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The Influence of Gum Arabic as Fat Replacer on Quality Characteristics of Low Fat Cake.

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Abstract: The aim of this study was to produce low calorie cake, by replacing fat with different levels (5, 10, 15 and 20%) of gum arabic. The chemical composition of gum arabic and chemical composition, physical properties, viscosity, PH, color and sensory properties of cakes were evaluated. The results showed that cakes prepared with 0, 5, 10, 15, 20% GA levels had a higher ($p \leq 0.05$) mean scores for appearance, crust color, crumb color, flavor, and overall acceptability as compared those prepared with 25 to 60% GA. Increasing the level of gum arabic resulted a significant decrease in the cakes content of fat and increased the moisture, protein, fiber and ash comparing to control cake. Cakes substituted fat with 15 and 20% of gum arabic had a higher volume, specific volume and viscosity than those prepared with 5 and 10% GA while gum arabic did not significantly affect on the weight and PH of prepared cakes. Moreover, there were significantly ($p \leq 0.05$) increased in the values of A*, B*and C and decreased in H values of crust color by increasing the level of gum arabic in cakes however, L* of crust color did not affected with gum arabic.

Key words: chemical composition, sensory evaluation, PH, physical properties.

Introduction:

As a food component, fat contributes key sensory and physiological benefits. Fat contributes to flavor, or the combined perception of mouth feel, taste, and aroma/odor **(Lucca and tepper, 1994; Mistry, 2001 and Sampaio *et al.*, 2004)**. Fat also contributes to

creaminess, appearance, palatability, texture, and lubricity of foods and increases the feeling of satiety during meals **(Romanchik-Cerpovicz *et al.*, 2002 and Sipahioglu *et al.*, 1999)**. Fat can also carry lipophilic flavor compounds, act as a precursor for flavor development (e.g., by lipolysis or frying) and stabilize flavor **(Romeih *et al.*, 2002 and Tamime *et al.*, 1999)**.

High fat diets are linked to obesity, hypertension, cardiovascular diseases and coronary heart diseases **(Choi *et al*., 2014 and Ozvural and Vural, 2008)**. So fat in foods may be partially or completely replaced by a wide range of products, classified as fat mimetics and fat substitutes. Fat mimetic are materials, usually carbohydrates and/or protein-based, that replace the bulk, body, and mouth feel of fats but do not replace calories on a one-to-one basis **(Finley and Leveille, 1996)**. Fat substitutes are physically similar to fats and oils and can, theoretically, replace fat on a one-to-one weight basis in foods **(Rosenthal, 1998 and Ognean *et al.*, 2006).**

There are a large number of ready to eat snack foods available in the markets worldwide, among which cakes occupy a predominant position as far as consumers' preference is concerned **(Guha, 2007)**. Cake one of high fat and calorie food products, has been extensively studied for fat reduction **(Berglund and Hertsgaard, 1986; Zambrano *et al*., 2004).** Reduction fat content affects cake characteristics, as a result of decreased air cells and also unstabilized air cells **(Akesowan, 2010)**.

Companies and researchers have attempted to minimize the fat and oil content of products like cakes. Most attempts to reduce the fat content of cakes and muffins have focused on their substitution by several carbohydrate fat replacers such as potato maltodextrins, polidextrose or crystalline cellulose **(Kamel and Rasper 1988 and Khalil, 1998),** β-glucan **(Kalinga and Mishra, 2009 and Lee *et al*., 2005) ,** modified corn starch **(Chung *et al*., 2010)**.

Gum Arabic (GA) or *Acacia gum* is a dibble biopolymer obtained as exudates of mature trees of *Acacia Senegal* and *Acacia seyal* which grow principally in the African region of Sahel in Sudan. The exudate is a non-viscous liquid, rich in soluble fibers, and its emanation from the stems and branches usually occurs under stressful conditions

such as draught, poor soil fertility, and injury **(Wiliams and Philliphs, 2000)**.

Gums are also hydro colloids that provide viscosity or thickening and in some cases gel formation. These gums contribute no calories and have potential health benefits as dietary fibers. There are a number of gums available to the food industry **(Dziezak, 1991)**. Some gums can provide a slippery, creamy, lubricacious mouth feel simultaneously that of fats can be used like fat replacers **(Glicksman, 1991)**. In low fat cake and muffin mixes, gum arabic functions as a partial oil replacer as well as peanuts and similar as a moisture binder **(Fennema, 1996).**

In the current study, fat in cake were partially replaced with different levels (0, 5, 10, 15and 20%) of gum arabic as fat replacer. Therefore, The objective of this study was to evaluate the effect of these replacements on the physical properties, chemical composition and sensory properties of cake.

Material And Methods

Materials:

Wheat flour (72% extract), powdered sugar and baking powder were obtained from Shibin El-Kom Milling Company, Shibin El-Kom, Minufiya, Egypt. Margarine (sunflower oil, stearin and palm oil) was obtained from Oil Refining Company, Alexandria, Egypt. Fresh whole egg was obtained from Poultry Farm, Minufiya University, Minufiya, Egypt. Defatted milk was obtained from Dairy Science and Technology Department Minufiya University, Minufiya, Egypt. Gum Arabic obtained from the Harraz company, Cairo, Egypt.

Methods:

Gum Arabic preparation:

Gum arabic was milled then sieved by 60 mesh screen.

Chemical composition of gum arabic and cake:

Moisture, crude protein, crude fat, ash and fiber were determined in gum arabic and cake according to the method of **AOAC (2012)**. Carbohydrate was calculated by difference.

Cake preparation :

cakes were prepared according to the formula of **Khalil (1998)** using the following recipe :28 g wheat flour, 24 g margarine, 24 g sugar,13.55g whole egg , 0.45 g backing powder and 10 g skim milk to prepare the control treatment, the sugar and margarine were creamed for

3 min at speed 5. The whole eggs were added and mixed in at the same speed for 2 min. The flour, backing powder and skim milk were added and the batter was minced for 4 min at speed 6. After scraping down the bowl the batter was mixed for an additional 1 min at speed 6. To prepare the fat replacer treatments, the margarine in the formula was replaced with either 5, 10, 15, 20, 25, 30, 35, 40, 45, 50, 55, 60% (fat weight basis) of gum arabic. The same order of mixing as described for the control was followed. Cakes batters were baked at 180ºC for 45 min.

The best treatments (5, 10, 15 and 20%) of gum arabic as fat replacers based on sensory evaluation as well as the control (0% gum arabic) were used in the current study.

Cake batter PH and viscosity:

The PH of cake were determined by direct immersion of a pH electrode in the batter at room temperature (~25 $^{\circ}$C) using a digital pH meter (Jenway, Model 3020, Dunmow, Essex, UK). Viscosity of the batter (aliquots of batter, 10 g/100 ml distilled water) was determined at 25_C with a viscometer (RV-1, Brookfield Engineering Laboratories, Inc., Stoughton, MA) equipped with spindle number 4 at 12 rpm and glass container. The spindle was allowed to rotate in the aliquot of cake batter for 30 seconds of spindle turns.

Physical characteristics of cake:

Physical characteristic of cake were evaluated according to **AACC (2010)**. The standing height (cm) was measured in the center of the cake . cake volume (cm^3) was measured by rapeseed displacement after cooling the cake for 1h at room temperature (25^0 c) .the cake was weighed (g) after removal from the pan and the specific volume (cm^3/g) was calculated according to the following equation : Specific volume =cake volume /cake weight.

Sensory evaluation

Sensory evaluation of cakes was performed by twenty master students and staff members in the Department of Nutrition and Food science, Faculty of Home Economics, Minufiya University. Panelists were selected on the basis of their interest and availability. Randomly coded Samples were served to the panelists individually. Panelists were supplied with cold tap water for cleansing the palate between samples. Cakes were evaluated for appearance, crust color, crumb color, flavor,

tender and overall acceptability. The scoring of sensory characteristics ranged from 1-10 degrees.

Colour evaluation:

The crust and crumb color of cakes were determined according to the method of **Huffman and Egbert (1990)** using a Lovibond Tintometer (The Tinto meter LTD., Salisburg, England). The readings were further converted into CIE units using visual density graphs and the instruction manual supplied with the apparatus. The L* value features the lightness and ranges from 0 (black) to 100 (white), A* ranges from –100 (redness) to +100 (greenness) and B* ranges from –100 (blueness) to +100 (yellowness)**.** Saturation index (Chroma): $C= (a^{*2} + b^{*2})^{1/2}$, Hue angle: $H= Tan^{-1}(B^*/A^*)$.

Statistical analysis:

Results were expressed as the mean ± SD. Data for multiple variable comparisons were analyzed by one-way analysis of variance (ANOVA). For the comparison of significance between groups, Duncan's test was used as a post hoc test according to the statistical package program (**Armitage and Berry, 1987).**

Results and Discussion:

Table (1) showed the chemical composition of gum Arabic powder. The results indicated that gum arabic contained moisture (11.52), total protein (2), crude fat (0.51), ash (2.6), carbohydrate (2.37) and crude fiber (81). These results are agree with **Hussein (2016)** who reported that the moisture content in gum arabic powder was 10.05%, protein 2.61%, fat 0.32%, ash 2.40% and carbohydrate 83.05%. Also, **Mohammed (2013)** mentioned that the contents of moisture, total protein, crude fat, ash and total soluble fiber of GA collected from Sudan Republic were 11.21, 2.30, 0.13, 2.95 and 83.41%, respectively.

Table (1):Chemical composition of gum arabic powder

Parameter	Moisture (g/100g)	C. Protein (g/100g)	T. Fat (g/100g)	Ash (g/100g)	Carbohydrate (g/100g)	Fiber (g/100g)
Gum Arabic	11.52±1.73	2 ±0.82	0.51±0.9	2.6±0.72	2.37±1.72	81±3.56

Each value in the table is the mean ± standard deviation of three replicates

Results in **Table (2)** revealed the effect of replacing fat content with different levels of gum arabic on sensory traits of cake. Data

showed that appearance and over all acceptability values of control cake were similar (p>0.05) to cake formulated with gum arabic up to 20% concentration. However, levels from 25 to 60% GA of cake prepared with gum arabic were decreased (p≤0.05) in appearance and over all acceptability values with increasing replacement levels. The lowest appearance and overall acceptability values were recorded in cake prepared with 60% GA of which were 3.91±1.23 and 3.45±1.44 respectively. **Hussien, (2016); Wekwete and Navder (2005) and Wekwete and Navder (2008)** found that no significant difference (p>0.05) were observed between control and cake prepared with 25% and 50% replacement levels in overall acceptance of cake prepared with squash and cantaloupe puree while, the 75% and 100% Squash and cantaloupe puree were significantly (p≤0.05) different in overall acceptance. **Seker *et al*., (2010) and Hayek and Ibrahim (2013)** studied producing chocolate chip cookies using apple sauce as a fat (butter) substitute and they reported that butter has limited contribution when it comes to color and appearance of baked products.

The treatment cake with 5, 10 and 15% GA did not differ (p>0.05) in their effects on crust color, crumb color and flavor compared to control cake. However, crust color, crumb color and flavor values of cake prepared with gum arabic at higher replacement levels were decreased with increasing replacement levels from 20 to 60% GA. Same trend was reported by **Hussein *et al*.,(2011)** who found that increasing the level of replacers from 25 to 75% in cake prepared with artichoke resulted in significant (p≤0.05) decreases in all sensory properties(appearance, crust color, crumb color, flavor, texture and overall acceptability) rating scores compared to that of the control. **Khalil (1998)** reported that cakes prepared with 25 and 50% fat replacers(N-Flate, Paselli MD 10 and Litesse) had higher mean scores for flavor, softness and eating quality than that prepared with other levels.

There were no significantly (p>0.05) differences among cake prepared with 5 and 10% of GA in tender and control cake. However, replacement after 10 % of GA tender was decreased (p≤0.05) with increasing replacement levels. Similar trend was reported by **Zoulias *et al*., (2002)** that tenderness of biscuits decreased with the increase of polydextrose and maltodextrins as fat substitution.

From the results in this table, it could be noticed that cakes prepared with 5, 10, 15 and 20% of gum arabic as fatty replacer were given the best sensory properties.

Table (2):Effect of replacing fat content with different levels of gum arabic on sensory traits of cake.

Property / Treatments	Appearance	Crust color	Crumb Color	Flavor	Tender	Overall Acceptability
Control Cake	7.82±1.22^{a}	7.59±1.1^{a}	7.64±1.14^{a}	7.86±1.04^{a}	7.32±0.95^{a}	8.23±0.87^{a}
5% GA	7.68± 0.78^{a}	7.45± 0.86^{a}	7.5± 0.86^{a}	7.77± 1.15^{a}	7.09± 0.61^{a}	8.05± 0.65^{a}
10%GA	7.64±0.9^{a}	7.41±0.59^{a}	7.36±0.58^{a}	7.55±0.8^{a}	7±0.82^{a}	7.95±0.85^{a}
15%GA	7.59±0.96^{a}	7.36±0.85^{a}	7.23±0.92^{a}	7.5±0.67^{a}	6.23±0.97^{b}	7.86±0.89^{a}
20%GA	7.14±0.89^{ab}	6.59± 0.73^{b}	6.5± 0.74^{b}	6.73± 0.7^{b}	5.45± 0.83^{c}	7.41± 0.73^{ab}
25%GA	6.86± 0.94^{b}	6.41±0.67^{bc}	6.32± 0.99^{b}	6.59± 0.8^{b}	5.32± 1.39^{c}	7.05± 0.79^{b}
30%GA	6.55±0.74^{b}	6.18±0.66^{bc}	6.09±0.75^{b}	6.5±0.6^{b}	5.23±0.75^{c}	7±1.11^{b}
35%GA	5.77± 0.75^{c}	5.91± 0.68^{c}	4.91± 1.66^{c}	5.32± 1.43^{c}	3.73± 1.78^{d}	5± 1.66^{c}
40%GA	5.41±1.14^{c}	5.27±0.88^{d}	4.82±1.68^{cd}	4.95±1.46^{cd}	3.36±1.62^{de}	4.82±1.92^{cd}
45%GA	5.18±1.3^{cd}	4.91±0.75^{de}	4.77±1.41^{cd}	4.73±1.52^{cd}	3.14±1.7^{def}	4.68±1.29^{cd}
50%GA	4.68± 1.52^{d}	4.55± 0.86^{e}	4.09±1.57^{de}	4.45± 1.47^{d}	2.95±1.53^{def}	4.05± 1.96^{de}
55%GA	4±1.23^{e}	4±0.98^{f}	3.45±1.34^{e}	4.23±1.48^{d}	2.59±1.26e^{f}	3.68±1.52^{e}
60%GA	3.91±1.23^{e}	3.32±1.04^{g}	3.36±1.14^{e}	3.18±1.68^{e}	2.41±1.37^{f}	3.45±1.44^{e}

Means in the same column with different letters are significantly different ($p \leq 0.05$)
GA: gum Arabic.

Data in **Table (3)** illustrated the effect of replacing fat content with different levels of gum arabic on chemical composition attributes of cake. Cake prepared with gum arabic at 15% and 20% were higher ($p \leq 0.05$) in moisture than those prepared with other levels. However, there were no significantly ($p > 0.05$) differences between cake prepared at 0%GA and those prepared with 5% and 10%GA. This increase in moisture might be due to water retention property of fibers. These results had the same trend by **El-Refai *et al.*, (2011)** who found that the moisture content was increased as maltodextrin replacement level increased. Moreover **Khouryieh *et al.*, (2005)** reported that the high

water-holding capacity of dietary fiber contributed to water retention in formulations and prevented evaporation during baking, resulting in high moisture content.

As for crude protein was increased ($p \leq 0.05$) with increasing replacement levels. The highest value was observed in 20%GA replacement of which was 15.58±0.68. These results had the same trend by **Hussein *et al.*, (2011)** who found that using high level of artichoke as fat replacer in cake resulted significantly ($p \leq 0.05$) increase in protein content compared with low level of artichoke.

Data indicated that total fat was decreased ($p \leq 0.05$) with increasing replacement level. The highest value was observed in cake prepared with gum arabic at 5% GA which was 22.94 ±1.05. The results are in agreement with **Qureshi *et al.*, (2017)** who reported that there was a gradual decrease in fat contents by addition of grape fruit peel fiber (as it replaces the fat) in fruit cake. Also, fat contents decrease from 21.9 to 16.62% in cake prepared with sweet potato flour with different proportions **(Alloush, 2015)**.

It was mentioned that ash and fiber were increased ($p \leq 0.05$) by increasing replacement levels. The highest values were recorded in cake prepared with gum arabic at 20%. Gum arabic is a rich source of fiber so addition to cake increases the level of fiber. These results are similar to those reported by **Qureshi *et al.*, (2017)** who showed that there was a gradual increase in fiber content by adding grape fruit peel powder in cake. There were no significant ($p > 0.05$) differences in total carbohydrates between cake prepared at 0%GA and those prepared with other levels.

Table (3):Effect of replacing fat content with different levels of gum arabic on chemical composition attributes of cake.

Property / Treatments	Moisture (g/100g)	C.Protein (g/100g)	T.Fat (g/100g)	Ash (g/100g)	Carbohydrate (g/100g)	Fiber (g/100g)
Control	20.33±1.29[b]	11.4±0.42[d]	24.48±2.29[a]	0.67±0.28[e]	33.92±3.32[a]	9.2±0.86[e]
5% GA	20.43±2.31[b]	11.42±0.42[d]	22.94±1.05[a]	1.06±0.41[d]	33.99±3.89[a]	10.16±0.58[d]
10% GA	20.56±1.94[b]	12.58±1.39[c]	20.27±1.08[b]	1.46±0.44[c]	34.04±4.29[a]	11.09±0.94[c]
15% GA	22.32±0.97[a]	14.09±1.41[b]	14.58±1.44[c]	1.87±0.23[b]	35.1±4.13[a]	12.04±1.04[b]
20% GA	22.50±1.6[a]	15.58±0.68[a]	11.04±1.83[d]	2.26±0.44[a]	35.61±3.86[a]	13.01±0.98[a]

Means in the same column with different letters are significantly different (p≤0.05)
GA: gumArabic

Results in **Table (4)** showed the effect of replacing fat content with different levels of gum arabic on physical properties, viscosity and PH attributes of cake. Data indicated that cake prepared with gum Arabic at 20% was lower (p≤0.05) in height than those prepared with other levels. Also, there were no significant (p>0.05) differences in height between control cake and cake prepared with different replacements of GA. These results are in agreement with **Sanchez *et al.*, (1995**) who reported that combinations of carbohydrate based fat substitutes (Litesse, N-Flate, Rice*Trin, Stellar, or Trim choice) had minimal effect on cookie height.

Furthermore, it is noticed that there were no significant (p>0.05) differences in weight and PH values between cake prepared at 0%GA and those prepared with other levels. The results are compatible with **Aydogdu *et al.*, (2018)** who showed that no significant difference was found between weight loss of control cake and cakes with oat, pea and apple fibers. **Hussein *et al.*, (2011)** reported that the pH values of cake batters prepared with artichoke were not affected (p>0.05) by the replacement levels

Volume, specific volume and viscosity were significantly (P≤0.05) increased with increasing replacement levels. The highest values were noticed in cake prepared with gum arabic at 15% (187.33, 2.32 and 67.87 respectively) and 20%GA (195, 2.4 and 69.6 respectively). This improvement of volume and height on cake might be due to the increasing levels of gum arabic added to the wheat flour which led to gas retention capacity of dough by forming gum arabic-gluten network, hence, induce the volume and height of loaf. Moreover, **Hussein *et al.*, (2011)** indicated that replacement of fat with 25% puree

artichoke in cake might aid in incorporation large numbers of air cells into the batter, which led to increased viscosity and thereby high stability, leading to higher retention of air bubble in the cake batter. Also, **Turabi *et al.*, (2010)** observed that higher apparent viscosity might help in the entrapment of air into the cake batters and thereby causes significantly higher porosity and volume.

Table (4): Effect of replacing fat content with different levels of gum arabic on physical properties, viscosity and PH attributes of cake

Property / Treatments	Height (cm)	Weight(g)	Volume(cm^3)	Specific volume(cm^3/g)	Viscosity ($CPSx10^4$)	PH
Control	$5.1\pm.22^a$	79.13 ± 6.72^a	151.67 ± 8.5^c	1.92 ± 0.06^c	42.23 ± 2.47^c	7.31 ± 0.03^a
5% GA	5.1 ± 0.19^a	79.87 ± 5.06^a	167.83 ± 14.3^b	2.1 ± 0.05^b	56.37 ± 5.45^b	7.4 ± 0.04^a
10% GA	5.08 ± 0.37^a	80.3 ± 2.58^a	170.33 ± 12.76^b	2.12 ± 0.09^b	57.37 ± 5.74^b	7.55 ± 0.04^a
15% GA	4.93 ± 0.05^{ab}	80.8 ± 6.22^a	187.33 ± 9.81^a	2.32 ± 0.09^a	67.87 ± 6.61^a	7.56 ± 0.18^a
20% GA	4.7 ± 0.14^b	81.23 ± 0.71^a	195 ± 4.08^a	2.4 ± 0.07^a	69.6 ± 8.21^a	7.81 ± 0.66^a

Means in the same column with different letters are significantly different ($p\leq0.05$)
GA: gum Arabic.

Table (5) showed the effect of replacing fat content with different levels of gum arabic on crust color attributes of cake. Results indicated that there were no significant ($P>0.05$) differences in L* value between cake prepared at 0%GA and those prepared with other levels of gum arabic. Color measurement indicated that the fat-reduced crust had higher L* values than the control in Flaky Chinese pastry (Pia) prepared with maltodextrin gel and inulin as fat replacer **(Chysirichote *et al.*, 2011)**.

A*and C of crust colour were significantly increased ($P\leq 0.05$) with increasing gum arabic levels. The highest values were recorded in cake prepared with gum arabic at 20%GA which were 12.33±0.42 and 39.11±0.9 respectively. This results disagreement with **Song *et al.*, (2017)** found that the crust of sponge cakes showed a decrease in A* value as the fat level of basil seed mucilage increased.

B* values were increased ($p\leq0.05$) with increasing the level of replacement. The lowest value was observed in control cake which was 33.44±0.54. followed by 5 and 10%GA which were 34.69±0.59 and 35.51±0.46 respectively; percent increase were 3.73 and 6.19%

respectively in comparison with control. While, the highest values were observed in B* values of cake prepared with 15 and 20%GA of which were 36.59±0.43 and 37.12±.83 respectively at 9.42 and 11% increases respectively. Similar observations on the increased lightness and yellowness of crust color of cakes with pectin have been made by **Psimouli and Oreopoulou, (2013)**. **Abozeid *et al*., (2011)** reported thatsubstitution with pectin had the highest "b" values than control cakes and cookiessamples indicating more yellowness. **Khalil (1998) found that** cakes prepared with fat replacers (N-Flate, Paselli MD 10, Litesse) exhibited higher crust and crumb colour values compared to control.

On the other hand, H(hue) was significantly decreased ($p \leq 0.05$) with increasing the levels of replacement fat with gum arabic in cake. While, 20%GA which was 74.63±0.36 showed the highest reduction in hue colour.

Table (5):Effect of replacing fat content with different levels of Gum Arabic on crust color attributes of cake.

Property / Treatments	L*	A*	B*	C	H
Control cake	65.59±3.2^{a}	4.61±0.44^{e}	33.44±0.54^{c}	33.768±.58^{e}	82.16±0.65^{a}
5% GA	67.25±6.54^{a}	6.69±0.5^{d}	34.69±0.59^{b}	35.69±0.67^{d}	79.09±0.64^{b}
10% GA	69.49±3.18^{a}	8.65±0.48^{c}	35.51±0.46^{b}	36.55±.26^{c}	76.32±0.58^{c}
15% GA	70.48±1.22^{a}	10.24±0.88^{b}	36.59±0.43^{a}	38±0.28^{b}	74.36±1.42^{d}
20% GA	71.09±1.34^{a}	12.33±0.42^{a}	37.12±.83^{a}	39.11±0.9^{a}	74.63±0.36^{e}

Means in the same column with different letters are significantly different ($p \leq 0.05$).
GA: gum Arabic; L*: lightness; A*: redness; B*: yellowness; c: chroma; H: hue.

From the above results, it could be concluded that the fat in the cakes formula could be partialy replaced by gum Arabic as fat replacer up to 20% level to produce high quality of low fat cakes.

References:

AACC. (2010): Approved Methods of American Association of Cereal Chemists. St. Paul, USA: American Association of Cereal Chemists.

Abozeid, W. M.; Salama, M. F. and Moawad, R.K.(2011): Utilization of Fat Replacer in the Production of Reduced Cakes and Cookies. Australian Journal of Basic and Applied Sciences, **5(12): 2833-2840.**

Akesowan, A.(2010): Effect of konjac flour incorporated with soy protein isolate on quality characteristics of reduced-fat chiffon cakes. African Journal of Biotechnology, **9(28):4386-4391.**

Alloush, S.A. (2015): Chemical, physical and sensory properties of sweet potato cake. Egypt. J. Agric. Res., **93: 101-115**

AOAC (2012): Official Methods of Analysis of the Association of Official Analytical Chemists, 19 th ed., Washington, DC, USA.

Aydogdu, A.; Sumnu, G. and Sahin, S.(2018): Effects of addition of different fibers on rheological characteristics of cake batter and quality of cakes. J. Food Sci.Technol., **55(2):667–677.**

Artimage, G.Y. and Berry, W.G. (1987). Statistical Methods 7th Ed. Ames, Iowa State University Press, 39-63.

Berglund, P.T. and Hertsgaard, D.M. (1986): Use of vegetables oils at reduced levels in cake, pie crust, cookie, and muffins. J. Food Sci., **51: 640- 644.**

Choi, Y. S.; Kim, H. W.; Hwang, K. E.; Song, D. H.; Choi, J. H.; Lee, M. A.; Chung, H. J. and Kim, C. J. (2014): Physicochemical properties and sensory characteristics of reduced fat frankfurters with pork back fat replaced by dietary fiber extracted from makgeolli lees. Meat Sci., **96: 892-900.**

Chung, H.J.; Lee, S.E.; Han, J.A. and Lim, S.T. (2010): Physical properties of dryheated octenyl succinylated waxy corn starches and its application in fat-reduced muffin. J. Cereal Sci., **52:496–501.**

Chysirichote, T; Utaipatanacheep, A. and Varanyanond, W. (2011): Effect of Reducing Fat and Using Fat Replacers in the Crust of Flaky Chinese Pastry. Kasetsart J. (Nat. Sci.), **45: 120 – 127.**

Dziezak, J.D.(1991): Afocusongums. Food.Technol.**, 45: 116–132.**

El-Refai, A. A.; Domah, M.B.; Kassem, A. E. M.and Askar, M. A. (2011): Biological Evaluation of Low–Fat Cake. J. Food and Dairy Sci., Mansoura Univ.,**2 (8): 429 – 441.**

Fennema, O.R. (1996): Food Chemistry Marcel Dekker, New York.

Finley, J.W. and Leveille, G.A. (1996): Macronutrient substitutes. In: Ziegler, E.E. and Filer, L.J., editors. Present knowledge in nutrition. 7th ed. Washington, D.C:. ILSI Press, **581–592.**

Glicksman, M. (1991): Hydrocolloids and the search for the "oil grail". Food Tech., **45:94.**

Guha, P. (2007): Extraction of essential oil from betel leaf for manufacturing of food, medicinal and cosmetic products. In Proc. Indian Convention of Food Scientist and Technologist, **44.**

Hand, D.B.; Moyer, J.C.; Ransford, J.R. and Hening, J.E.(1955): Effect of processing condition on the viscosity of tomato juice. Food Technol., **19(5):225.**

Hayek, S. A. and Ibrahim, S.A. (2013): Consumer acceptability of chocolate chip cookies using apple sauce as a fat (butter) substitute. Emir. J. Food Agric., **25 (3): 159-168.**

Huffman, D.L. and Egbert, W.R.(1990): Advances in lean ground beef production. Alabama Agriculture Expermental station Bulletin 606. Auburn University.

Hussein, E. A.; El-Beltagy, A. E. and Gaafar, A. M. (2011): Production and quality evaluation of low calorie cake.American Journal of Food Technology, **6 (9): 827-834.**

Hussien, H.A.(2016): Using Vegetable Puree as a Fat Substitute in Cakes. International Journal of Nutrition and Food Sciences, **5(4): 284-292.**

Kalinga, D. and Mishra, V.K. (2009): Rheological and physical properties of low fat cakes produced by addition of cereal Beta glucan concentrates. J. Food Process Preserv., **33:384–400.**

Kamel, B.S. and Rasper, V.F. (1988): Effects of emulsifiers, sorbitol, polidextrose, and crystalline cellulose on the texture of reduced calorie cakes. J. Texture Stud, **19:307–320.**

Khalil, A.H. (1998): The influence of carbohydrate-based fat replacers with and without emulsifiers on the quality characteristics of low fat cake. Plant Food Hum.Nutr.,**52: 299–313.**

Khouryieh, H. A.; Aramouni, F. M. and Herald, T. J. (2005): Physical and sensory characteristics of no-sugar-added/low-fat muffin. Journal of Food Quality, **28:439–451**

Lee, S.; Kim, S. and Inglett, G.E. (2005): Effect of shortening replacement with oatrim on the physical and rheological properties of cakes. Cereal Chem., **82:120–124.**

Lucca, P.A. and Tepper, B.J. (1994): Fat replacer and the functionality of fat in foods, Trends in Food Science and Technology, **5: 12-19.**

Mistry, V.V. (2001): Low fat cheese technology. International Dairy Journal, **11: 413-422.**

Mohammed, N.H.(2013): Chemical and Technological Studies on some Food Products Supplemented with Gum Arabic. M.Sc. Faculty of Home Economics Dept. of Nutrition and Food Science, Minoufia University.

Ognean,C.F.; Darie, N. and Ognean, M.(2006): Fat Replacers – Review. Journal of Agroalimentary Processes and Technologies, **XII(2):433-442.**

Ozvural, E. B. and Vural, H. (2008): Utilization of interesterified oil blends in the production of frankfurters. Meat Sci., **78: 211-216.**

Psimouli ,V. and Oreopoulou, V.(2013):The Effect of Fat Replacers on Batter and Cake Properties. Journal of Food Science, **78(10):1495-1502.**

Qureshi, A.; Ainee, A.; Nadeem, M.; Munir, M. ;Qureshi, T.M.; Jabbar, S. (2017): Effect of Grape Fruit Albedo Powder on the Physicochemical and Sensory Attributes of Fruit Cake. Pakistan Journal of Agricultural Research, **30 (2):185-193.**

Romanchik-Cerpovicz, J.E. ; Tilmon, R.W. and Baldree, K.A. (2002): Moisture Retention and Consumer Acceptability of Chocolate Bar Cookies Prepared With Okra Gum as a Fat Ingredient Substitute, Journal of the American Dietetic Association, **102: 1301-1303.**

Romeih, E.A.; Michaelidou, A.; Biliaderis, C.G. and Zerfiridis, G.K.(2002): Low-fat white-brined cheese made from bovine milk and two commercial fat mimetics: Chemical, physical and sensory attributes. International Dairy Journal, **12: 525-540.**

Rosenthal, A.J. (1998): Technological factors in the development of low-calorie foods. In: Henry, C.J.K. and Heppell, N.J. editors. Nutritional aspects of food processing and ingredients. Oxford, U.K., Aspen Publication, **24–41.**

Sampaio, G.R.; Castellucci, C.M.N.; Silva, M.E.; Torres, E.A. (2004): Effect of fat replacers on the nutritive value and acceptability of beef frankfurters, J. Food Composition and Analysis, **18:469-474.**

Sanchez, C.; Klopfenstein, C. F. and Walker, C.E.(1995): Use of carbohydrate based fat substitutes and emulsifying agents in reduced-fat shortbread cookies. Cereal Chem., **72: 25–29.**

Seker, I. T.; Ozboy-Ozbas, O.; Gokbulut, I.; Ozturk, S. and Koksel, H. (2010): Utilization of apricot kernel flour as fat replacer in cookies. J. Food. Process. Pres., **34: 15-26.**

Sipahioglu, O.; Alvarez, V.B. and Solano-Lopez, C. (1999): Structure, physico-chemical and sensory properties of feta cheese made with tapioca starch and lecithin as fat mimetics, International Dairy Journal, **9:783-789.**

Song, K.Y.; H. O; Joung, K.Y.; Shin, S.Y. and Kim, Y.S. (2017): Effects of basil (OCIMUM BASILICUM L.) seed mucilage Substituted for fat source in sponge cake: physicochemical, structural and retrogradation properties. Ital. J. Food Sci., **29:681-696.**

Tamime, A.Y.; Muir, D.D.; Shenana, M.E.; Kalab, M. and Dawood, A.H. (1999): Processed Cheese Analogues Incorporating Fat-Substitutes 2. Rheology, Sensory Perception of Texture and Microstructure, Lebensmittel-Wissenschsft und Techologie, **32: 50-59.**

Turabi, E; Sumnu, G and Sahin, S. (2010): Quantitative analysis of macro and micro-structure of gluten free rice cakes containing different types of gums baked in different ovens. Food Hydrocolloids, **24 (8): 755–62.**

Wekwete, B. and Navder, K. P. (2005): Effects of avocado fruit puree as a fat replacer on the physical, textural and sensory properties of oatmeal cookies. J. Am. Diet. Assoc., **105 (8): 47.**

Wekwete, B. and Navder, K. P. (2008): Effects of avocado fruit puree and oatrim as fat replacers on the physical, textural and sensory

properties of oatmeal cookies. Journal of Food Quality, **31 (2): 131-141.**

Wiliams, P.A. and Philliphs, G.O.(2000): In handbook of Hydrocolloids; Williams, P. A. Philliphs, G. O., CRC Press: Cambridge.; **155-168.**

Zambrano, F.; Despinoy, P.; Ormenese, R.C.S.C. and Faria, E.V. (2004): The use of guar and xanthan gums in the production of 'light' low fat cakes. Int. J. Food Sci. Technol., **39: 959-966.**

Zoulias, E.I.; Oreopoulou, V. and Tzia, C. (2002): Textural properties of low-fat cookies containing carbohydrate or protein-based fat replacers, J. Food Eng., **55: 337-342.**

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تأثير الصمغ العربي كبديل للدهون على جودة خصائص الكيك منخفض الدهن

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الملخص العربي

هدفت هذه الدراسه الى انتاج كيك منخفض السعرات , عن طريق استبدال الدهون بمستويات مختلفة (٥ ، ١٠ ، ١٥ و ٢٠٪) من الصمغ العربي. تم تقييم التركيب الكيميائي للصمغ العربي والتركيب الكيميائي ، الفيزيائي ، اللزوجة ،رقم الحموضه ، اللون والخصائص الحسية للكيك. وأوضحت النتائج أن الكيك المعد بمستويات ٠ ، ٥ ، ١٠ ، ١٥ ، ٢٠٪ حصلت على أعلى ($p \leq 0.05$) متوسط لدرجات المظهر ، لون القشرة ، لون اللب ، النكهة ، والقبول العام مقارنة مع الكيك المعد بنسبة ٢٥ إلى ٦٠٪ من الصمغ العربي. أدت زيادة مستوى الصمغ العربي إلى انخفاض معنوي في محتوى الدهون فى الكيك وزيادة في الرطوبة والبروتين والألياف والرماد بالمقارنة مع الكنترول (صفر% صمغ عربى). الكيك المعد باستبدال الدهون بالصمغ العربى بنسبة ١٥ و ٢٠٪ كان أعلى حجمًا ,حجمًا نوعيا ولزوجة من الكيك المعد بنسبة ٠ ، ٥ و ١٠٪ صمغ عربى. بينما لم يؤثر الصمغ العربي معنويا على وزن و رقم حموضه الكيك. بالاضافه الى ذلك أدت زياده الصمغ العربى الى زيادة قيم ال *A ,*B وC معنويا وانخفاض فى قيم H فى لون القشره ومع ذلك لم تتأثر قيم *L للون القشره بالصمغ العربى.

الكلمات المفتاحيه: التركيب الكيماوى, التقييم الحسى, رقم الحموضه, الخواص الطبيعية