Zucchini Puree as a Novel Egg Substitute in Cake: Comparing with Other Substitutes

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ABSTRACT

Recently, there is increasing demand and interest in egg substitutes, mainly due to health problems. The aim of this investigation evaluates the possibility of using zucchini puree (T4) as a new egg substitute and comparing it with over-ripening banana (T1), chia seeds powder (T2), defatted soy flour (T3) as egg substitutes to prepare an egg-free traditional cake. Foam and emulsification properties were determined for different egg substitutes. Moreover, the prepared cakes were analyzed for batter rheological, color, physical, textural and sensory properties and compared with control cake(C). The results of foam and emulsification properties of egg substitutes showed that soybean flour was the best. The batter density of C was the lowest (1.12 g/cm^3), which was preceded byT4 batter (1.21 g/cm^3). The viscosity of the T4 batter was the lowest (1.52 g/s). Additionally, the physical properties of C cake were significantly affected by egg substitution in most cakes exception T1, which had no significant differences with T4. Furthermore, color parameters showed no significant effect between C and T4 cakes. For textural properties, no significant diffrences could be traced when C was compered with T4. Finally, for sensory evaluation, the overall acceptability of egg-free cake was no significant effect among C, T3 and T4 cakes, which was 8.9, 8.3 and 8.1 respectively. The T2 cake was the lowest in the most measured parameters. Based on our data, it appears that zucchini puree has the potential to replace egg in egg-free cake recipes.

Keywords: Egg-free cake, egg substitutes, foaming and emulsification properties, physical and sensory properties, zucchini puree.

INTRODUCTION

The cake is a type of flour confectionery and it is the most common bakery product consumed by various consumers that led to increase its demand in the global market (Lin *et al*., 2017). Cakes are considered semi-dry foam products with airtight pockets in the starch and protein network. Egg proteins play an important role in the formation of foam cakes (Shi *et al*., 2011). The egg is one of the main ingredients for preparing cakes for providing texture and nutrition. The egg is necessary to foam formation, binding, flavorings, coloring agents and many other properties (Lin *et al*., 2017). Notwithstanding these positive effects, egg consumption is limited for some consumers due to health considerations (phenylketonuria, cholesterol, avian influenza, vegans or vegetarians and egg allergies), and, religious beliefs of consumers and also, rising costs (Yazici and Ozer, 2021). Those consumers are interested in searching for egg-free products, but without loss of appearance, sacrifice taste and functional properties that are contributed by eggs in their food (Mustafa *et al*., 2018). Consequently, the identification, characterization of egg substitutes and proofing their functionality in food is a significant first step in presenting this ingredient in the market (Tan *et al*., 2015).

Numerous prior researches have been trying to use a range of substances as egg substitutes partially or completely such as soy flour, wheat flour, rye, whey, starch, gums, casein, etc. (Ratnayake *et al*., 2012).

The soybean (*Glycine max*) has been known as an excellent source of good quality protein, omega-3-fatty acids, dietary fibers and iso-flavones when used in the human diet (Riaz, 2005). Soybean products enhance textural profiles, gelling properties, water retention, and elongate the shelf life of food products (Majzoobi *et al*., 2014).

Chia (*Salvia hispanica*) seeds are rich in protein (20%), dietary fiber, vitamins, minerals and antioxidants (Ixtaina *et al*., 2008). Chia can form gum, which has good functional properties. Thereby, they improve the functional properties of its food products as emulsifiers and stabilizer agents (Coorey *et al*., 2014; Mohammed et al., 2019).

Banana (*Musa sp*.) is a rich source of minerals, fiber, antioxidants and starch (Kanazawa and Sakakibara, 2000). Previous researches revealed that the intention to purchase over-ripened bananas was significantly lower because of their poor quality, the appearance of brown spots with decreased pulp firmness (Symmank *et al*., 2018). However, the overripe banana is an excellent source of dietary fiber, vitamins, minerals and natural sweeteners (Kumar *et al*., 2012). Additionally, it has shown the ability to foam formation (Alam *et al*., 2014).

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Zucchini (*Cucurbita pepo* L.) is also known as courgette or summer squash (Paris, 2016). Zucchini is the most popular vegetable and seasonal harvest with high nutritional value, which is rich in the phytochemicals. Unfortunately, zucchini is considered a highly perishable vegetable that is attributed to easy occur enzymatic browning during storage and processing (Neves *et al.*, 2012).

Currently, many new food ingredients are being used as an ingredient to use in food preparation are announced. To the best of our knowledge, there are very little researches that compare some of these used ingredients as egg substitutes in scientific work. The hypothesis of this work that using some of the available ingredients may emulate some of the functional characteristics of whole-egg and compete in all physical and sensory properties in the cake system. The purpose of this work was to evaluate and compare the foaming, physical and sensory properties of different egg substitutes such as over-ripening banana, chia seeds powder, defatted soybean flour and zucchini puree as a new egg substitute with egg to prepare the traditional cake.

MATERIALS AND METHODS

MATERIALS

Refined wheat flour (72% extraction), chia seeds, banana (over-ripening), zucchini and other ingredients of cake preparation such as sugar, baking powder, vegetable oil, vinegar, egg and vanilla essence were purchased from the local markets in Alexandria, Egypt. Defatted soybean flour was obtained from the Department of animal production, Ministry of Agriculture, Cairo, Egypt.

METHODS

Properties of foam and emulsion

Foaming capacity (FC) and foaming stability (FS) for different egg substitutes were assessed as explained by Narayana and Narasinga Rao (1982). The FC was expressed as the foam volume at 60 sec after whipping. The volume of the foam was measured after 1 h of whipping to measure the FS as a percent of the initial foam volume. The emulsion stability was recorded by following the presented method by Yassumatsu *et al*. (1972).

Preparation of cake batters and baking

The cakes were made as described by Hedayati and Tehrani (2018) with slight modifications. The recipes of the control cakes (egg cake) and the egg-free cakes (soybean flour, chia seeds powder, overripe bananas and zucchini puree) are shown in Table (1). Zucchini puree was prepared by washing fruits then cuting into cubes and choping by using kitchen machine module Braun, Combi Max 700 to get a smooth puree. For chia seeds powder, it was soaked in water for 30 min befor blending with other ingredients. Egg or egg substitute, vanilla, and sugar were whipped for 5 min in a Kitchen mixer (Moulinex, super blender, France), and then vinegar, water and vegetable oil were added and whipped for 2 minutes. Then, the mixing of flour and baking powder were added and stirred slightly to obtain a creamy batter. Finally, one hundred grams of batter were poured into a baking mold (diameter of 8.5 cm) and baked in a preheated conventional oven at 170°C for 35 min. After baking, the baked cakes were cooled, then packed in polyethylene bags and frozen for carrying further analysis.

Table 1. The formulation of ingredients in the cakes

Ingredients	C*	T1	T2	T3	T4
Refined Wheat flour(g)	100	100	100	100	100
Egg(g)	100	-	-	-	-
Banana(g)	-	133	-	-	-
Chia seeds powder(g)	-	-	5	-	-
Defatted Soybean flour(g)	-	-	-	12.5	-
Zucchini puree(g)					100
Vinegar (ml)	-	5	5	5	5
Sugar(g)	70	70	70	70	70
Sunflower oil (ml)	50	50	50	50	50
Baking powder(g)	3	3	3	3	3
Vanilla essence(g)	0.5	0.5	0.5	0.5	0.5
Water (ml)	40	30	110	94	60

C*=cake+egg, T1= cake+banana overripe, T2=cake+chia seeds powder, T3=cake + defatted soybean flour and T4= cake + zucchini puree

Batter properties

Batter density

The density of cake batters was measured at room temperature by dividing the weight of a certain volume filled with batter by the weight of the same volume of water (Majzoobi *et al*., 2012).

Batter viscosity

The viscosity of cake batters was determined as described by Ebeler *et al*. (1986). The cake batters were filled in a funnel with a top diameter of 10 cm and a bottom diameter of 1.6 cm then allowing the flow of the cake batter for 15 sec. and then dividing the weight of the flowed cake batter by 15. Viscosity values are expressed as g/s.

Physical properties of cake

After removing cake samples from the oven and cooling for 1 h, the volume of the cake was measured by using rapeseed displacement as described by Sowmya *et al.* (2009). Weight loss of cake as a percentage (WL %) was calculated by the following method presented by Rodríguez-García *et al.*(2013) by deducting the weight of the baked cake from the initial weight of the cake batter before baking, then dividing the result on the weight of the cake batter and a multiple by 100. The volume index of the cake was measured following the method 10-91.01 (AACC, 2000). The cake was cut vertically at its center and the heights of the cake were measured at three points (B, C, D) along with the cross-sectioned cakes. Volume index was calculated by using the following equation: Volume index = B+C+D

Where, C is the height of cake center, B and D are the heights of cake after 2.5 cm away from the center towards the left and right sides of the cake, respectively.

Color evaluation of Cake

The color of the internal crumb of fresh cake was measured by using a Hunter colorimeter (CR-200, Konica Minolta, Japan), assessing the *L* (lightness), *a* (redness) and *b* (yellowness) parameters according to the method given by Çelik *et al.* (2007).

Evaluation of the textural properties of the cakes

The texture profiles of the internal crumb of fresh cake were performed by the Texture analyzer (Brookfield CT3 No. M08-372-C0113, USA) as described by Ratnayake *et al*. (2012). The size of the crumb piece was 4 × 4 × 1.5 cm^3, which was cut from the center of every cake. Hardness (N), chewiness (N), cohesiveness, resilience and springiness were calculated from the TPA graphic.

Sensory evaluation

Sensory evaluation was performed by ten panelists. They were selected from the staff of Food Sci. Dept. Faculty Agric. Saba Basha, Alexandria University. Panelists evaluated the cake's sensory properties including taste, the color of crust and crumb, texture, aroma and overall acceptability were evaluated according to Stone and Sidel (2004). Hedonic sensory evaluation (9-point scale) for fresh cakes of 4 samples of egg-free cake and one sample as a control (egg cake) was performed by using 1-dislike extremely, 2- dislike very much, 3- dislike moderately, 4- dislike slightly, 5- neither like nor dislike, 6- like slightly, 7- like moderately, 8- like very much, 9- like extremely.

Statistical analysis

All work was done in triplicates. Results were subjected to analysis of variance using the System (SAS) Program (SAS Institute, Carey, NC) (SAS, 1999). Significance was accepted at $p \leq 0.05$.

RESULTS AND DISCUSSION

Foam and emulsion properties of different egg substitutes

Foaming ingredients are often used in food preparation to obtain desired textural quality. Foaming agents are widely used in cake and other food to produce food with a light texture (Liu *et al*., 2009). The foam properties of different egg substitutes used here to make cake are presented in Fig.1. It could be respected that there was a significant difference ($P \leq 0.05$) between soy flour and other substitutes, whereas there was no significant differences betweenT1 (banana) and T2 (chia), also between T2 (chia) and T4 (zucchini) used as egg substitutes. The foaming capacity (FC) of soy flour was significantly ($P \leq 0.05$) the highest (250%), followed by zucchini puree being 135%. This could be attributed to exist substances that can form foam such as the higher protein content of soy flour on contrary to the other egg substitutes investigated in the present work. It is well known that the proteins are capable of forming and stabilizing foam, especially albumin (Liu *et al*., 2009). Legumes contain significant amounts of albumin, which might be responsible for the formation of stable foams (Stantiall *et al.*, 2018). For the ability of zucchini puree to form foam, it may be attributed to existence of polysaccharides especially those that are sticky as gum in the peel. Some polysaccharides can form foam because of high molecular cross-linking degree and molecular weight such as those are in beer (Ren *et al*., 2018). Furthermore, previous research have been trying to use a range of substances as egg substitutes partially or completely such as soy flour, wheat flour, starch, gums, casein, rye, whey, etc. (Ratnayake *et al*., 2012).

The findings of foaming stability (FS) of the egg substitutes are shown in Fig 1. It could be noted that the FS of soybean flour was significantly ($P \leq 0.05$) the

highest (80%), whereas the zucchini puree was the lowest (13.49%). This could be related to the properties of soy flour.

The emulsion stability (ES), as observed in this study ranged from 86.50 to 39.81% (Fig 1). It was clear that the emulsion stability of soy flour was significantly ($P \leq 0.05$) the highest, whereas the zucchini puree was the lowest. Soy proteins are known to have the emulsifying ability (Molina *et al*., 2001). Along with protein, saponins posses surfactant activity (Güçlü-Üstündağ and Mazza, 2007).

Batter properties

Batter density is an indicator for the amount of incorporating air bubbles that depend on emulsifier properties and viscosity of cake batter and also the whipping design and speed. The batter with low density is desired as it indicates more air bubbles are integrated into the cake batter (Ronda, *et al*., 2011). The results of batter density are given in Table 2. It could be noted that the density of the C batter (control) was significantly ($P \leq 0.05$) the lowest (1.12 g/cm^3), which preceded with T4 batter, whereas T2 batter (chia seeds) was significantly ($P \leq 0.05$) the highest (1.39 g/cm^3). This may be related to the emulsion properties of egg lecithin that play a role in reduction of interfacial tension in liquid and gas bubbles along with the formation and improvement of the stabilization of air bubbles. These findings are in agreement with those presented by Agrahar-Murugkar *et al*. (2018) who found that the batter density of egg cake was the lowest compared with egg-free cakes (banana, chia and soy milk powder).

Determination of rheological properties of cake batter such as viscosity is very important because the good characteristics of the cake (texture and volume) are related to battering rheological properties (Turabi *et al*., 2008). The use of the chia seeds (T2) instead of egg, led to a significant ($P \leq 0.05$) increase in the batter viscosity (3.36 g/s), whereas the lowest of batter viscosity was 1.52 g/s in T4 batter (Table. 2). This could be mainly attributed to the higher efficiency of chia seeds gel to bind great capacity of water comparing with egg and other egg substitutes investigated here. Moreover, the other egg substitutes such as banana and zucchini were characterized with high moisture content, which helped lower the viscosity of the batter.

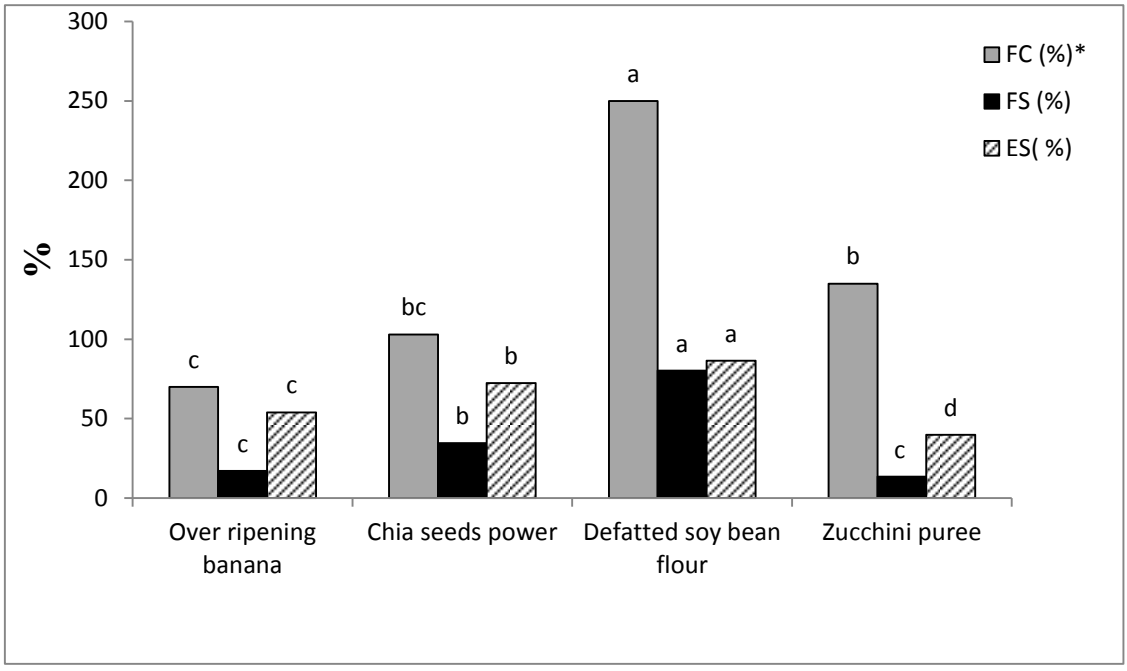

Fig. 1. Foaming and emulsion properties of different egg substitutes

FC* = foaming capacity; FS =foaming stability and ES= emulsion stability.

Means in the same column with different superscript letters are significantly different ($P \leq 0.05$).

Table 2. Effect of egg substitution on batter properties

Samples	Density (g/cm^3)	Viscosity (g/s)
C*	1.12^e	1.94^e
T1	1.30^c	1.59^c
T2	1.39^a	3.36^a
T3	1.33^b	2.09^b
T4	1.21^d	1.52^d

C*=cake+egg, T1= cake+banana overripe, T2=cake+Chia seeds powder, T3=cake + defatted soybean flour and T4= cake + zucchini puree

Means in the same column with different superscript letters are significantly different ($P \leq 0.05$)

Our results are following those given by Ronda *et al*. (2011) who attributed the high viscosity of batter due to the ability of ingredients to absorb high amounts of available water that is necessary to facilitate the movement of particles in the batter.

Physical properties of cakes

The data of physical properties of cake treatments are shown in Table (3). It could be noted that the C cake (control) had significant differences ($P \leq 0.05$) in most cake physical properties with other cake treatment with an exception of T1 cake (banana) as egg substitutes. For egg substitutes, cakes were not significantly different ($P \leq 0.05$) in volume, volume index and specific volume between T1 (banana) and T4 (zucchini puree) cakes. It can be summarizing the results of cake physical properties of the C cake (control) had the best physical properties, which followed by T1 (banana) and T4 (zucchini puree) cakes as egg-free cakes. This may be mainly due to the properties of egg proteins, which had unique foaming, emulsifying and heat coagulation of proteins and water-vaporization during baking. The cake physical properties of T1 (banana) and T4 (zucchini) cakes as egg -free cakes were almost similar to the control cake. This could be related to the higher moisture content, which can produce more steam and therefore, increased production of air cells in cake crumbs. Thereby, it causes light, porous structure, high volume and low density of the cake. Ronda *et al*. (2011) observed that the amount of air entrapped was lower in cake batter, which is characterized by high density and consistency.

The aforementioned results are consistence with those obtained by Agrahar-Murugkar *et al*. (2018) who reported that banana cake showed no significant difference in physical and textural properties than control cake (egg cake) comparing with other egg substitutes (chia seeds powder and soy milk powder) to prepare egg free and gluten-free cakes and they attributed that to high moisture content and presence of starch, pectin and maltodextrins in banana.

Cake color analysis

Color parameters of cakes crumb are given in Table (4). It could be observed that *L*-values varied from 64.57 to 55.27. Furthermore, there was no significant effect of *L*-values between C cake (control) and T4 cake (zucchini) as egg -free cake. The *L*- value was the highest in C cake (control), whereas T2 cake (chia seed) was the lowest (55.27). This means that the crumb became darker by using chia seeds which may be due to the dark color of the chia seed. Thus,the inclusion of chia seeds led to a darker crumb. The crumb color is affected by color of raw material used in the cake formulation (Barcenilla *et al*., 2016). The *L*- value of cake crumb is related with the lighter color of the crumb, which is more desired for the consumer.

Table 3. Effect of egg substitution on physical properties of cakes

samples	Volume (cm^3)	Weight loss (%)	Specific volume (cm^3\g)	volume index (cm)	density (g\cm^3)
C*	280^a	14.76^a	3.28^a	25^a	0.31^c
T1	272^{ab}	14.32^a	3.17^a	22^b	0.32^c
T2	160^d	14.57^a	1.87^d	18^d	0.54^a
T3	194^c	15.25^a	2.29^c	19^{cd}	0.44^b
T4	240^b	14.37^a	2.81^b	21^{bc}	0.36^c

C*=cake+egg, T1= cake+banana overripe, T2=cake+chia seeds powder, T3=cake + defatted soybean flour and T4= cake + zucchini puree

Means in the same column with different superscript letters are significantly different ($P \leq 0.05$).

Table 4. Effect of egg substitution on color parameters of cake crumbs

samples	Color parameters		
	L	***a***	***b***
C*	64.57[a]	0.94[d]	22.33[a]
T1	56.07[c]	2.77[a]	20.88[b]
T2	55.27[c]	1.17[c]	17.43[d]
T3	60.65[b]	1.44[b]	19.14[c]
T4	63.40[a]	0.97[d]	21.43[ab]

C*=cake+egg, L (lightness), a (redness), b (yellowness),

T1= cake+banana overripe, T2=cake+chia seeds powder, T3=cake defatted soybean flour and T4= cake + zucchini puree.

Means in the same column with different superscript letters are significantly different ($P \leq 0.05$).

The results of *a*- values and *b*- values for egg substitutes cakes are shown in Table (4). It could be concluded that their data followed the same trend as of *L*-values data mentioned previously.

In the light of the results obtained here, zucchini as a new egg substitute was the best comparing to the other substitutes in terms of cake crumb color. This may be due to the low concentration of chlorophyll dye in zucchini puree, which was broken by baking heat to become the cake like the color of the control cake.

Textural properties of different egg substitute cakes

The results of the effect of egg substitution on textural profiles of cakes are presented in Fig (2). It could be observed that the highest value of hardness was 8.01 N in T2 cake (chia seeds), whereas the lowest value was 6.46 N in C cake (control). Moreover, the cake hardness did not significantly vary for T1, T3, T4 and C cakes. This could be attributed to the amount of incorporated air into the batter. In other words, the baked cake with lower numbers of gas cells will take more time to recover its structure after compression. Arozarena *et al*. (2001) found that the cakes with high volume had lower hardness values. These data are in accordance with Nguyen *et al*. (2020) who stated that hardness values of egg-free cake was remarkably reduced with increasing level of egg replacement by using lima bean aquafaba.

Cohesiveness determines the internal resistance of food structure. Together with springiness, these two parameters are indicators of the internal resistance of the structure of food to compression (Paraskevopoulou *et al*., 2015). The data of cohesiveness and springiness are presented in Fig (2). It could be noted that the highest value of cohesiveness was 0.89 in C cake (control), which not significantly ($P \leq 0.05$) different from T1 (banana), T3 (soy flour), T4 (zucchini) cakes. For springiness values were the highest (0.91) in C cake (control), which did not exhibite difference as compered with T1 (banana) and T4 (zucchini) cakes. Furthermore, cohesiveness and springiness values were the lowest in T2 cake (chia seed) being 0.81 and 0.82, respectively. This may be related to the properties of egg proteins that help to produce a strong internal network. The given results of the effect of egg substitution by using different egg substitutes to prepare cake are in agreement with those presented by Ratnayake *et al.* (2012) who declared that the control cake made with egg had a higher cohesiveness value than soy-based as an egg substitute in cakes.

Resilience measures how well products regain their original structure after the first compression (instant springiness). The resilience value was the lowest (0.42) in T2 cake (chia seed), that means more time was required to recover its structure after compression (Fig. 2). The obtained data are similar with those obtained by Agrahar-Murugkar *et al*. (2016) who reported that using chia seeds for preparing egg-free and the gluten-free cake had the lowest values for resilience compared with banana and soy milk powder used as egg substitutes.

The chewiness is defined as a measure of the energy required for chewing semi-solid foods (Hedayati and Tehrani, 2018). Chewiness values of different cake samples ranged from 4.33 to 4.99 N (Fig 2). Our data for chewiness value revealed that using banana (T1) was the lowest chewiness value (4.33 N) in the egg-free cake. Furthermore, no significant difference ($P \leq 0.05$) could be traced between T1 (banana) and T4 (zucchini) cakes. This may be attributed to their high content of moisture and fiber.

From the aforementioned results, we can conclude that among egg-free cakes treatments, T1 (banana) and T4 (zucchini) cakes possesed textural properties similar to that for the control cake. Thereby, the high potential of using banana and zucchini to be as an alternative to the egg in egg-free cakes.

Sensory attributes

Sensory evaluation data for this study are given in Table (5). It could be observed that the prepared egg-

free cakes by using different egg substitutes (banana, chia seeds, soy flour and zucchini) were perceived to be significantly ($P \leq 0.05$) lower in all sensory parameters compared with the C cake (control). Despite that, all samples of egg-free cakes were accepted by the panelists concerning their overall acceptability, and its score ranged from 8.34 to 6.4. For samples of egg-free cakes, T3 cake (soy flour) was exhibited no significant difference ($P \leq 0.05$) compared with the C cake (control) for most sensory attributes. The crust color, crumb color, taste, odor and desirable appearance are the important properties that attributed to the higher the score acceptability score for the T3 cakes (soy flour) as egg-free cake, which had no significant difference ($P \leq 0.05$) with T4 cake (zucchini). The samples of T2 cake (chia) recorded the lowest score of overall acceptability by the panelists as egg-free cake. Using chia seeds as shown in the T2 cake resulted in undesirable changes in most attributes.

It can conclude that all sensory attributes of egg-free cakes, T3 (soy flour) and T4 (zucchini) cakes showed high acceptability. Therefore, it is a possibility to use zucchini puree as an ingredient for preparing egg-free cake without losing sensory attributes. Generally, the sensory and physicochemical of bakeries are greatly dependent on crumb structure. It affects structure, appearance of crumb along with texture and volume of bakery product (Turabi *et al*., 2010).

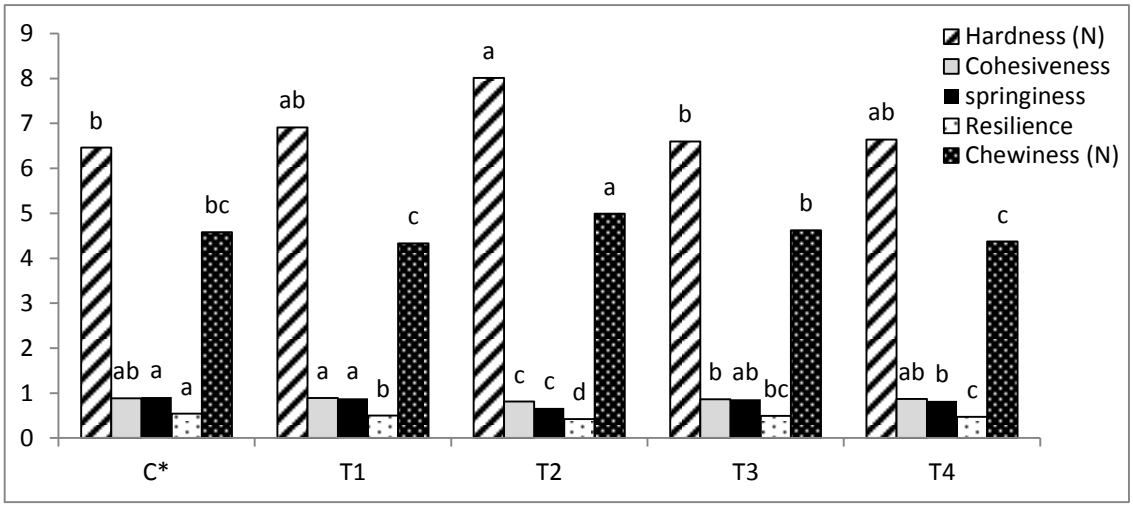

Fig. 2. Effect of egg substitution on textural profiles of cake

C*=cake+egg, T1= cake+banana overripe, T2=cake+chia seeds powder, T3=cake + defatted soybean flour and T4= cake + zucchini puree.

Means in the same column with different superscript letters are significantly different ($P \leq 0.05$).

Table 5. Effect of egg substitution on sensory attributes of cakes

samples	Crust color	Crumb color	taste	odor	texture	Overall acceptability
C	9.0^{a}	9.0^{a}	8.8^{a}	8.9^{a}	8.8^{a}	8.9^{a}
T1	8.3^{ab}	6.6^{c}	6.0^{b}	7.9^{b}	8.6^{a}	7.6^{b}
T2	6.3^{c}	6.2^{c}	5.8^{c}	8.1^{ab}	5.6^{c}	6.4^{c}
T3	8.0^{ab}	8.6^{ab}	8.4^{a}	8.7^{ab}	8.0^{b}	8.3^{ab}
T4	7.7^{b}	8.2^{b}	8.2^{a}	8.3^{ab}	8.2^{ab}	8.1^{ab}

C*=cake+egg, T1= cake+banana overripe, T2=cake+Chia seeds powder, T3=cake + defatted soybean flour and T4= cake + zucchini puree.

Means in the same column with different superscript letters are significantly different ($P \leq 0.05$).

CONCLUSIONS

According to the findings of this work, the egg-free cake can be prepared by using different egg substitutes such as over-ripening banana, chia seeds powder, soybean flour and zucchini puree. The better results were obtained when soy flour or zucchini puree were used to make egg-free cakes than other egg substitutes, that due to they gave cakes nearer of control cake in physical, textural, rheological and sensory attributes. This could help food manufacturers to produce cakes at low cost and of health benifits especially for people with dietary restrictions such as high cholesterol people and vegetarians. Thereby, using zucchini puree as a new egg-substitute has a high potential to be used as an alternative to eggs in making egg-free cakes.

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الملخص العربي

مهروس الكوسة كبديل جديد للبيض في الكيك: مقارنة ببدائل اخري

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في الآونة الأخيرة، زاد الاهتمام والطلب على استخدام بدائل البيض ويرجع ذلك أساسًا لاسباب صحية. الهدف من هذا البحث تقييم امكانية استخدام الكوسة المهروسه(T4) كبديل جديد للبيض ومقارنته مع بدائل للبيض اخري مثل الموز الزائد في النضج(T1) ومسحوق بذور الشيا(T2) ودقيق الصويا منزوع الدسم (T3) لتحضير الكيك التقليدي الخالى من البيض. تم تقدير خصائص الرغوة والاستحلاب لمختلف بدائل البيض المستخدمة. علاوة على ذلك، تم تحليل الكيك المحضرمن حيث الخصائص الريولوجية واللون والقوام والصفات الحسية ومقارنتها بالكنترول (C). أظهرت النتائج أن خواص الرغوة والاستحلاب لبدائل البيض كانت الأعلى في دقيق الصويا. كانت كثافة عجينة الكيك C هي الأقل (١,١٢ جم/ سم^{٣}) والتي سبقت نظيرتها T4. كانت لزوجة العجينة T4 هي الأدنى (١,٥٢ جم/ ثانية). بالإضافة إلى ذلك، تأثرت الخصائص الفيزيائية للمعاملة C بشكل معنوي باستبدال البيض في معظم أنواع الكيك باستثناء T1، والتي لم تظهر فروقا معنوية مع T4. علاوة على ذلك، لم تظهر قياسات اللون فروقا معنوية بين كيك المعاملتين C وT4. بالنسبة لقوام الكيك لم تظهر المعاملة C تأثيرا معنويا مقارنة بالمعاملةT4. أخيرًا ،بالنسبة للخصائص الحسية كان هناك قبول عام للكيك الخالي من البيض حيث لم يظهر هناك فروق معنوية بين المعاملات C وT3 وT4، حيث كان تقييم المحكمين للتقبل العام ٨,٩ و٨,٣ و٨,١ من تسع درجات على الترتيب. كانت المعاملة T2 هي الأدنى. على ضوء النتائج المتحصل عليها من هذه الدراسة فانه يمكن القول أن مهروس الكوسة لديه القدرة على ان يحل محل البيض في وصفات الكيك الخالية من البيض.

الكلمات المفتاحية: الكيك الخالي من البيض، بدائل البيض، خصائص الرغوة والاستحلاب، الخصائص الفيزيائية والحسية، مهروس الكوسة.