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Influence of Substitution Table Sugar by Fruit Flour on Quality Attributes of Gluten-Free Cake

Eman A. A. Abd Rabou[1] and Lamiaa M. L. Al-Sadek[2]
[1]Home Economics Department, Faculty of Specific Education, Aswan University, Egypt
[2]Home Economics Department, Faculty of Specific Education, Kafr El-Sheikh University, Egypt

ABSTRACT

Gluten-free bakery products are regarded as low quality and poor nutritionally as minerals and dietary fiber. So, this search was investigated to study the effect of table sugar substitution by fruit flour as carob (*Ceratonia siliqua* L), doum (*Hyphaenethebaica)* and dates (*Phoenix dactylifera* L.) at 0, 10, 20 and 30 % on quality attributes of gluten-free fruit cake samples. The results of chemical composition showed that the moisture, protein, fat, ash and fiber contents were progressively increased, but carbohydrate content was decreased as the levels of substitution were increased. Additionally, mineral contents as magnesium, phosphor, potassium, calcium and iron were gradually increased. Besides, the moisture content was decreased by increasing the period of storage at room temperature. Moreover, the results of physical properties showed that the baking loss value was decreased, but volume, weight and density values were increased. Also, the results of sensory propertied showed that all fruit cake samples were acceptable. The fruit cake contained 30% date flour had the highest sensory scores compared to others. Finally, substitution table sugar by fruit flour as carob, doum and date can be improved the nutritional value, physical and sensory properties of gluten-free cake.

Keywords: quality attributes, carob, doum, date**,** fruit cake**,** minerals**,** gluten-free

INTRODUCTION

Increase of demand for gluten-free goods has favored the objective of frequent gluten-free bakery products that planned to simulate the quality properties of wheat bakery products. Overall, baked gluten-free consider of are low quality nutritionally and high in fat content (Alvarez-Jubete *et al*., 2009, Segura and Rosell, 2011 and Lamacchia *et al*., 2014). So, about 28–30% of celiac patients have suffered from calorie, protein, vitamins, minerals, and dietary fiber deficiency (Giménez-Bastida *et al*., 2015). Thus, it is so important to improvement of gluten-free products in minerals (Suliburska *et al*., 2013). Moreover, the physic-chemical properties of fiber can be used to improve the texture, viscosity, sensory properties and shelf life of industrial bakery products (Foschia *et al*., 2013). The final bakery product was influenced by the quality of constituents and their interaction. So, quality of cakes is influenced by many elements as the constituents used for preparation, aeration and process conditions of batter (Sakiyan *et al*., 2004; Yang and Foegeding, 2010).

Sweeteners are used to enrich or enhance the sweet-tasting of most bakery products. Natural sweeteners are consisted of mixtures with natural origin and have great nutritionally; the main compound of natural sweeteners is either mono- or di-saccharides (Sudan *et al.,* 2016). Natural and artificial sweeteners have been used to produce a low calorie cake by reducing the sugar amount (Mehrabi *et al., 2017)*. Dried fruits have been used by many researchers to sweeten the customary foods as the functionality of the nature sugar. It was united within the structure of whole fruits is healthier than adding sugar (Manickavasagan *et al.,* 2013). Industries should investigate the potential of new products with fruits as a sweetener. It is also important to create awareness among people to include the fruit based products in their diet (Kumar *et al*., 2017)

Flour of carob is characterized as a health- improving component that can be used for development of gluten-free bakery. There is a lack of information about using it in food, especially in gluten-free bakery (Tsatsaragkou *et al.,* 2014). Carob flour is mildly sweet. It is used as a constituent in cookies and cakes, and is considered a replacement of chocolate (Bengoechea *et al*., 2008 and Kamal *et al*., 2013). Carob pods are an important source of fiber, carbohydrate and potassium and calcium minerals. They are effective in lowering cholesterol, preventing diarrhea, osteoporosis, antidepressant, skin diseases and fighting in some of the cancer tumors. Therefore, polyphenols are influenced to prevention against many diseases as neuronal and cardiovascular (Ibrahim *et al.,* 2015 and Gübbük *et al.,* 2016).

Doum fruit is an important source of fiber, carbohydrate and micro nutrients as vitamins, especially (B vitamins) and minerals were included Na, K, Ca, Mg and P which help body to organize the biological process in body and afford healthy advantages (Admassu *et al.,* 2013 and Aboshora *et al.,* 2014). Also, doum has antimicrobial, antioxidant, hypolipidemic, antidiabetic, anticancer and antihypertensive activities (Abd El-moniem *et al.,* 2015 and Bayad 2016).

Date fruits have also been used as a sweetener for food products in many procedures such as spread, syrups, flour and sugar in food (Manickavasagan *et al.,* 2013). Date fruit has higher natural sugar and bioactive composites. So, it is a perfect substitute for added sugar in foods (Salehi *et al*., 2014 and Thangavel *et al*., 2015.)

For these reasons the purpose of this search was to study the influence of replacement table sugar with carob, doum and date flour at 0, 10, 20 and 30% on quality attributes as chemical composition, physical properties and sensory properties of gluten-free fruit cake samples.

MATERIALS AND METHODS

Materials:

Greek carob pulp (*Ceratonia siliqua* L*.)* flour, doum (*Hyphaenethebaica)* flour, dried dates (*Phoenix dactylifera* L.) named dagnah, it is a municipal varieties fruit dates in Egypt, hen eggs, (white rice and white corn flour from Zamzam Packaging Food, Mokattam, Cairo, Egypt), table sugar, butter, skimmed milk powder, salt, vanilla and baking powder were purchased from local markets from Aswan city government, Egypt. All flours were kept at 4 ± 1 °C until analysis or for further use in the preparation of fruit cake samples.

Methods

Preparation of ingredients:

The seeds were removed manually from dried dagnah dates fruit and then the flesh was dried by using an

electric oven with air fan (Indeset 6-EM-IN-02, Italy) at 60 °C for 2 hours. After that, the dried flesh was ground in the house mincer (Moulinex, LM207041 Super Blender, France). All flour were packed in polyethylene bags and kept at 4 ± 1 °C until analysis or for further use in the preparation of cakes.

Preparation of fruit cake samples

Ten cake batters samples were prepared using the recipe as presented in Table (1) according to AACC (2000). The table sugar and butter were creamed. The whole egg was mixed with vanilla and whipped to obtain a homogeneous cream. Other dry ingredients and water were mixed individually to obtain homogeneous dough by using a hand mixer (Moulinex ABM11A30, France) at low speed for 2 minutes. 400g of the prepared cake batter was put in a cookie sheet (diameter 17x14 cm) and baked at 180°C for 45 minutes in an electric oven with air fan (Indeset 6-EM-IN-02, Italy).

Table 1. formula of fruit cake samples

Ingredient	Control cake	Carob cake			Doum cake			Date Cake		
		10% Carob	20% Carob	30% Carob	10% Doum	20% Doum	30% Doum	10% Date	20% Date	30% Date
Rice flour	75	75	75	75	75	75	75	75	75	75
White corn flour	75	75	75	75	75	75	75	75	75	75
Carob flour	--	10	20	30	--	--	--	--	--	--
Doum flour	---	--	--	--	10	20	30	--	--	--
Date flour	--	--	--	--	--	--	--	10	20	30
Table sugar	100	90	80	70	90	80	70	90	80	70
Butter	40	40	40	40	40	40	40	40	40	40
Skimmed milk powder	12	12	12	12	12	12	12	12	12	12
Hen egg (whole, fresh)	60	60	60	60	60	60	60	60	60	60
Salt	1	1	1	1	1	1	1	1	1	1
Baking powder	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5
Vanilla	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Water	70	70	70	70	70	70	70	70	70	70

The control cake that contained (1:1) white rice and white corn flour was chosen as the best one according to the sensory evaluation. The fruit cake samples were kept at room temperature for 2 hours and were packed in low-density polyethylene bags for further analysis.

Chemical analysis

Moisture, protein, ash , fat and curde fiber of fruit flour and its fruit cake samples were determined according to AOAC (2005). Total carbohydrates were calculated by difference as following: Carbohydrates % = 100 - (moisture % + protein % + fat % + ash %). Energy values of fruit cake samples were calculated by using the energy alteration factor: (4x 1g carbohydrate + 4x 1g protein +9x 1g fat) according to Paul and Southgate, (1979). Mineral contents as magnesium, phosphor, potassium, calcium and iron were determined according to AACC (1983). These determinations were carried out in Micro Analysis Unit, Agricultural Chemistry Department, Faculty of Agriculture Mansoura University, Egypt.

Physical properties of fruit cake samples

Weight, volume and density of fruit cake samples were determined according to Akubor and Ishiwu, (2013).

The baking loss according to Sumnu *et al*., (2005) it was calculated as the following equation:

Baking loss (%) = (weight batter (g) – weight cake (g)/weight batter (g)) ×100

Sensory properties of fruit cake samples

All fruit cake samples were estimated for taste, color, flavor, distributed pores, smoothness and overall acceptability by panelists composed of 20 students from the Home Economics Department, Faculty of Specific Education, Aswan University, Egypt. Sensory properties were carried out according to the method of AACC (2000).

Statistical analysis

All data were analyzed by using the Statistical Package for Social Science (SPSS) version 17.00 to perform an ANOVA according to SPSS, (2008). The means of treatments were considered statistically significant at 5% level ($P<0.05$), using Duncan test and the results were expressed as means ± standard deviation (SD) according to Duncan, (1955).

RESULTS AND DISSCUSION

The chemical composition of carob, doum and date flour (on dry weight)

Data obtainable in Table (2) displayed that the carob flour had the highest content of moisture and date flour showed the highest carbohydrate content compared to other fruit flour**.**

Table 2. Chemical composition of carob, doum and date flour (on dry weight)

Constituents	Moisture %	Dry matter(%)	Protein %	Ether extract %	Ash %	Curde Fiber %	Carbohydrate %
Carob flour	11.23±0.05^{a}	88.77±0.05^{c}	5.53±0.04^{b}	1.95±0.06^{b}	3.88±0.01^{b}	10.33±0.10^{b}	78.31±0.02^{b}
Doum flour	10.08±0.08^{b}	89.92±0.08^{b}	8.27±0.05^{a}	2.59±0.02^{a}	7.06±0.07^{a}	21.36±0.10^{a}	60.71±0.20^{c}
Date flour	9.52±0.04^{c}	90.48 ±0.04^{a}	3.14±0.04^{c}	0.91±0.04^{c}	2.71±0.07^{c}	9.99±0.14^{b}	83.26±0.16^{a}

Means in the same column with different superscript differ significantly at p< 0.05

Furthermore, doum flour had the highest contents of protein, ether extract, ash and curde fiber compared to others. The results of chemical composition of carob were confirmed by those of Khlifa *et al*., (2013) and El-Refai *et al.,* (2015). Moreover, the chemical composition of doum flour was contracted with those of Abd El-Hafez, (2015) and Seleem, (2015). Besides, the chemical composition of

date flour was in conformity to those of El-Sharnouby *et al*., (2012).

Mineral contents of carob, doum and date flour (on dry weight)

Data found in Table (3) displayed that the carob flour had the highest contents of minerals as magnesium , potassium and calcium compared to other fruit flours. Also, doum flour had the highest contents of iron and phosphor compared to others. Likewise, the results of minerals contents of carob flour were in harmony with those of Sigge *et al*., (2011), Khlifa *et al.,* (2013) and Oziyci *et al*., (2014). As well, the results of mineral contents of date flour were in concurrence with those of Mohamed *et al*., (2014).

All these results might be due to the difference between fruit species and variety. These results were in agreement with those of Ayaz *et al*., (2007) they found that the fruit can differ frequently according to type, variety, physiological ripeness, gathering season and storage status.

Table 3. Minerals contents of carob, doum and date flour (on dry weight)

Constituents	Magnesium (Mg) mg/100g	Phosphor (P) mg/100g	Potassium (K) mg/100g	Calcium (Ca) mg/100g	Iron (Fe) mg/100g
Carob flour	88.99	82.23	1098.34	343.58	2.40
Doum flour	72.14	441.93	351.36	259.10	5.18
Date flour	75.30	83.36	920.36	247.83	2.81

The chemical composition of fruit cake samples (on dry weight) and energy value (kcal/100g) on wet weight

Data presented in Table (4) demonstrated that the protein, fat, ash and curde fiber contents of fruit cake samples were increased, but carbohydrates content was decreased by increasing levels of fruit flour.

These results were due to the difference between the chemical compositions of these fruit flour and table sugar. Thus, the caloric values of fruit cake samples were decreased by increasing levels of fruit flour. On the other hand, the date cake sample that contained 10% date flour had the highest caloric values compared to other cake fruit samples. These results were due to date flour had the highest carbohydrate content compared to others fruit flour as shown in Table (2). The results of date cake samples were concurred with those of Obiegbuna *et al.,* (2013) they found that the using of date fruit as sugary factor to substitute granular sugar in bread enriched the nutritional value of bread. All these results were in harmony with those of Cvetković *et al.,* (2009).

Table 4. The chemical composition of fruit cake samples (on dry weight) and energy value (kcal/100g) on wet weight

Constituents		Protein %	Fat %	Ash %	Carbohydrate %	Fiber %	Energy Value (kcal/100g) on wet weight
Control cake		7.94±0.15^{f}	18.92±0.07^{h}	1.38±0.02^{f}	70.83±0.21^{a}	0.92±0.03^{i}	352.17±0.34^{a}
Carob cake	10%	8.59±0.06^{e}	20.20±0.02^{g}	1.61±0.03^{e}	67.26±0.24^{b}	2.34±0.02^{f}	345.67±0.66^{c}
	20%	9.39±0.07^{c}	21.24±0.16^{f}	2.14±0.03^{c}	63.16±0.62^{f}	4.07±0.06^{d}	337.41±0.84^{d}
	30%	9.76±0.03 ^{b}	21.72±0.02^{e}	2.66±0.04^{ba}	60.93±0.17^{h}	4.94±0.11^{c}	334.64±0.60^{e}
Doum cake	10%	8.88±0.09 ^{d}	21.64±0.12 ^{d}	1.92±0.04^{d}	64.20±0.09 ^{d}	3.35±0.06^{e}	347.1±0.99^{b}
	20%	9.79±0.05^{b}	23.72±0.06^{b}	2.59±0.03^{b}	57.96±0.03^{h}	5.94±0.19^{b}	340.05±0.23^{c}
	30%	10.71±0.02^{a}	25.33±0.02^{a}	2.73±0.01^{a}	52.76±0.09^{j}	8.47±0.02^{a}	333.87±0.26^{f}
Date cake	10%	8.98±0.03^{d}	21.00±0.10^{f}	1.68±0.06^{e}	66.80±0.22^{b}	1.54±0.04^{h}	351.31±0.38^{a}
	20%	9.31±0.04^{c}	22.00±0.02^{d}	1.95±0.03^{d}	64.84±0.11^{e}	1.90±0.02^{g}	349.13±0.18^{b}
	30%	9.76±0.03^{c}	22.62±0.03^{c}	2.22±0.04^{c}	63.12±0.08^{f}	2.28±0.04^{f}	345.42±0.39^{c}

Means in the same column with different superscript differ significantly at p< 0.05

Moisture contents of fruit cake samples as affected by storage at room temperature at 25-30 °C

Moisture content is an essential factor for staling since starch retro gradation. So, when the moisture content is high when the retro-gradation reduces. The shelf life of bread is increased by one day when the moisture content of bread is increased by 2% (Stauffer, 2000).

Data in Table (5) showed that the moisture content of fruit cake samples was increased by increasing levels of fruit flours compared to control cake samples. Thus, the shelf life of all fruit cake samples was increased compared to control cake. In contrast, the moisture content was decreased as affected by storage at room temperature at zero time, 4, 8 and 12 days. Also, the cake contained 30% doum flour had the highest moisture content compared to others. Thus, it had the longest shelf life compared to other fruit cake samples. These results might to due to doum flour had the highest protein and fiber contents, which have an ability to absorb more water compared to other fruit flour. These results were in agreement with those of Rosell *et al*., (2006).

Table 5. Moisture contents of fruit cake samples as affected by storage at room temperature

Constituents		Zero time	4 Days	8 days	12 Days
Control cake		27.45±0.05^{g}	27.24±0.05^{g}	27.08±0.06^{g}	26.71±0.05^{f}
Carob cake	10%	28.75±0.06^{f}	28.59±0.03f^{e}	28.4±0.24f^{e}	28.05±0.04^{e}
	20%	29.91±0.13d^{c}	29.7±0.12^{c}	29.51±0.20^{c}	29.11±0.18^{c}
	30%	30.02±0.16^{c}	29.8±0.17^{c}	29.63±0.14c^{b}	29.24±0.15^{c}
Doum cake	10%	28.74±0.13^{f}	28.62±0.14^{e}	28.44±0.08^{e}	28.14±0.12^{e}
	20%	29.81±0.07^{d}	29.67±0.03^{c}	29.48±0.10^{c}	29.16±0.08^{c}
	30%	30.71±0.04^{a}	30.53±0.14^{a}	30.35±0.00^{a}	29.99±0.06^{a}
Date cake	10%	28.61±0.06^{f}	28.36±0.05^{f}	28.22±0.09^{f}	28.01±0.04^{e}
	20%	29.41±0.06^{e}	29.17±0.06^{d}	29.05±0.07^{d}	28.79±0.01^{d}
	30%	30.23±0.08^{b}	30.07±0.06^{b}	29.83±0.07^{b}	29.56±0.05^{b}

Means in the same column with different superscript differ significantly at p< 0.05

Mineral contents of fruit cake samples (on dry weight)

Data tabled in Table (6) showed that the mineral contents as magnesium, phosphor, potassium, calcium and iron of fruit cake samples were gradually increased by increasing levels of substitution table sugar by fruit flour.

Also, carob cake had the highest contents of magnesium, potassium and calcium, but the doum cake had the highest contents of phosphor and iron compared to other fruit cake samples. These results were due to the differences in chemical composition between these fruit flour as found in Table (3). The results of date cake samples were in harmony with those of El-Sharnouby *et al.,* (2012) they reported that the content of minerals was gradually increased by increasing the level of date flour in the blend of biscuits. Therefore, that could partly provide children and adults their daily requirements of iron, phosphorus, potassium, and calcium by consuming these kinds of biscuit. The results of carob cake samples were compatible with those of Öksüz and Karakaş, (2016) they found that the replacing table sugar by carob syrup caused increasing minerals of biscuits. All these results were in line with those of Cvetković *et al.,* (2009) they found that substation table sugar with fruit flour caused increasing in natural colorants, vitamins, fibers, minerals and health claims in finished bakery products.

Table 6. Minerals contents of fruit cake samples (on dry weight)

		Magnesium (Mg) mg/100g	Phosphor (P) mg/100g	Potassium (K) mg/100g	Calcium (Ca) mg/100g	Iron (Fe) mg/100g
Control cake		41.08	1152.31	671.26	11.03	0.63
Carob cake	10%	49.68	1181.75	812.63	25.26	0.91
	20%	66.64	1219.72	866.03	42.80	1.11
	30%	76.49	1241.78	998.86	58.59	1.16
Doum cake	10%	46.37	1203.44	719.48	22.45	1.28
	20%	57.24	1278.34	778.26	35.62	2.17
	30%	62.84	1321.79	823.50	46.18	3.06
Date cake	10%	51.53	1235.19	731.24	24.37	0.98
	20%	66.91	1315.72	814.38	32.72	1.37
	30%	71.82	1376.52	869.33	41.57	1.79

Physical properties of fruit cake samples

Data found in Table (7) showed that the baking loss of fruit cake samples was gradually decreased by increasing substitution levels compared to control cake sample. So, the weight values of the fruit cake samples were increased. These results might be due to the increase of protein and fiber contents which increased the water absorption capacity.

These results were in concurrence with those of Obiegbuna et *al*., (2013) they found that the protein and fiber presented into the cake by adding date palm fruit pulp meal held some moisture, preventing them from evaporation. Moreover, the increasing in air incorporation caused increasing in volume values of fruit cake samples.So, the density values of fruit cake samples were increased compared to that of control cake sample. These results were not agreement with Masood *et al*., (2002) they stated that increasing apple pomace levels caused decreases in volume of cake. A number of researches which carried out by Ngo and Taranto, (1986) and Paton *et al*., (1981) they reported that a good cake batter must keep enough viscosity to inhibit the inserted air bubbles from rising to the surface and being lost during primary heating. The setting cake must be timed so, the air bubbles can be properly expanded by the carbon dioxide gas and water vapor before the cake sets. Thus, the resulting cake structure is highly aerated and has a more defined structure (Hafez, 2012).

On the other hand, date cake samples had the highest density values compared to others fruit cake samples. These results might be due to date fruit cake had low fiber content or due to the kind and particle size of date fruit fiber compared to others fruit flour. These results were in accordance with those of Gómez *et al*., (2010) they mentioned that the level and particle size of the fibers, especially insoluble fibers that adding to wheat batter could increase the density of wheat batter.

Table 7. Physical properties of fruit cake samples

Constituents		Baking loss%	Volume (cm^3)	Wight (g)	Density (cm^3/g)
Control cake		7.51 ± 0.03^{a}	698.25 ± 1.98^{i}	369.96 ± 0.11^{h}	1.89 ± 0.01^{h}
Carob cake	10%	6.96 ± 0.15^{b}	723.2 ± 2.71^{g}	372.08 ± 0.63^{g}	1.94 ± 0.01^{g}
	20%	$6.34\pm0.08d^{c}$	786.6 ± 4.08^{e}	374.64 ± 0.31^{fe}	2.1 ± 0.01^{e}
	30%	$5.94\pm0.06f^{g}$	837.4 ± 2.51^{d}	376.24 ± 0.24^{bc}	2.23 ± 0.01^{d}
Doum cake	10%	6.49 ± 0.16^{c}	710.5 ± 6.87^{h}	374.04 ± 0.66^{f}	1.9 ± 0.02^{h}
	20%	6.26 ± 0.12^{de}	761.25 ± 5.95^{f}	374.96 ± 0.50^{de}	2.03 ± 0.02^{f}
	30%	5.99 ± 0.23^{fg}	837.38 ± 10.00^{d}	376.04 ± 0.93^{bc}	2.23 ± 0.03^{d}
Date cake	10%	6.12 ± 0.07^{fe}	862.75 ± 2.54^{c}	375.52 ± 0.29^{dc}	2.3 ± 0.01^{c}
	20%	5.92 ± 0.08^{hg}	888.13 ± 10.07^{b}	376.32 ± 0.42^{ba}	2.36 ± 0.02^{b}
	30%	5.75 ± 0.06^{h}	964.25 ± 9.15^{a}	377 ± 0.22^{a}	2.56 ± 0.03^{a}

Means in the same column with different superscript differ significantly at p< 0.05

Sensory properties of fruit cake samples

Optimizing consumer acceptability is depending on sensory properties (Shittu *et al.,* 2007).

Data in Table (8) showed that the color scores were decreased because the darker color was increased by increasing levels of fruit flour. These results were due to

the difference in level of combination and chemical change (Gayas *et al.,* 2012). Also, the result due to fruit pigments and polyphenol components underwent oxidation reaction and sucrose was participated in caramelization and the Maillard browning during baking. These results were in harmony with those of Admassu *et al*., (2013) and Aboshora *et al.,* (2016) they stated that the darkening of crust and crumb might have been attributed to high contents of total phenol of doum flour. Also, the Maillard reaction during baking might be due to high lysine content. Furthermore, the results of date cake samples were in line with those of El-Sharnouby *et al*., (2012) and Sudha *et al.,* (2007). All the results of cake color were confirmed by those of Pathak *et al.,* (2017) they found that color is an essential for a quality indicator for baked products that indicate different influences including raw material, baking temperature and time etc.

All fruit cake samples had high taste scores except the cake contained 30% carob flour. Furthermore, the odor scores were increased in fruit cake samples contained 10% doum or 10% carob flour, but it was decreased in fruit cake samples contained 20 or 30% doum or carob flour compared to control cake sample. Otherwise, fruit cake samples contained 20 or 30% date flour had high odor scores compared to other cake. These results might be due to date flour had soft flavor and odor scores compared to carob or doum flour. Moreover, these results in harmony with those of Aboshora *et al.,* (2017) they decided that the volatile components found in doum fruit parts can be used in food industries to improve flavor and taste of food products. All these results were in harmony with those of Orwa *et al.,* (2009) they reported that the dried fruit often added to food as a flavoring agent.

Distributed pores scores of fruit cake samples were decreased as levels of fruit flour were increased compared to control cake sample. Furthermore, distributed pores scores of date cake at three levels were more than those of other fruit cake samples. Besides, smoothness scores of fruit cake samples were decreased as fruit flour levels were increased, but the fruit cake contained 10% of date flour had the highest smoothness score compared to other carob and doum cake samples. These results were due to increasing fiber content of other cake samples that caused increasing the cohesiveness and hardness and also lowered the resilience (Gularte, *et al.,* 2012). Also, these results were in line with those of Hoseney, (1986) who found that most of the sugars of date are invert sugar that caused increasing the bread and cookie softness. Moreover, all fruit cake samples were accepted at all levels. But, it was decreased at levels 20 and 30% of carob or doum fruit cake compared to control cake and other date cake samples.

These results were due to the differences between chemical composition of carob, doum and date flour. All these results were in harmony with those of Souza *et al.,* (2013) they reported that the replacement of the sugar kind is related to significant changes in color, texture, flavor and shelf life.

Table 8. Organlipitic sensory properties of fruit cake samples

Constituents		Color (10)	Taste (10)	Odor (10)	Distributed pores (10)	Smoothness (10)	Overall acceptability (10)
Control cake		8.9±.09^{a}	8±1.07^{a}	8.5±1.1^{bc}	8.3±0.9^{cb}	8.7±1.03^{b}	8.1±1.2^{a}
Carob cake	10%	8.4 ±0.70^{bc}	8.1 ±1.12^{a}	8.8 0.75^{ba}	8.4 ±1.35^{b}	8.3 ±.80^{cb}	8.2 ±1.2^{a}
	20%	7.5 ±.98^{fe}	7.8 ±1.25^{a}	8.2 ±1.35^{c}	7.5 ±0.94^{d}	7.2 ±.29^{e}	7.8 ±1.5^{b}
	30%	7.2 ±0.82^{f}	7.2 ±1.23^{b}	7.2 ±1.41^{e}	7.1 ±1.23^{e}	6.8 ±0.91^{f}	7.5 ±1.4^{bc}
Doum cake	10%	8.6 ±0.70^{ba}	8.2 ±1.62^{a}	8.8 0.79^{ba}	8.4 ±1.35^{b}	8.5 ±1.08^{b}	8.3 ±1.6^{a}
	20%	7.8 ±1.08^{de}	8 ±1.55^{a}	8.4 1.36^{bc}	7.9 ±0.94^{cd}	7.6 ±1.20^{d}	8 ±1.8^{a}
	30%	7.7 ±0.82^{de}	7.8 ±1.23^{a}	7.7 ±1.49^{d}	7.8 ±1.23^{d}	7.2 ±0.92^{e}	7.6 ±1.23^{b}
Date cake	10%	8 ±1.83^{dce}	8.3 ±1.34^{a}	8.6 1.06b^{c}	9±0.67^{a}	9.2 ±0.42^{a}	8.4 ±1.34^{a}
	20%	8±0.82^{dc}	8.3±1.06^{a}	8.7±1.06b^{a}	8.5±1.26^{b}	8.5 ±1.05^{b}	8.5±1.06^{a}
	30%	8.7 ±0.48^{ba}	8.2±1.32^{a}	9.1±0.99^{a}	8.4±1.08^{b}	8. ±1.60^{cd}	8.2±1.32^{a}

Means in the same column with different superscript differ significantly at p< 0.05

CONCLUSION

Gluten-free fruit cake samples can be improved macro and micro - nutritional value, physical properties and sensory properties by substitution table sugar by carob, doum and date flour. So, these results suggested that consumer should investigate the produce new bakery products with these fruits as a sweetener. It is also important to create awareness among people to include these fruits based products in their nutrition.

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تاثير استبدال سكر المائدة بمطحون الفاكهة على خواص الجودة للكيك خالى الجلوتين

إيمان عبد الحميد أحمد عبد ربه[١] ولمياء محمود لطفي الصادق[٢]

[١]قسم الاقتصاد المنزلي ـ كلية التربية النوعية ـ جامعة أسوان- مصر

[٢]قسم الاقتصاد المنزلي ـ كلية التربية النوعية ـ جامعة كفرالشيخ- مصر

تعتبر منتجات المخبوزات الخالية من الجلوتين منخفضة فى جودتها وفى قيمتها الغذائية خاصة الأملاح المعدنية و الالياف الغذائية ولذلك اجري هذا البحث لدراسة تأثير استبدال سكر المائدة بمطحون الفاكهة مثل الخروب و الدوم و التمر بنسب صفر و ١٠ و٢٠ ة ٣٠% على خواص الجودة للكيك خالى الجلوتين مثل التركيب الكيميائى والخواص الفيزيقية و الخواص الحسية . أظهرت نتائج التركيب الكيميائى للكيك الناتج ارتفاع فى محتوى الكيك من الرطوبة و البروتين و الدهن والالياف و الرماد بينما إنخفض محتواها من الكربوهيدرات وذلك بإرتفاع مستوى الإستبدال. كما إرتفع محتواها تدريجيا من الاملاح المعدنية مثل الماغنسيوم و الفوسفور والبوتاسيوم و الكالسيوم والحديد. كما انخفض محتوي الكيك من الرطوبة بزيادة فترة التخزين على درجة حرارة الغرفة. كما أظهرت نتائخ الخواص الفيزيقية انخفاض قيمة فاقد الخبز بينما إرتفعت قيم الحجم و الوزن و الكثافة النوعية. كما اظهرت نتائج الخواص الحسية أن كل أنواع كيك الفاكهة كانت مقبولة حسيا. و أن الكيك المحتوية على ٣٠% مطحون التمر كانت أعلى درجة قبول حسى بالمقارنة بباقى أنواع كيك الفاكهة الأخرى. و الخلاصة أن إستبدال سكر المائدة بمطحون الخروب والدوم والتمر يعمل على رفع القيمة الغذائية وتحسين الخواص الفيزيقية والحسية للكيك خالى الجلوتين.

الكلمات الدالة : خواص الجودة, خروب, دوم, تمر, كيك الفاكهة,املاح, خالى الجلوتين