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Development of Traditional Date Cookie Formulation Using Pumpkin Puree

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ABSTRACT: The aim of this study is the application of pumpkin puree (PP) in the formulation of a traditional date cookie in order to promote its sensory and cooking qualities. In addition its nutritional value due to the on pumpkin β-carotene content is improved. Date was replaced with pumpkin puree with different ratios (0, 5, 10, 20 and 25 %) as a filling and its effect was investigated on the physicochemical and qualitative properties in addition to the staling of the cookie after 1, 3 and 7 days of production. The β-carotene content was measured using HPLC. The results indicated that incorporation of pumpkin puree into the cookie caused a significant increase in its moisture, ash, fiber, protein and β-carotene contents but its specific volume reduced significantly. The rise in the pumpkin puree ratio brought about a pH reduction and an insignificant effect in the lipid content of the cookie. The addition of pumpkin puree to the formulation did not have a significant effect on the color parameters of the cookie surface; however, was effective on the core of the cookie as it increased its L^*, a^* and b^*. The hardness of the samples containing higher levels of pumpkin puree was significantly lower than that of blank during storage.

Keywords: *β-carotene, Cookie, Date, Hardness, Pumpkin Puree.*

Introduction

The importance of diet in preventing several diseases has been well known. Recently, consumer demand for the production and consumption of natural foods and utilization of fat and sugar replacers in diets for enhancing the consumer health have been following an increasing trend. With regards to this viewpoint, nowadays, sufficient physical activity and modification of food patterns have been seriously paid attention so that people would stay healthy (Fresco *et al.*, 2004).

Food industry is one of the most important industries throughout the world. In this industry, the production of products with a higher level of safety and nutritional value for promoting the human health is regarded as one of the most significant strategies causing the longevity increase and health promotion as well as obviation of hunger. Diet changes, working pattern and leisure time which are referred to as nutritional development and include the qualitative and quantitative changes in the diet, are considered effective factors on non-contagious diseases in the whole world (Guo *et al.*, 2000). Improvement in diet and lifestyle for the reduction of diseases depends on various aspects including the approaches of food industry and agriculture in the society (Popkin, 2001).

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During recent years, more attention has been paid to the third function of foods. The third function of foods is the role of food compounds in preventing diseases through the modification of physiological systems. Antioxidant, anticarcinogenic, antimutagenic and antimicrobial activities are the examples of the role of these compounds. Owing to the increasing concerns for healthy diet, many efforts have been made in several countries to develop novel foods with the third function. The foods with the third function which are referred to as functional foods have been known as an important factor in the promotion of people`s health. Functional foods are associated with the improvement in food components along with the inhibition of diseases and the increase in the physical and intellectual health of consumers (Siro *et al.*, 2008). That is why the global market demand for these products is increasing day by day (Grajek *et al.*, 2005). Pumpkin, a member of the Cucurbitaceae family, is divided into four groups of *Cucurbita*, *Cucurbitapepo*, *Cucurbita maxima moschata* and *Cucurbitamixta* according to stem tissue and shape (Hosseini Ghaboos *et al.*, 2016). This plant is both directly and indirectly used for the preparation of gel, soap and puree. There are different methods for the processing of this useful plant and puree is one of its major products (Provesi *et al.*, 2011). Pumpkin puree (PP) contains a lot of carotenoids which are derived from isoterpenes and cause the development of a color spectrum in plantsfrom orange to red. Carotenoids are the precursors of vitamin A and their consumption prevents cardiovascular diseases, cataract and some cancers (Provesi *et al.*, 2011). Researchers have shown the proteins and polysaccharides of this plant have antibacterial, cholesterol-reducing, anti-mutagenic, anti-cancer, anti-inflammatory, antioxidant, Immunomodulatory and parasiticidal effects (Obahiagbon, 2012; Simpson & Morris, 2014).

Date cookie is a kind of traditional cookie prepared from date, wheat flour, sugar, oil, saffron, water, rosewater and egg. In order to prepare this cookie, deseeded date is squashed and covered with a dough made from flour. It is then baked in an oven. Utilization of the afore-mentioned raw materials in this cookie could classify it as a functional food (Al-Rawahi *et al.*, 2005). Various researches have suggested the unique properties of date and pumpkin in preventing different diseases (Abbès *et al.*, 2013; Simpson & Morris, 2014; Siro *et al.*, 2008).

Thus, it would be beneficial to develop the novel formulation of date cookie with pumpkin. The aim of this study is to investigate the physicochemical and sensory properties of date- pumpkin cookie with 0, 5, 10, 20 and 25 % of date replaced by pumpkin puree.

Materials and Methods

Commercially available sugar, eggs, shortening, vegetable oil, baking powder and other ingredients were used for this study. All chemicals and reagents were of analytical grade.

- *Cookie preparation*

Materials used in the preparation of the traditional cookie were mixed in three stages. Table 1 provides the composition of the cookie dough formulation. In the first stage, sugar, egg and vanilla were mixed and in the next stage, liquid and semi-liquid ingredients including water, oil and rose water were added to the mixture. Finally, solid ingredients were added to the mixture and mixed for 3 min. At the same time, cookie filling was prepared at different ratios as shown in Table 2. Date paste and pumpkin puree were prepared according to the methods described by Al-Rawahi *et al.* (2005) and Provesi *et al.* (2011), respectively. After the preparation of the cookie dough

and filling, the cookie samples were formed by placing the filling in the center of the spherical dough ball at the ratio of 1:2 (w/w) followed by the oven baking at 200˚C for 15 min, then allowed to cool down in pans for 15 min and wrapped in polyethylene bags, sealed and stored at room temperature until required for further analyses.

Table 1. The composition of the cookie

Ingredients	Amounts (%)
Wheat flour	36
Sugar	20
Drinking water	17.5
Vegetable oil	8
Baking Powder	1
Egg	11
Invert	2
Emulsifier	1.5
Glycerin	2

Table 2. Filling formulation of the cookie

Filling formulation	Date proportion (%)	Pumpkin proportion (%)
Control	100	0
F1	95	5
F2	90	10
F3	80	20
F4	75	25

- *Physicochemical analysis of the cookie*

The cookies were characterized in terms of moisture, protein, fat, crude fiber and ash contents and pH. Water content of the samples was examined gravimetrically by drying at 105 ˚C for 16 h (Kawai *et al.*, 2014). The Kjeldahl method with a conversion factor of nitrogen to protein of 6.25 was used to determine the protein content (AOAC Method 979.09), Fat and ash contents were determined by petroleum ether extraction under reflux conditions in the Soxhlet apparatus (AOAC Method 963.15) and by the gravimetric method through burning at 550 ˚C in a furnace (AOAC Method 923.03), respectively. The general method (ISO 5498:1981) was applied for the determination of crude fiber. A Metrohm 744 pH meter (Herisa, Switzerland) was used for pH measurement according to the Iranian Standard, ISIRI 37.

- *Carotenoids extraction and total content*

The sample (10–20 g) was mixed with refrigerated acetone for l-2 min in a blender. The initial mixture was filtered through a sintered funnel (5 µm) under reduced pressure and the residue was re-extracted until the sample became colorless. Distilled peroxide-free petroleum ether (PE) was then added to an equal volume with the acetone extract and diluted with distilled water. Right after the formation of the two layers, the aqueous phase, located at the bottom, was re-extracted once with PE. To remove acetone, the bulked PE solutions were rinsed three times with water.

- *Saponification*

Saponification was carried out as follow: the extracts were dried in a rotary evaporator, a solution of KOH in methanol (15%) was added to the dry extract, kept for 14 h in the dark at room temperature; and then it was added drop wise to distilled PE, water was added drop wise to the mixture in a way not to form an emulsion. Upon formation of two layers, lower aqueous phase was extracted three times with PE. To remove alkali from the ethereal solutions, water was successively added followed by discarding the resultant aqueous layers. Finally, rotary evaporator was used to concentrate each saponified extract to 100 ml and stored under nitrogen by volumetric flask (Alfawaz, 2004).

The carotenoids were analyzed in a HPLC apparatus with a column of RP-18 (30 m×0.25 mm ID), equipped with a UV-VIS detector, operating at 470 nm. The mobile phase consisted of chloroform: acetonitrile (8:92) and 1g of butylatedhydroxytoluene. The flow rate was 1 ml/min and the column temperature was kept at 35˚C (Alfawaz, 2004; Kurz *et al.*, 2008).

- *Specific volume*

Cookie specific volume was determined by the rapeseed displacement method (Williams, 1984). Analyses were performed after cooling of the product for 1 h.

- *Color analysis*

The color of the cookie samples was determined using a Hunter Lab Color Flex (Hunter Associates Laboratory, Inc., USA) (Salehi, 2017; Salehi & Kashaninejad, 2014). Before measurements, the spectrocolorimeter was calibrated with a white reference tile (L= 70:93, a = -1:13, b = 1:24).

- *Texture analysis*

Cookie firmness was measured by a texture analyzer (CT3-10k, Brookfield Engineering Laboratories, Inc., Middleboro, MA, USA). Each sample was cut into 25×25×25-mm^3 pieces. The sample was compressed using an aluminum probe of 2 mm diameter at a rate of 2 mm/s until 50% of the cookie thickness (Salehi *et al.*, 2016a).

- *Sensory evaluation*

Sensory evaluation of the cookies was completed by a 15-member experienced panelist as described by Meilgaard *et al.* (2006). All cookie samples were evaluated for appearance/color, flavor, texture and overall acceptability using a 5-point hedonic scale with scores ranging from liked extremely (5) to disliked extremely (1) (Salehi *et al.*, 2016b).

- *Statistical analysis*

The results were expressed as mean ± standard deviation. The results were analyzed through one-way analysis of variance (ANOVA) and the mean comparison was performed using the Duncan`s multiple range test at the significance level of 5% ($P< 0.05$). All analyzes were performed using SPSS software (version 18.0) and all plots were drawn using Excel software.

Results and Discussion

- *Effect of pumpkin incorporation on traditional date cookies quality*

Moisture, protein, fat, crude fiber and ash contents (expressed as % dry matter) of the developed cookie were in the range of: 20.1-26.9%, 7.59-9.38%, 6.4-7.1%, 1.32-3.45% and 1.15-2.89%, respectively.

Pumpkin puree showed high amounts of fiber, carbohydrates and β- carotene and as compared to date, it had higher moisture, protein and ash contents (Tamer *et al.*, 2010). As expected, incorporation of pumpkin into the cookie caused an increase in the moisture, protein, fat, crude fiber and ash contents as compared to the control sample.

Table 3 shows the results of pumpkin incorporation on the cookies quality. All the pumpkin containing cookies had significantly higher levels of moisture, protein, ash and crude fiber contents than the control made from 100% date. Conversely, fat content and

Table 3. Chemical composition (% dry matter) of the developed cookies containing pumpkin

Sample	Control	F1	F2	F3	F4
Moisture	20.11 ± 0.10 ^{d}	22.70 ± 0.03 ^{c}	23.32 ± 0.06 ^{c}	25.10 ± 0.02 ^{b}	26.92 ± 0.01 ^{a}
Protein	7.59 ± 0.01 ^{c}	7.98 ± 0.07 ^{bc}	8.35± 0.06 ^{b}	9.11 ± 0.14 ^{a}	9.38 ± 0.12 ^{a}
Fat	7.11 ± 0.06 ^{a}	6.90 ± 0.03 ^{a}	7.00 ± 0.11 ^{a}	6.53 ± 0.08 ^{b}	6.42 ± 0.10 ^{b}
Crude fiber	1.32 ± 0.01 ^{d}	1.55 ± 0.11 ^{d}	1.98 ± 0.06 ^{c}	2.72 ± 0.08 ^{b}	3.45 ± 0.03 ^{a}
Ash	1.15 ± 0.03 ^{d}	1.78 ± 0.01 ^{c}	1.89 ± 0.11 ^{c}	2.57 ± 0.01 ^{b}	2.89 ± 0.06 ^{a}
pH	7.34 ± 0.10 ^{a}	7.12 ± 0.05 ^{ab}	7.01 ± 0.10 ^{b}	6.66 ± 0.03 ^{c}	6.12 ± 0.11 ^{d}

Values are the mean of three replications; different letters in each column indicate significant differences ($P\leq 0.05$).

pH of the samples decreased with an increase in the pumpkin proportions. In agreement with our results, Bhat and Bhat (2013) revealed that the incorporation of pumpkin powder for the preparation of cake caused an increase in the moisture, crude fiber, ash and β-carotene contents while crude protein and crude fat contents decreased.

- *β- carotene content*

The carotenoid analyses of 5 different formulations obtained by reverse phase HPLC are presented in Figure 1. In Table 4, β-carotene content of the analyzed pumpkin-date cookie can be observed. Some researchers reported that the total carotenoid content of pumpkin and date ranges from 0.234 to 0.404 mg/g and 0.032 to 0.773 mg/100 g fresh weight (Boudries *et al.*, 2007), respectively. As shown in Table 4, β-carotene content in the cookie samples was lower than expected.This trend could be related to the effect of the processing conditions on carotenoids.

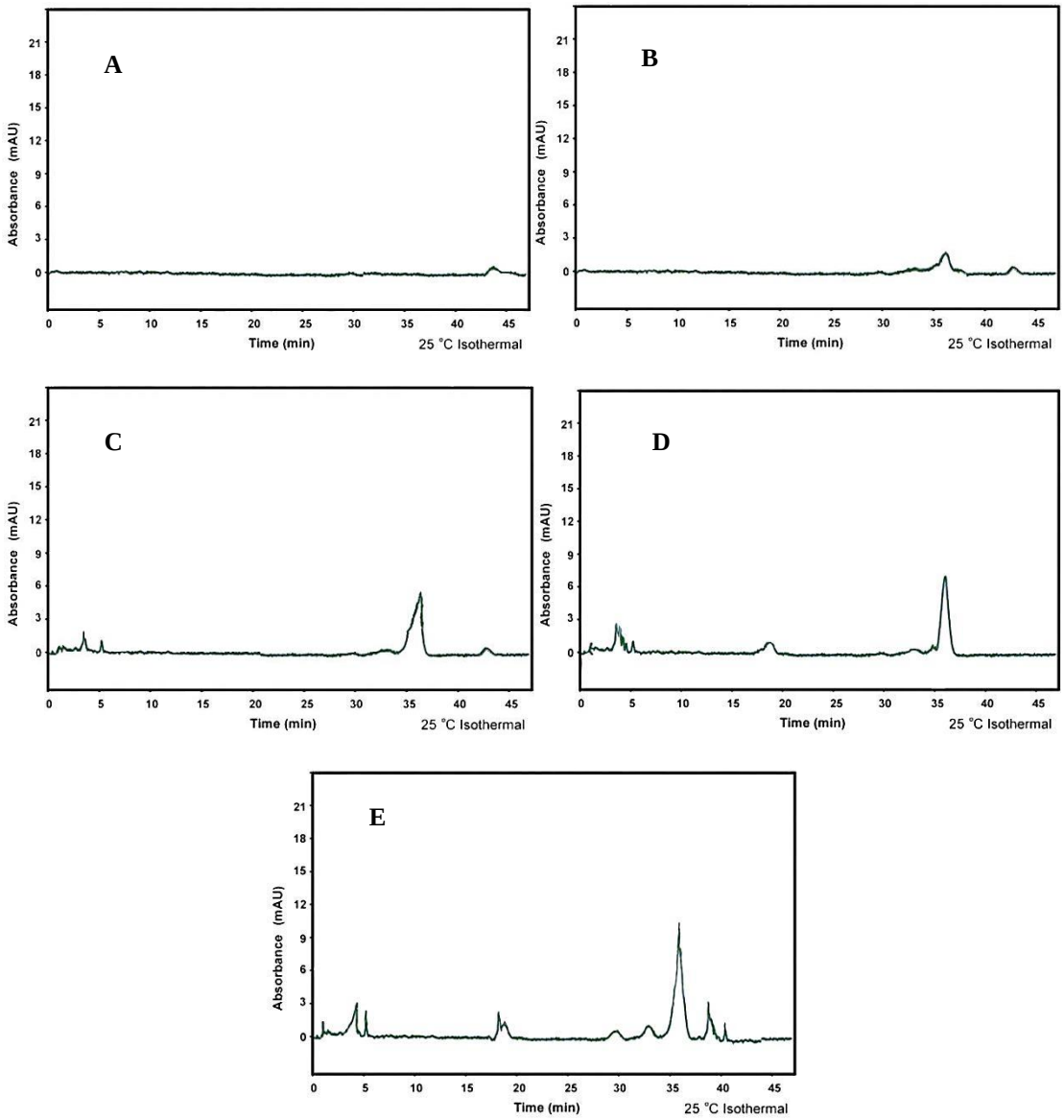

Fig. 1. HPLC chromatograms of the carotenoids of the control cookie (A), F1 (B), F2 (C), F3 (D) and F4 (E)

Table 4. β-carotene content from the analyzed pumpkin- date cookie samples

Sample	Control	F1	F2	F3	F4
β-carotene content (mg/100g)	0.15 ± 0.02 ^{e}	0.38 ± 0.01 ^{d}	0.52 ± 0.10 ^{c}	0.86 ± 0.04 ^{b}	1.03 ± 0.04 ^{a}

Values are the mean of three replications; different letters in row indicate significant differences (P≤0.05).

Provesi *et al.* (2011) revealed that heating applied during cooking process causes a decrease in β-carotene content. Other researchers also reported similar results in the case of orange juice (Gama & de Sylos, 2007) and mango (Vásquez-Caicedo *et al.*, 2007). On the other hand, it should be noted that locating of pumpkin in the center of cookie that was surrounded with a layer of dough, could decrease the negative impact of heat.

From the nutritional point of view, as shown in Figure 1 and Table 4, β-carotene content of the cookie significantly increased with the rise in the pumpkin proportion, indicating the incorporation of this fruit in the cookie could improve its nutritional profile and increases the society health level due to the mentioned functional properties of carotenoid.

- *Specific volume*

The increase in weight and the decrease in volume caused the cookie specific volume to decrease. Our results indicated that the cookie specific volume (SV) was significantly influenced by the pumpkin content during 7 days of storage (Table 5). The SV of the samples decreased significantly by increasing the storage time. The highest and the lowest SVs were observed for the cookies with 5% pumpkin in the first day and 25% pumpkin in the seventh day, respectively. On the other hands, as the pumpkin content increased, the specific volume of the cookies decreased. This interaction could be revealed as follows: The ability of pumpkin to absorb water had the cookie volume reduced followed by the weakening of the gluten network resulting in the gas maintaining ability loss. Similar results were obtained by Kulaitiene *et al.* (2014).

- *Date cookies color*

Measurements of filling cookies color are presented in Table 6. The lightness parameter L* increased as more pumpkin puree was added to the filling cookies formulation, therefore F1 cookies had the darkest color. The difference in L* values for the control and F4 are correlated with the difference between the pumpkin puree content. Thus, date paste had the lowest lightness. Sudha *et al.* (2007) reported that wheat cookies were darkened after the incorporation of bran from different sources including wheat, rice, oat and barley.

The mixed pumpkin puree/ date paste fillings, namely, F1, F2, F3 and F4 had significant differences. This is due to the fact that these fillings were obtained from mixtures of different ratios of pumpkin puree and date paste.

The same trend was observed for redness (a*) and yellowness (b*) therefore the increase in the pumpkin puree as filling resulted in a significantly higher a* and b* as compared to the control sample. In agreement with our results, Duta and Culetu (2015) reported similar trend in the case of oat-based gluten free cookies.

- *Textural properties*

Textural properties are considered as one of the most important qualitative indices in bakery products, especially confectionaries. Regarding texture measurements, the cookies of F4, prepared with 25% pumpkin puree, showed the lowest hardness value than other formulations, while the control sample showed the highest hardness (Table

7). This trend might be due to the moisture diffusion from the filling to the surface and maintains it moisture during storage. The loss of moisture causes the product to become hard in texture during storage and organoleptically it is unacceptable (Labuza & Hyman, 1998). Guy (1983) examined the relationship between consumer perception of freshness and the moisture content of cakes and revealed that increasing the water content of the cake crumb gave products that were perceived as being fresher by a taste panel. They illustrated the important role played by the moisture content in the texture in relation to quality perception.

An inverse relationship was observed between pumpkin puree proportion and days of storage therefore cookies hardness was increased in a linear manner with increasing the days of storage and vice versa. While lower amounts of pumpkin puree were added to the filling, no statistical difference was observed in the hardness of F1 and F2 as compared to the control cookie. On the other hand, the compressibility of the crumb, for all formulations, was less than that of the control, demonstrating that the crumb became softer. Similar result was reported by Labuza and Hyman (1998).

Table 5. Changes in the cookies specific volume for different formulations during storage (cm^3/g)

Sample	Storage day		
	1	3	7
Control	3.20 ± 0.20 ^{a}	3.10 ± 0.20 ^{a}	2.8 ± 0.39 ^{a}
F1	3.20 ± 0.10 ^{a}	3.00 ± 0.10 ^{a}	2.60 ± 0.14 ^{b}
F2	3.10 ± 0.20 ^{a}	2.80 ± 0.10 ^{b}	2.50 ± 0.50 ^{b}
F3	2.70 ± 0.23 ^{ab}	2.60 ± 0.30 ^{bc}	2.20 ± 0.36 ^{c}
F4	2.50 ± 0.15 ^{b}	2.20 ± 0.20 ^{c}	2.10 ± 0.22 ^{c}

Values are the mean of three replications; different letters in each column indicate significant differences (P≤0.05).

Table 6. Influence of pumpkin puree on the color of traditional date cookies

Sample	L*	a*	b*
Control	11.55 ± 0.42 ^{e}	4.44 ± 0.09 ^{d}	2.12 ± 0.14 ^{e}
F1	15.32 ± 0.35 ^{d}	4.90 ± 0.08 ^{cd}	4.22 ± 0.20 ^{d}
F2	17.89 ± 0.25 ^{c}	5.56 ± 0.06 ^{c}	6.78 ± 0.16 ^{c}
F3	20.26 ± 0.24 ^{b}	7.17 ± 0.11 ^{b}	9.64 ± 0.24 ^{b}
F4	21.34 ± 0.33 ^{a}	8.49 ± 0.11 ^{a}	11.14 ± 0.24 ^{a}

Values are the mean of three replications; different letters in each column indicate significant differences (P≤0.05).

Table 7. Influence of pumpkin puree on the hardness of traditional date cookies (N)

Sample	Days of storage		
	1	3	7
Control	2.84 ± 0.04 ^{Ca}	3.33 ± 0.03 ^{Ba}	3.77 ± 0.01 ^{Aa}
F1	2.50 ± 0.13 ^{Ca}	3.26 ± 0.06 ^{Ba}	3.55 ± 0.04 ^{Aab}
F2	2.24 ± 0.03 ^{Cb}	2.48 ± 0.03 ^{Bb}	3.21 ± 0.03 ^{Ab}
F3	1.95 ± 0.19 ^{Bc}	2.11 ± 0.04 ^{Bc}	2.75 ± 0.03 ^{Ac}
F4	1.90 ± 0.11 ^{Bc}	2.08 ± 0.04 ^{Bc}	2.44 ± 0.03 ^{Ad}

Values are the mean of three replications; different letters in each column and row indicate significant differences (P≤0.05).

- *Sensory evaluation*

In order to develop a new product, sensory properties and consumer acceptability must be considered and taken into account. The color, texture, flavor, and overall score based on the panelists` assigned scores for each parameter using a 5- point hedonic scale are presented in Table 8. The statistical results indicated that no difference in color was found between the cookies. This trend may be due to the fact that pumpkin puree was applied as filling that did not have any influence in the cookie appearance. With the addition of PP, the texture became softer and all of the samples were statistically different. There was no statistically significant difference (*P* 0.05) in the flavors of the control cookies with F1and F4, while F2 gained the highest score followed by F3. According to ANOVA results, the cookies containing 10% PP were scored with a higher overall acceptability as compared to other formulations, while the lowest score belonged to the control and F4 cookies. However, all the cookies were considered acceptable because the scores were higher than 2.5, ranging from 3.80 to 4.10. Sensory evaluation suggested that the cookies using PP up to 20% were acceptable in all respects.

Conclusion

Pumpkin puree can be used as a partial replacement for traditional date cookies filling formulations, in order to increase the nutritional value of the product. Significant improvement in overall cookies acceptability was observed when pumpkin puree is used in proportion of 10%. The results from HPLC analysis showed that pumpkin puree addition had positive effects on cookie carotene content. By increasing the pumpkin puree addition from 5% to 25% caused a significant increase in its moisture, ash, fiber, protein and β-carotene contents. The texture analysis showed that the hardness of the samples containing higher levels of pumpkin puree was significantly lower than that of control during storage. Therefore, the addition of pumpkin puree relatively retarded the cookie staling during storage. This study showed that pumpkin puree might be incorporated into formulations of products up to 25%, to diversify the diet of people and to enhance the carotene intake and other functional components. The knowledge obtained from this study might be important to improve the nutritional value of traditional product.

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Table 8. Consumer sensory evaluation. Mean ± standard deviation; n = 6; means having by the same letter within the same column are not significantly different (P > 0.05)

Sample	Appearance	Texture	Flavor	Overall
Control	3.90 ±0.34 [a]	4.00 ±0.31 [a]	4.20 ±0.33 [c]	3.80 ± 0.34 [c]
F1	3.80 ±0.23 [a]	4.20 ±0.30 [b]	4.20 ±0.27 [c]	4.00 ±0.22 [b]
F2	3.90 ± 0.10 [a]	4.30 ±0.12 [b]	4.50 ±0.18 [a]	4.10 ±0.13 [a]
F3	4.00 ±0.44 [a]	4.50 ± 0.36 c	4.30 ±0.33 [b]	4.00 ± 0.37 [b]
F4	4.10 ±0.14 [a]	4.60 ±0.11 [d]	4.25 ±0.21 [c]	3.90 ± 0.19 [c]

Values are the mean of three replications; different letters in each column indicate significant differences (P≤0.05).

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