerobic bacteria and total fungi were performed according to APHA (1992). Aflatoxins were identified by TLC according to Maia & Bastos de Siqueira (2002). Ochratoxin "A" was detected according to the method of Beretta *et al.* (2002). And Zearalenone by the method described by Park *et al.* (2002).

Particle size distribution and water activity: A 100g *Doum* sample was placed on the top of a graded set of sieves of 0.5, 0.315, 0.25 and 0.1 mm. The stak of sieves with the attached collecting pan were mechanically shaken by vibrator (Veb MIW laboratechnik II. Menau MIW, Germany) until the weight of the material on the smallest screen (0.1mm) had reached equilibrium. When sieving was completed, the residual material on each sieve was weighed (Phillips *et al.*, 1988). The water activity "a_w" of the *Doum* powder samples was measured using Rotronic Hygroskop DT, as mentioned by Cadden, (1988).

Fiber fractionations: Hemicellulose, cellulose and lignin were fractionated according to the method of Roberton & Van Soest (1991).

Physiochemical properties of ice cream: Titratable acidity of mixes was determined according to Richardson (1986). Protein stability was estimated as mentioned by Kramer & Twigg (1973). Specific gravity was determined at 20°C using pycnometer as described by Winton (1985). Melting resistance of the resultant ice cream was examined at different levels (1, 3, 5 and 7%) of *Doum* powder (0.1mm) according to Bolliger *et al.* (2000). The overrun in the produced ice cream was examined according to Sommer (1951). The freezing point was tested for the mixes as in FAO (1977). The pH value was measured using a laboratory pH meter (HI 93 1400).

Rheological properties: Rheological properties of the investigated ice cream and *Tehena* samples were performed at 20°C by using Rotary Viscometer (Rheotest II, Medingen, Germany). The applied rheological measurements were based on the shear rates ranging from 3 to 1312 sec^{-1} for ice cream and 0.1 to 43.74 sec^{-1} for *Tehena* samples as described by Rosenthal *et al.* (2001). The Newtonian behavior index (n) and consistency coefficient (k) were calculated as given by Dail & Steffe (1990).

Hypertension measurements (Preliminary experiment): Hypertension measurements of selected individuals consumed the tested ice cream samples with different levels of *Doum* palm fruit 1, 3, 5 and 7% were measured at intervals of 0.5, 1.0 and 3.0 hr after eating 100 ml ice cream. The test was based on using wrist blood pressure monitor (OMRON HEALTHCARE EUROPE B.V VERSION EU/RX.M 1.0/6), which confirmed automatic measurement of blood pressure and pulse of the wrist. The developed measurements were considered for different age ranging from 30 to 60 years. With such a view in mind, 30 individual of the staff members of the Food Sci. Dept. Fac. of Agric. Ain Shams Univ.; 10 from each age were put forward to check their blood pressure after consuming ice cream containing different levels of *Doum* powder as previously mentioned.

Sensory evaluation: Evaluation of the acceptability of the ice cream and *Tehena* samples in terms of colour, odour, taste, consistency and mouth feel were carried out using 10-point numerical scale. In such a case, the higher score values indicate greater preference. The ice cream with the different *Doum* powder levels after 24 hr hardening at -26°C were judged by 10 panelists as suggested by Arbuckle (1986). Furthermore, sensory evaluations of the investigated *Tehena* samples replaced with different levels of *Doum* were evaluated according to Rosenthal *et al.* (2001).

Statistical analysis

Statistical computer program (SAS 1996) was applied. Correlation coefficient was also performed using the same program.

RESULTS AND DISCUSSION

Chemical composition: Chemical composition of the *Doum* palm (*Hyphaene thebaica mart.*) is shown in Table (1). It was clear that samples contain high level of carbohydrate being (67.64%), crude fiber (13.67%) and 6.10% of ash. On the other hand, the same sample had low concentration of fat and protein being 0.39 and 2.90%, respectively. The samples of *Doum* palm under investigation were characterized by a reasonable quantity of heavy metals; and Fe came in the first order with a concentration of 23.25 ppm. The samples contain also high levels of minerals with potassium being the highest concentration; (1950 mg/100 g sample). These results are in agreement with Bonde *et al.* (1990).

Microbial Analysis: Experiments were considered to shade a light upon the microbial content of the investigated *Doum* samples as shown in Table (1). The total counts were found to be 1.6×10^3 whereas the total fungus was 4×10^3. Aflatoxin, ochratoxin and zearalenon were completely absent in *Doum* powder. These results could be attributed to the lowest water activity of *Doum* powder (0.424). Cauvain & Young, (2000), reported that yeasts and moulds can not grow below a_w 0.60 a subsequently, the reduced a_w is important in combination with other factors to prevent out growth of spores.

Particle size distribution and fiber fractionation: Table (2) shows the trend of particle size distribution and fiber fractionation of the *Doum* samples. These results proved that the *Doum* fractions collected over the 0.50 and

Table 1: Specified parameters of the whole *Doum* samples under investigation.

(A) Major Chemical Constituents (g/100g sample)

Moisture	Protein	Carbohydrates	Ash	Crude Fiber	Fat
9.30	2.90	67.64	6.10	13.67	0.39

(B) Heavy Metals and Minerals

Heavy Metals				Minerals (mg)		
Fe (ppm)	Cu (ppm)	Mn (ppm)	Se (ppp)	Ca	P	K
23.25	9.00	10.80	4.90	330	175	1950

(C) Microbiological measurements and Mycotoxin detection

Microbiological measurement		Mycotoxin detection		
Standard plate count bacteria	Total fungi	Aflatoxin	Ochratoxin	Zearalenone
$1.6x10^3$	$4x10^3$	Nil	Nil	Nil

0.10mm sieves being the highest fractions (33.71, 34.99 g, respectively) comparing with 9.48 g, that related to the fraction collected over 0.25 mm sieve which representing 9.62%, whereas 20.70% of the particles were collected by using a sieve of 0.315 mm with a corresponding a_w 0.441.

Table 2: Particle size distribution, water activity and fiber fractionation of the tested *Doum* powder

Mesh (mm)	Particle size		Water activity (a_w)
	Weight (g)	%	
0.500	33.71	34.19	0.426
0.315	20.41	20.70	0.441
0.250	9.48	9.62	0.422
0.100	34.99	35.49	0.408

Fiber fractionation (%)			
	Hemi cellulose	Cellulose	Lignin
0.50	9.83	13.64	11.81
0.315	12.73	18.00	7.69
0.25	15.60	14.75	5.95
0.10	12.88	21.37	1.08

These results are in agreement with Mattern (1991) who proved that during milling and reduction, almost all the embryo, and most of the scutellum that localized in coarse stocks, were flattened.

Fiber fractionation of particle size of the tested *Doum* powder namely 0.50, 0.315, 0.25 and 0.10 mm, are given in Table (2). From the obtained data, fraction 0.10 mm was characterized by a higher cellulose content (21.37%) and the lowest value of lignin (1.08%), however, fraction 0.25 mm was found to contain high level of hemicellulose (15.60%) and fraction 0.50 mm was characterized by high level of lignin (11.81%) than other fractions.

Physiochemical properties of ice cream mixes and the resultant ice cream: Table (3) shows some properties of ice cream mixes containing different levels of *Doum* powder from which the pH values realize proportion relation with *Doum* palm ratio in the ice cream mix. The pH values showed a slight decrease as a result of increasing the percentage of *Doum* level, a pattern which was associated with the high acidity of *Doum* palm. For the same reason, the protein stability in the mix showed also slight differences. The protein stability indicated a reversible trend with *Doum* powder ratio in the ice cream mixes. These results are in agreement with those mentioned by Azzam (1992). Specific gravity and weight (gallon) of ice cream mixes were improved by addition of *Doum* powder. On the other hand, freezing point of all mixes at the substitution level was found to increase.

Table 3: Physiochemical properties of ice cream mixes and the resultant ice cream containing different levels of *Doum* powder (0.1 mm)

Tested properties	Ice cream mixes				
	Treatments (*Doum* level %)				
	Control	1	3	5	7
pH Value	6.5	6.5	6.3	6.2	6.2
Protein Stability*	8	7	6	6	6
Specific gravity	1.098	1.061	1.110	1.120	1. 139
Weigh of gallon (lb)	9.190	8.880	9.290	9.374	9.533
Freezing point °C	-2.11	-2.10	-1.88	-1.80	-1.78
Titratable acidity %	0.20	0.20	0.22	0.23	0.23
	Resultant ice cream				
	Control	1	3	5	7
Specific gravity	0.910	0.892	0.942	0.953	0.981
Weigh of gallon (lb)	7.593	7.442	7.860	7.951	8.185
Overrun%	40.75	35.97	32.63	22.82	14.83
Melting resistance Loss % at 30 °C					
After 30 min.	10.5	12	13	10	7.5
After 45 min.	32	35	34	30	28
After 60 min	56	52	52	56	63

*Milliliters of ethanol (95 %) was necessary to form a slight turbidity.

The control sample of ice cream had the highest-overrun (40.75%). Table (3) indicates that the overrun of ice cream containing different levels of *Doum* powder decreased with further addition of *Doum* powder. The reduction in the overrun of ice cream containing *Doum* powder may be due to its effect on elevating viscosity. However, the addition of *Doum* powder increased slightly the specific gravity and weight of gallon (lb) of ice cream. These results are in agreement with Mahran *et al.*, (1984) who stated that the specific gravity of ice cream is inversely related to changes in the overrun. This may be due to the specific gravity depends on the formula components as well as mix ability to hold the air bubbles and overrun percent in the resultant ice cream. Melting resistance of ice cream was expressed as the loss in weight percent of the initial weight of the tested samples. The melting resistance of ice cream showed a positive proportional with the added quantity of *Doum* powder in ice cream that subsequently caused soggy body and low overrun. Sogginess is contributes to high melting resistance (Arbukle, 1986).

Apparent viscosities: Apparent viscosity of ice cream samples containing 1, 3, 5 and 7 % *Doum* powder (0.1 mm) is illustrated in Table (4) and Fig (1). The apparent viscosity for the control and 1% *Doum* ice cream samples was found to be similar at any shear rate from 3 to 1312 S^{-1}. For instance, at shear rates 729.0 S^{-1} the apparent viscosity was 28.89 and 28.49 cp, respectively. However, in case of using 3, 5, 7 % *Doum* powder in the tested ice cream the recorded apparent viscosity was found to be 80.70, 84.5 and 107.50 cp, respectively at the same shear rate. Such an increment trend may be due to the addition of different levels of *Doum* palm to the ice cream mix that can be attributed to the higher content of fiber and protein, which are characterized by its high water hydration capacity (Vani & Zayas, 1995).

Tehena samples are of non-Newtonian fluid; a pattern which was confirmed when apparent viscosity (cp) is figured against shear rate (S^{-1}) for both the control and the samples prepared by replacement with different levels of *Doum* powder as seen in Fig (2). The obtained values of viscosity indicated the presence of a noticeable variation between the control and *Tehena* samples at any given shear rate. For instance; of shear rate 0.1 S^{-1} the apparent viscosity was 30100.0 cp for the control *Tehena* and 60200.0 cp for all the

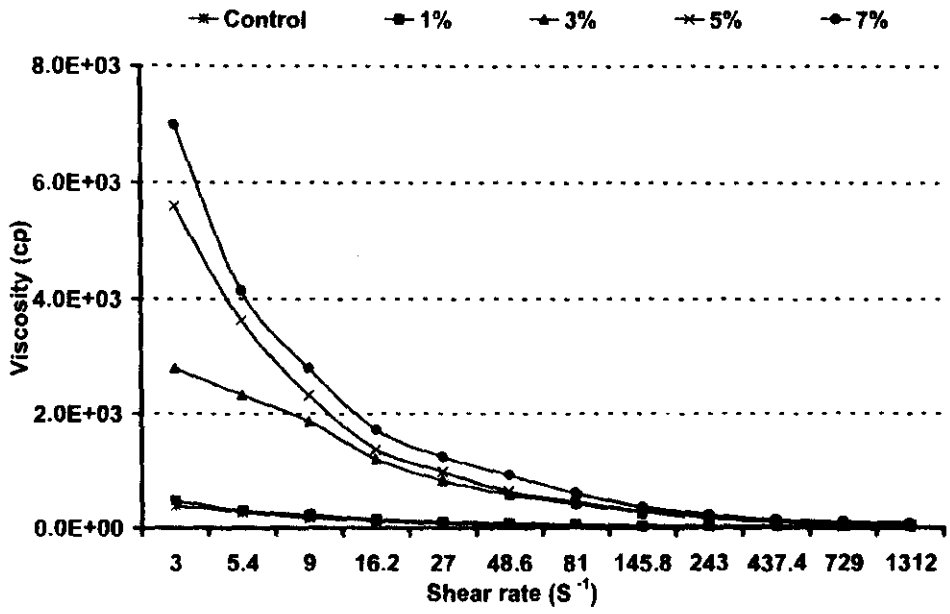
other *Tehena* samples prepared with different levels of *Doum* powder (Table 5). The available data also proved that replacement *Tehena* samples with *Doum* powder had a higher apparent viscosity than the control sample. At shear rate 24.3 S^{-1}, that recorded for the control *Tehena* sample; apparent viscosity was 5202.5 cp, However increasing of *Doum* levels from 5,10,15,20 % in *Tehena* samples, the corresponding viscosities were 7432.1, 7927.6, 8423.0 and 9661.7cp, respectively. The increase of the apparent viscosity could be attributed to the fiber content in *Doum*, which caused a higher molecular mass than control sample (Bonde *et al.*, 1990).

Table 4: Apparent viscosity of ice cream mixes made from different levels of *Doum* powder

Shear rate	Apparent Viscosity (cp)				
(S^{-1})	Control	1%	3%	5%	7%
3.00	384.72	480.83	2800.0	5600.0	7000.0
5.40	267.21	293.84	2333.3	3629.6	4148.1
9.00	176.30	224.39	1866.7	2333.3	2800.0
16.20	115.80	151.37	1209.9	1382.7	1728.4
27.00	85.48	106.85	829.6	985.2	1244.4
48.60	59.36	71.23	576.1	633.7	921.8
81.00	46.30	53.43	414.8	449.4	604.9
145.8	37.60	39.57	268.9	288.1	364.9
243.0	34.43	35.62	184.4	190.1	230.5
437.4	31.00	31.66	115.2	115.2	140.8
729.0	28.89	28.49	80.7	84.5	107.5
1312.0	26.83	26.83	55.5	64.0	81.1

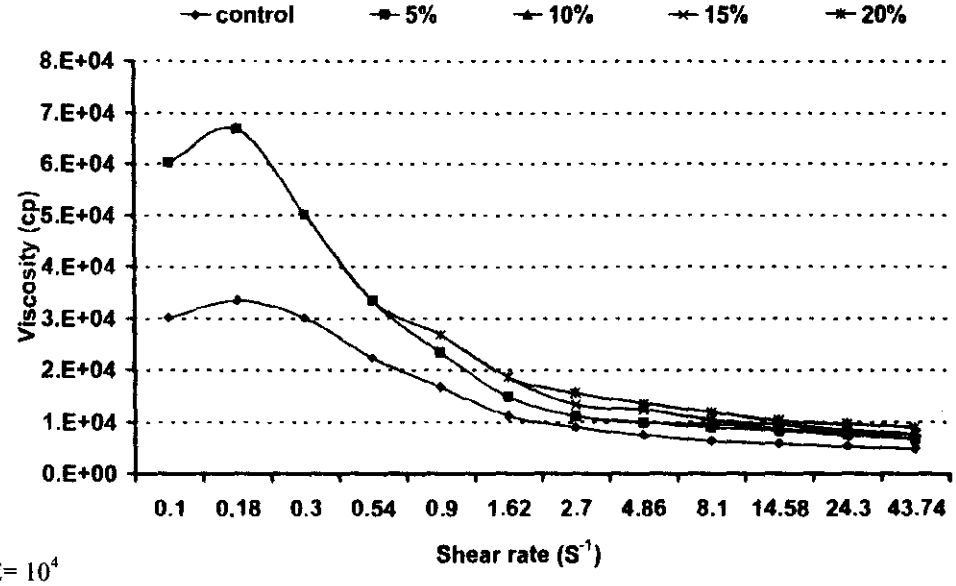
Table 5: Apparent viscosity of *Tehena* made with replacement of different levels of *Doum* powder

Shear rate	Apparent Viscosity (cp)				
(S^{-1})	Control	5%	10%	15%	20%
0.10	30100.0	60200.0	60200.0	60200.0	60200.0
0.18	33444.4	66888.9	66888.9	66888.9	66888.9
0.30	30100.0	50166.7	50166.7	50166.7	50166.7
0.54	22296.3	33444.4	33444.4	33444.4	33444.4
0.90	16722.2	23411.1	23411.1	26755.6	26755.6
1.62	11148.1	14864.2	14864.2	18580.2	18580.2
2.70	8918.5	11148.1	11148.1	13377.8	15607.4
4.86	7432.1	9909.5	9909.5	12386.8	13625.5
8.10	6317.3	8918.5	9661.7	10404.9	11891.4
14.58	5780.5	8257.9	8670.8	9496.6	10322.3
24.30	5202.5	7432.1	7927.6	8423.0	9661.7
43.74	4817.1	6606.3	6881.6	7707.4	8946.0



* E = 10^3

Fig 1: Apparent viscosity of ice cream mixes made with different levels of *Doum* powder



* E= 10^4

Fig 2: Apparent viscosity of *Tehena* made with replacement of different levels of *Doum* powder

Flow behavior constants: The flow behaviour index (n) is considered to be a characteristic constant used to differentiate between Newtonian and non –Newtonian foods. The calculated parameters (n) and (k) for ice cream and *Tehena* samples with different *Doum* levels are summarized in Table (6). The correlation coefficient (R^2) for the regression analysis in terms of log shear stress against log shear rate was ≤0.9521 in all the ice cream and ≤0.9633 in all *Tehena* samples indicating a strong correlation of the tested parameter. However, the following observation could be concluded from the data given in Table (6). The flow behavior index (n) of ice cream and all *Tehena* samples were less than 1.0 giving a value ranged from 0.2497 to 0.6390; a pattern which indicates their strong non-Newtonian pseudoplastic behavior. The calculated consistency coefficient (k) for control *Tehena* was 155.05 whereas at 5,10,15 and 20% levels of *Doum* powder *Tehena* samples had high (k) values being 241.25, 243.98, 263,64 and 274.78, respectively. A

Table 6: Flow behavior constant (k) and (n) of the investigated ice cream mixes and *Tehena* containing different levels of *Doum* powder

Doum level%	Ice cream			*Doum* level%	*Tehena*		
	n	K	R^2		n	K	R^2
Control	0.5535	4.480	0.9521	Control	0.6352	155.05	0.9845
1	0.5108	6.040	0.9533	5	0.5795	241.25	0.9643
3	0.3156	75.81	0.9665	10	0.5907	243.98	0.9633
5	0.2497	120.63	0.9832	15	0.6100	263.64	0.9806
7	0.2563	148.08	0.9754	20	0.6390	274.78	0.9837

noticeable increasing in consistency coefficient (k) occurred in sample of ice cream with 1% *Doum* (6.04) which is higher than that of the control ice cream sample (4.48). With respect to the ice cream samples containing 3, 5 and 7% *Doum*, they showed high consistency coefficient (k); (75.81, 120.63 and 148.08, respectively). These results are in accordance with data reported by Ibrahim *et al.*, (1992).

Hypertension measurement: It is well understood that hypertension is one of a serious disorder in human beings and if it is not effectively treated the probability of strokes and heart can be expected. On the other hand, most of the people who consumed *Doum* are approximately free from facing hypertension; a remark that noticed by the people of Luxor and Aswan. They also considered *Doum* as one of the best foodstuffs that contain other ingredients such as dietary fiber and nutrient minerals. From such a point of view and with the scattering of *Doum* drink that mixed with milk, the problem at hand is considered in brief the capability of *Doum* in lowering the hypertension.

Table (7) shows the effect of ice cream containing different levels of *Doum*-powder 1, 3, 5 and 7 % having a dimension of (0.1 mm) on blood pressure values (Systolic/Diastolic) in terms of mmHg. The available data indicated stepwise decrement of both systolic and diastolic blood pressure after consumption of ice cream containing any given levels of *Doum* palm powder. A high level of *Doum* palm (5 and 7%) is more effective as antihypertension for these under 40 years of age since systolic blood pressure was lowered by a value of 8.0 mmHg after 30 min. The data in the same table also showed that *Doum* powder added in ice cream lowered diastolic blood pressure in mildly hypertensive adult aged 30-40 years. The decrease of systolic blood pressure of the group aged 30-40 years of consuming ice cream containing *Doum* powder (0.1mm) 1, 3, 5 and 7 % was 5.5, 6.5, 8.0 and 10 mmHg, respectively. On the other hand, the net reduction of diastolic blood pressure after 3 hr dropped from 3.0mmHg to 1.1 mmHg by those aged 40-50 years, respectively.

In normotensive 30-40 years, it was noticed that when 1 % *Doum* powder was applied in preparing ice cream, the combined systolic and diastolic blood pressure dropped by 1.7 and 0.4 mmHg after 3 hr, respectively. But diastolic blood pressure of the group aged 50-60 years were reduced by 1.6, 3.0, and 3.5, 5.0 mmHg, respectively after 30 min.

Compared to people with normal blood pressure (30-40 years) of utilizing *Doum* powder of 0.1mm those with high blood pressure (Table 7) at 3 hour, the reduced of systolic and diastolic blood pressure of hypertinsive people was greater than that of the normotensive. And the reduction in blood pressure seems to be less in case of ice cream with 5 and 7% *Doum* powder. This may be due to the higher levels of fiber, calcium and potassium in the *Doum* powder. It is of worth to refer to the opinion of Miller *et al.* (1994) who proved that a high calcium intake lowers sodium chlorid induced blood pressure or attenuates the development of hypertension in the consumer. The preliminary results confirmed the previous trend but to be under ser-ious consideration further experiments are required to be carried over at least 500 candidate and the results should be statistically analyzed.

Table 7: The effect of ice cream containing different levels of *Doum* powder on blood pressure reduction (Systolic / Diastolic) of different ages

Doum level%	Blood pressure reduction mmHg Systolic / Diastolic (hr.)		
	½	1	3
	(30-40 years) average 120/80 mmHg blood pressure		
1	5.5/3.5	6.5/2.5	1.7/0.4
3	6.5/3.4	4.5/3.0	3.0/1.4
5	8.0/4.0	5.5/3.0	3.0/1.4
7	10.0/5.0	9.8/5.0	5.7/2.5
	(40-50 years) average 140/90 mmHg blood pressure		
1	5.0/3.0	5.4/3.0	6.7/1.1
3	5.7/5.7	5.7/5.0	5.4/2.5
5	8.5/6.4	8.5/5.7	7.5/7.4
7	8.7/7.3	8.7/6.8	7.7/7.5
	(50-60 years) average 160/93 mmHg blood pressure		
1	4.0/1.6	4.0/1.6	3.1/1.6
3	5.5/3.0	5.5/3.0	5.5/3.0
5	8.0/3.5	8.0/3.3	5.5/3.5
7	8.1/5.0	8.0/5.0	7.7/4.5

Sensory evaluation: A regular scoring panel of 10 persons, including the staff member of Food Science. Dept. Ain Shams Univ. scored ice cream samples as given in Table (8). Treatments namely 1,3,5 and 7 % *Doum* powder (0.1mm) proved that no significant difference was found between control and ice cream with 1.0% *Doum* powder. Ice cream prepared in the presence of 3 % *Doum* powder (0.1mm) was characterized by creamy colour, acceptable flavour and described with soft body & texture with good nutritional value of fiber and higher scores of sensory parameters. On the other hand, degree of significance was more pronounced in the ice cream samples with 5% and 7% *Doum* powder.

Table 8: One way ANOVA of Ice cream and *Tehena* samples prepared by replacement with different levels of *Doum* powder

(Ice cream)

```
Analysis of Variance
Source      DF        SS        MS        F        P
Factor       4    10.378     2.594    22.52    0.000
Error       20     2.304     0.115
Total       24    12.682

                                        Individual 95% CIs For Mean
                                        Based on Pooled StDev
Level        N      Mean     StDev  -----+---------+---------+---------+-
Control      5    8.5800    0.5404                        (----*---)
1% Doum      5    8.6000    0.2449                        (----*---)
3% Doum      5    8.7000    0.1581                          (---*----)
5% Doum      5    7.8200    0.4025              (----*---)
7% Doum      5    7.0200    0.1924   (---*----)
                                     -----+---------+---------+---------+-
Pooled StDev =    0.3394               7.00      7.70      8.40      9.10
```

(*Tehena*)

```
Analysis of Variance
Source      DF        SS        MS        F        P
Factor       4   19.7487    4.9372    67.88    0.000
Error       25    1.8183    0.0727
Total       29   21.5670

                                        Individual 95% CIs For Mean
                                        Based on Pooled StDev
Level        N      Mean     StDev  --------+---------+---------+--------
CONTROL      6    9.4667    0.1966                                   (--*--)
5% Doum      6    9.3333    0.2338                                 (--*---)
10% Doum     6    8.9167    0.3312                          (--*---)
15% Doum     6    7.9500    0.2345              (---*--)
20% Doum     6    7.3833    0.3251   (--*---)
                                     --------+---------+---------+--------
Pooled StDev = 0.2697                 7.70      8.40      9.10
```

On the other hand, the investigated *Tehena* prepared by replacement sesame seeds with different levels of *Doum* powder of 0.25mm realized (to be eaten) a reasonable acceptability from the view points of colour, odour, taste, consistency and mouth feel. Analysis of variance of the *Tehena* manufactured with *Doum* powder at levels 5, 10, 15 and 20 % are given in Table (6). The results obtained proved that no significant difference between control (*Tehena* without *Doum*) and *Tehina* with 5% *Doum*. But *Tehina* with 10 % *Doum* was slightly different from control samples. On the other hand, degree of significance was more pronounced in the *Tehina* with 15 and 20 % *Doum* powder. From the available data, it seems evident that *Tehina* containing 5 and 10% *Doum* powder of 0.25mm were acceptable with nutritional value, their contents of fiber could be recommended. Such a trend was based on the highest scores of sensory parameters given by the panelists and statistical analysis in terms of degree of significance confirming such a conclusion.

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امكانية ألاستفادة من الخواص الوظيفية والصحية لثمار نخيل الدوم فى انتاج المثلوجات اللبنية والطحينة

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يهدف هذا البحث إلى دراسة إضافة ثمار نخيل الدوم المطحونة حيث تحتوى على (١٣,٦٧% ألياف خام، ٦٧,٦٤% كربوهيدرات، ٢,٩ % بروتين، ٦,١% رماد) لتدعيم كل من الأيس كريم والطحينة لاستبدال جزء من مكوناتهما بمكونات الدوم ذات التأثير الوظيفي الغروي المثبت للقوام والتأثير الصحي الذى قد يفيد في خفض ضغط الدم وتحسين عمل الجهاز الهضمي. وعلى هذا الأساس أستخدم الدوم في الأيس كريم بنسب ١%، ٣%، ٥%، ٧% (١,٠ مم) وكذلك تم استخدام الدوم بنسب ٥%، ١٠%، ١٥%، ٢٠ % (٠,٢٥ مم) من وزن السمسم في صناعة الطحينة وتم دراسة الخواص الريولوجية بالإضافة الى التقييم الحسي.

وقد أظهرت النتا ئج أن إضافة الدوم في صناعة الأيس كريم أدت إلى زيادة في الحموضة ونقطة التجمد ونقص في الثبات البروتينى للمخلوط. كما أظهرت النتائج أنة بزيادة نسبة الدوم في مخاليط المثلوجات اللبنية أرتفع كل من الوزن النوعي و وزن الجالون من الأ يس كريم المنتج . كما أدى استخدام الدوم بنسب ١%, ٣%, ٥%, ٧% إلى زيادة نسبة الألياف في الأيس كريم ومن ثم رفع قيمته التغذوية. .كما أن استخدام الدوم بنفس النسب السابقة قد أدى إلى تدعيم مخلوط الأيس كريم بالعناصر المعدنية مما ساعد على خفض ضغط الدم. أما بالنسبة للمثلوجات اللبنية الناتجة (الأيس كريم) فقد أظهرت انخفاضا في نسبة الربع كما أظهرت مقاومة عالية للانصهار بزيادة نسبة الدوم المضاف . وكانت درجات التقييم الحسى للأيس كريم المنتج من المخاليط المحتوية على ٣% دوم أعلى مايمكن يليها المحتوية على ٥% أما تلك التي استخدم بها ٧% فقد حصلت على أقل الدرجات من حيث القوام والتركيب مقارنة بالكنترول. وعند تقدير الخواص الريولوجية لكل من الأيس كريم والطحينة أظهرت النتائج أن زيادة نسبة الدوم المضافة إلى كل من العينات السابقة قد أدت إلى زيادة اللزوجة الظاهرية ومعامل القوام.

كما أظهرت النتائج أن الطحينة المصنعة من استبدال ١٠،٥% دوم من وزن السمسم أدت إلى تدعيم المنتج بالألياف والعناصر المعدنية والحصول على منتج مرتفع في القيمة الغذائية وذي خواص حسية جيدة. لذلك توصى الدراسة أنة يمكن استخدام الدوم بنسبة ١-٣% فى الأيس كريم وبنسبة ٥-١٠% في صناعة الطحينة حيث يؤدى ذلك إلى الحصول على منتج مرتفع في القيمة التغذوية ومدعم بالألياف الغذائية (السليلوز والهيمى سليلوز وكذلك اللجنيين) والعناصر المعدنية.

ومن الناحية الوظيفية وفى تجربة مبدئية اتضح أن إضافة مسحوق الدوم بأي نسبة مابين (١-٧%) في تصنيع الأيس كريم قد أدى إلى خفض ضغط الدم المنقبض (السيستولك) من ٥-١٠ ملليمتر زئبق بينما أدى إلى خفض ضغط الدم المنبسط (الدياستولك) من ١,٦-٥ ملليمتر زئبق من خلال الاعمار التى تحت الدراسة (٣٠-٦٠ عاما) مع التنويه إلى أن هذه النتائج في حاجة إلى مزيد من الدراسة وتوكيدها إحصائيا.