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Research Article
Effect of Mixing Wheat Flour with Pumpkin and Dates on the Nutritional and Sensory Characteristics of Cake

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Abstract

Background: The development of food products is a major goal of the food industry. Pumpkin is a rich source of nutrients that may help improve products. **Objective:** The aim of this study was to evaluate the effect of replacing wheat flour with pumpkin or both pumpkin and dates on the chemical and sensory characteristics of cake. **Methodology:** Three different cakes were prepared: (1) Control, (2) 50% of the wheat flour replaced with pumpkin mash and (3) 50% of the wheat flour replaced with 30% pumpkin and 20% dates. The moisture, protein, fat, ash, fiber, carbohydrate and fatty acid contents were measured. **Results:** There were no significant differences ($p<0.05$) among the control, pumpkin and pumpkin and date cakes in terms of protein, fat and ash content ($p = 4.62, 4.51$ and 4.0, respectively). A sensory evaluation showed that the pumpkin and date cake and control cake were not significantly different ($p<0.05$) in terms of odor, texture and overall acceptability. The cake supplemented with pumpkin and dates had increased essential fatty acid content. The pumpkin cake had the highest scores for all quality attributes compared to others, likely because of the stronger pumpkin odor and taste. Moreover, the color appeared to be a very important criterion for initial acceptability of the cakes by consumers. The color of the pumpkin cake was significantly affected ($p<0.05$) by the addition of pumpkin. **Conclusion:** Pumpkins can be a good source for the development of food products because of their ability to improve the appearance, nutritional value and overall acceptability of cakes.

Key words: Cakes, pumpkin, dates, strengthened chemical sensory product

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Competing Interest: The authors have declared that no competing interest exists.

Data Availability: All relevant data are within the paper and its supporting information files.

INTRODUCTION

Changes in consumer trends are occurring because of the high rates of chronic diseases, such as diabetes, obesity and celiac disease. There have been increasing demands for healthier pastries that are low in sugar, fat, cholesterol and calories in general and contain health promoting components, such as protein, unsaturated fatty acids and fiber[1].

Cakes are convenient food products[2]. They are usually sweet, often baked and prepared from flour, sugar, shortening, baking powder, eggs and other flavor essences as principal ingredients[2].

Pumpkins are extensively grown in tropical and sub-tropical countries. Pumpkin species include *Cucurbita moschata*, *Cucurbita pepo*, *Cucurbita maxima*, *Cucurbita mixta*, *Cucurbita ficifolia* and *Telfairia occidental*[3]. When pumpkins are fully mature, they can be used in preparing sweets and candy or fermented into beverages. Pumpkins have high productivity and nutritive value, good stability, long periods of availability and can be easily transported[4]. Pumpkin colors vary, they can be green, white, blue grey, yellow, orange or red, depending on the species. Pumpkins are used both in mature and immature stages as a vegetable. The flesh is delicious when fried, stewed, boiled, or baked.

Pumpkins are also rich in minerals, vitamins, pectin and dietary fiber. Pumpkins are a valuable additive to cakes because they provide a good source of protein, antioxidants and monounsaturated and polyunsaturated fatty acids[5]. The chemical composition of pumpkins varies among cultivars and species. Several studies[2] have shown the ranges of moisture (75.8-91.33%), crude protein (0.2-2.7%), crude ash (0.47-2.1%) and carbohydrate content (3.1-13%) in pumpkin pulp. Additionally, as pumpkins are nutritionally rich, the fruit also possesses many medicinal properties. The yellow-orange characteristic color of pumpkins is due to the presence of carotenoids, which are the primary source of vitamin A. Vitamin A deficiency is common in developing countries[6].

Dates are rich in carbohydrates, minerals, vitamins, fatty acids, proteins and fiber[7-10]. The development of dates is classified into four stages: stage 1: 'Kimiri' stage, stage 2: 'Khalal' stage, stage 3: 'Rutab' stage and stage 4: 'Tamer' stage. The tamer stage is the final stage of maturation, when the date has dried to a fairly firm consistency with a darker color[11].

The utilization of fruits in food preparation that require a sweet taste is a wise strategy to reduce the added sugar intake. Dates have a high sugar content, thus, when developing a new product, it may be an ideal fruit to substitute for sugar[12]. Studies have shown that dates are a nutritive product that contain sugar substances (approximately 70.6-76.3%)[7,13,14].

Regulatory mandates and self-imposed guidelines for healthy public nutrition force companies to introduce snacks with refined features, such as a new raw material basis and improved texture, shape, color, flavor and nutritional content. The over consumption of refined products is one of the primary cause of disease. It is therefore vital to consume less processed, more natural and nutritious products.

Bakery products such as cakes, cookies and bread are enjoyed by diverse people, both young and old, residing in rural and urban areas. Thus, an attempt was made to develop wholesome and nutritious cakes by strengthening them with pumpkin and dates, along with other ingredients.

MATERIALS AND METHODS

This investigation was carried out in 2014-2015 at the Department of Nutrition and Food Science.

Materials: A date cultivar (*Phoenix dactylifera* L.) was procured from a local farm in Riyadh district of Saudi Arabia. Ten pieces of dates weighing approximately 5 g were selected at random and individually weighed on a top pan balance. The dates were placed into polyethylene bags for storage at 4°C until use.

Pumpkins (*Cucurbita maxima*) were harvested from a field at a local farm in Riyadh district of Saudi Arabia and two pieces of pumpkin were selected at random. Pieces weighing approximately 125 g each on a top pan balance were then washed and boiled. The pumpkin pieces were subjected to downstream milling and placed into polyethylene bags for storage at 4°C until use.

Wheat flour, sugar, butter, eggs, condensed milk, sodium bicarbonate, salt and vanilla were purchased from a local market in Riyadh, Saudi Arabia. The quantity of these ingredients is presented in Table 1.

Cake: The formulations of the cakes prepared from different proportions of wheat, date and pumpkin are given in Table 1.

Table 1: Cake recipes

Ingredients	Control (g)	Pumpkin (g)	Pumpkin and date (g)
Wheat flour	250	125	125
Sugar	100	100	0
Butter	80	80	80
Eggs (whole, fresh)	80	80	80
Condensed milk	70	70	70
Sodium bicarbonate	7	7	7
Vanilla	3	3	3
Salt	5	5	5
Pumpkin (mashed)	0	125	75
Date (mashed)	0	0	50

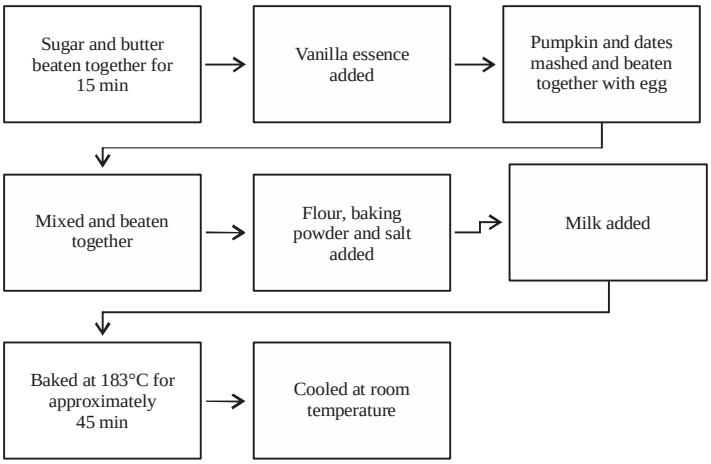

Fig. 1: Cake production process

Other ingredients, such as butter (80 g), sugar (100 g), eggs (70 g), sodium bicarbonate (7 g) and vanilla essence (3 g), were added to each of these cake recipes. Cake samples were prepared by following the procedure suggested by Singh *et al.*[15] with slight modification, as shown in Fig. 1.

The sugar and butter were creamed together until the mixture was light and fluffy. Vanilla essence was added and the mixture was creamed further. The eggs were cracked open and the liquid content (mashed pumpkin or dates) was beaten together. This was incorporated into the creamed mixture by beating together. Then, the flour, baking powder and salt were sieved together and folded alternately with the milk into the creamed mixture until smooth. The batter was then poured into prepared cupcake pans (greased with vegetable oil) to approximately 2/3 volume. The cakes were baked at 183°C for approximately 45 min. After baking, the cakes were cooled for 1-2 h at room temperature (25°C) in a sealed plastic bag. The cakes were then cut into 2×3×5 cm slices using a bread knife for chemical and sensory evaluation.

Chemical composition: In the chemical analysis, moisture, crude protein, crude fiber, fat and ash contents were determined according to the methods of the AOAC[16]. Total carbohydrate content was calculated as the difference.

Essential fatty acids: Fatty acids were measured after hydrolysis and GC-MS (GC-17A Gas Chromatograph, Semenis, Shimadzu LC-10 AD Corporation, Kyoto, Japan) electron impact ionization according to the method reported by the AOAC[16].

Sensory evaluation: The sensory evaluations of pumpkin, date and pumpkin-supplemented cake samples were carried out by a panel of 10 semi-trained students and staff members of Princess Nourah Bint Abdulrahman University. The panelists were asked to evaluate the appearance, color, odor, taste, textures and overall acceptance on a 9-point hedonic scale used for different sensory attributes, where 1 = Dislike extremely and 9 = Like extremely.

Statistical analysis: The data obtained were described as the Mean±SD and statistically analyzed using software SPSS Inc., (Chicago, IL, USA). Significant difference was evaluated by Duncan's Multiple Range Test (DMRT) with differences considered significant when the probability was less than 5%.

RESULTS AND DISCUSSION

The chemical compositions of the different prepared cakes are shown in Table 2. There were no significant ($p<0.05$) differences in the moisture and protein content between the control and pumpkin cakes. However, there were significant ($p<0.05$) differences in the protein, fat and ash contents among the control, pumpkin and pumpkin and date cakes. The fat content was lower in the pumpkin cake and the pumpkin and date cake compared to the control. This may be attributed to the low fat content in pumpkins and dates[17].

The protein content of the control was significantly ($p<0.05$) higher than all other type of cakes. This result may be due to the increased protein content in wheat flour compared to dates and pumpkin. Moreover, the addition of pumpkin and dates led to reductions in the protein content[18].

The ash and fiber contents in the pumpkin cake were significantly higher ($p<0.05$) than those in the control. These results are consistent with the findings of Sudha *et al.*[19] and Eke *et al.*[20] for banana cake and Singh *et al.*[21] in biscuits supplemented with various levels of jaggery.

Table 2: Chemical composition of the pumpkin cake and the pumpkin and date cake

	Composition						
Types of cake	Moisture (g/100)	Protein (g/100 g)	Fat (g/100 g)	Ash (g/100 g)	Fiber (g/100 g)	Carbohydrate (g/100 g)	Energy (kcal/100 g)
Control	34.39^{b}	4.62^{a}	7.51^{a}	1.01^{c}	0.93^{b}	51.54	292.23
PC	35.72^{b}	4.51^{b}	7.36^{b}	1.43^{a}	1.21^{a}	49.77	283.36
PDC	36.70^{a}	4.50^{b}	7.35^{b}	1.30^{b}	1.15^{a}	49.00	280.15

Control: Cakes without additions, PC: Pumpkin Cake, PDC: Pumpkin and Date Cake, Means in the same column with different letters are significantly different (p<0.05)

Table 3: Mean fatty acid content in the pumpkin cake and the pumpkin and date cake

	Types of cakes		
Fatty acids	Control	PC	PDC
Oleic acid	25.42^{a}	44.23^{a}	32.33^{a}
Palmitic acid	18.45^{a}	21.58^{a}	21.34^{a}
Stearic acid	10.12^{a}	15.57^{a}	16.35^{a}
Linoleic acid	9.05^{a}	12.49^{b}	22.36^{c}
Elaidic acid	0.59^{a}	1.79^{b}	1.50^{c}
Linolenic acid	0.56^{a}	0.97^{b}	3.12^{c}
Palmitoleic acid	0.34^{a}	1.14^{b}	0.76^{c}
Myristic acid	0.30^{a}	0.45^{b}	0.53^{c}
Butanoic acid	0.10^{a}	0.04^{a}	0.04^{a}

Control: Cakes without additions, PC: Pumpkin cake, PDC: Pumpkin and date cake, Means in the same column with different letters are significantly different (p<0.05)

Table 4: Sensory evaluation of the pumpkin cake and the pumpkin and date cake

Types of cake	Appearance	Color	Odor	Taste	Texture	Overall quality
Control	7.50^{b}	8.50^{b}	8.75^{a}	8.50^{b}	8.25^{b}	8.00^{a}
PC	7.75^{a}	8.95^{a}	8.95^{a}	8.75^{a}	8.95^{a}	8.50^{a}
PDC	6.25^{c}	6.75^{c}	8.50^{b}	8.95^{a}	7.50^{c}	7.75^{b}

Control: Cake without additions, PC: Pumpkin cake, PDC: Pumpkin and date cake, Means in the same column with different letters are significantly different (p<0.05)

The carbohydrates and energy kcal/100 g decreased by 8.87 and 12.08%, respectively, with the addition of pumpkin and dates, which also reduced the total carbohydrate content of the cakes. These results are in agreement with those of See *et al.*[22], who found that increasing the level of pumpkin flour led to increases in the ash and crude fiber. However, there was a significant decrease in the protein and fat content.

Table 3 shows the fatty acid content in the different cakes. Oleic acid content was high compared with other fatty acids, while butanoic acid content was the lowest. Fatty acid content, except for butanoic acid, was increased in both pumpkin-containing cakes. There were no significant (p<0.05) differences in the oleic acid and linoleic acid contents between the control and the other types of cakes. Additionally, there were no significant (p<0.05) differences in the levels of palmitic acid and stearic acid between the pumpkin cake and the pumpkin and date cake. The fatty acid content in the other cakes was significantly (p<0.05) higher than the control. These results could be due to the higher content of fatty acids in pumpkin and dates. This result is consistent with the study of Pericin *et al.*[5] and Popovic *et al.*[23].

Sensory evaluation of the prepared cakes: Table 4 shows the results of the sensory evaluation of the cakes. The odor, texture and overall acceptability scores for the control treatment, the pumpkin cake and the pumpkin and date cake are presented in Table 4. There were no significantly differences (p<0.05) in the scores of the appearance of all types of cakes and the mean scores of the appearance ranged from 6.25 to 7.75.

The pumpkin-containing cake had the highest scores for all quality attributes compared to the control and the pumpkin and date cakes. This was likely due to the stronger pumpkin odor and taste, consistent with the findings of El-Demery[17] and Bhat and Bhat[24].

Moreover, color appeared to be a very important criterion for initial acceptability of the cakes by the consumer. The color of the pumpkin cake was significantly (p<0.05) affected by the addition of pumpkin. However, the color of the pumpkin and date cake caused significant (p<0.05) decreases in the sensory evaluation scores. The development of food products with attractive colors has been a major goal in the food industry. In a study by El-Demery[17], higher levels of pumpkin powder produced toasted bread with improved

color. In addition to the increase in nutritional value, the attractive color resulting from the pumpkin improved the appearance of the cake and its overall sensory characteristics. One limitation to this study, however, is that there are no data concerning the health effects of cake with dates and pumpkin and therefore, such effects should be studied in the future.

CONCLUSION

Cakes prepared using pumpkin were found to be the best in terms of sensory analysis. The best sample was found to be rich in crude fiber and protein and had less fat and energy content. This showed great potential for the integration of pumpkin in baked products.

SIGNIFICANCE STATEMENT

This study found that the addition of pumpkin and dates to cakes may play an important role in the daily nutrition of many people and may be beneficial for many areas of health. This study will help uncover the importance of pumpkin and date addition to cakes in terms of health, thus facilitating new insight in food production.

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