

Chemical and Rheological Characteristics of Butter Cake as Affected by Date Seed Powder Addition

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Abstract: Ground date seeds and wheat flour (72 % extraction) blends (0, 2.5, 5, 7.5, and 10 % date seeds powder) were rheologically evaluated and used to produce butter cake. Results showed that water absorption, batter stability, development time, time to break down, begin of gelatinization, gelatinization temperature and gelatinization maximum were negatively affected by the addition of date seed powder. The processed cake samples were chemically and organoleptically evaluated. Results showed that by increasing date seed powder levels, the fiber, fat and ash contents increased. The substituted cake (2.5 %) scored high sensory scores and was not significantly ($p < 0.05$) different from the control. While, the other substituted cakes, (5, 7.5, and 10 %) scored low sensory scores. Therefore date seed powder could be added to some bakery products such as cakes at a level of 2.5% of the flour.

Keywords: Cake, date seeds, rheology, flour.

INTRODUCTION

Date (*Phoenix dactylifera* L.) fruit is composed of a fleshy pericarp and seed. The seed constitutes between 10 and 15 % of date fruit weight (Hussein *et al.*, 1998). The date seed considered a by-product of many date processing plants producing pitted dates, date syrup and date confectionaries (Al-Farsi *et al.*, 2007). At present, seeds are used mainly for animal feeds i.e., the cattle, sheep, camel and poultry industry (Al-Farsi and Lee, 2008). The production of date fruits in the world is estimated at 6.9 million tons, from these approximately 863 thousand tons of date seeds are produced (FAO, 2007). Identifying new ingredients with multiple roles (enhancing the rheological properties of dough and bread quality that are beneficial for health) is one of the priorities of the last decade (Mironeasa *et al.*, 2012). Date seeds could be considered as a great source of valuable products such as phenolics and dietary fibers (Al-Farsi and Lee, 2008), antioxidant activity (Al-Farsi *et al.*, 2007 and Ammar and Habiba, 2010) and oils (Besbes *et al.*, 2004). Many researchers have been studied different composite flours forming mixes in which wheat flour is mixed with chickpea (Faheid and Hegazi, 1991), amaranth (Oszvald *et al.*, 2009), soy and lupin (Doxastakis *et al.*, 2002), pea (Kasprzak and Rzedzicki, 2010), palm date seeds (Bouaziz *et al.*, 2010) and grape seed flour (Mironeasa *et al.*, 2012), therefore, the aim of this study is the evaluation of the chemical and rheological quality of butter cake as affected by date seed powder addition.

MATERIALS AND METHODS

Wheat flour (72% extraction), eggs, sucrose, skimmed milk, salt "sodium chloride", baking powder and butter were purchased from local market, Cairo, Egypt. Date seeds were kindly obtained from Al-Saudia For Dates, Qassim, Saudi Arabia.

Preparation of date seed powder:

The date seeds were ground to a powder using a laboratory mill and the particle size of seeds powder was 0.01mm. The date seed powder (ground date seed) was kept in closed jars and cooled until used.

Preparation of butter cake:

Date seed powder was mixed with the wheat flour (72 % extraction) at 2.5, 5.0, 7.5, and 10 %. Then, 320 g of the flour mixture was well mixed for 20 min with sucrose (175g), skimmed milk (125g), baking powder (10g), butter (125g), eggs (120g) and salt (2g). The mixture, with and without (control) date seed powder, were rheologically evaluated and baked at 275°C for 30 min. Then, the cakes were allowed to cool and chemically evaluated according to the methods outlined in A.O.A.C. (2000).

Rheological Properties

Farinograph measurements

For 300 gm of wheat flour (control) and wheat flour containing of each 2.5, 5, 7.5, and 10% ground date seeds were separately studied using Farinograph-E (Brabender GmbH&Co. KG, Duisburg, Germany), according to standard AACC methods (2000). The parameters determined were percentage of water absorption (WA), batter development time (BDT), batter stability (BS) and time to breakdown (TBD). Wheat flour alone was used as a control.

Amylograph test:

For 80 gm of wheat flour (control) and wheat flour containing of each 2.5, 5.0, 7.5, and 10 % ground date seeds with 450 ml distilled water were separately studied using Amylograph-E (Brabender GmbH&Co. KG, Duisburg, Germany) according to standard AACC methods (2000). The parameters determined were begin of gelatinization (BG), gelatinization temperature (GT), and gelatinization maximum (G Max).

Physical characteristics of cake fortified with date seed powder:

Physical characteristics such as weight, height and index to volume were determined in butter cake samples containing 0.0, 2.5, 5.0, 7.5, and 10% date seed powder.

Sensory evaluation of cake:

Sensory evaluation of the prepared butter cakes was carried out according to Amerine *et al.*, (1965). Fresh samples of butter cakes containing 0.0, 2.5, 5.0, 7.5, and 10% date seed powders were sensory evaluated by 20 panelists. All samples were evaluated for color, texture, taste, odor, appearance and overall acceptability using ten- point hedonic scale, which a score of 10 represented attributes most liked; 5 represented attributes at an unacceptable margin; and 1 represented attributes most disliked.

Statistical analyses:

The physical and sensory properties data were statistically analyzed using one – way analyses of variance, ANOVA (Rao, and Blane, 1985).

RESULTS AND DISCUSSION

Chemical composition of date seed powder:

Proximate analysis of the prepared date seed powder is shown in Table (1). Data show that date seeds contained protein, fat, fiber, ash and total carbohydrate as follows 6, 6.6, 29.8, 1.1 and 56.5 %, respectively. The results indicated that date seed powder contained high amounts of fibers, crude fats and proteins, therefore, date seeds could be used as a source of fibers, fat and protein taking into consideration studying the quality of its fat and protein with respect to their content of essential fatty acids and essential amino acids, respectively. These results are in agreement with those found by Rahman *et al.*, (2007) and Ammar and Habiba (2010).

Butter cake composition as affected by date seed powder addition:

The butter cake composition of unfortified and fortified cakes with 2.5, 5.0, 7.5, and 10% date seed powder was presented in Table (2). The percentages of ash, moisture, protein, fat, fiber and carbohydrates (control) were 0.73, 17.81, 7.5, 1.3, and 0.30 %, respectively. Increasing date seed powder addition led to increase the content (%) of fiber, ash and fat in the fortified cake and decrease the content (%) of protein. However the rest of constituents were slightly changed.

Effect of added date seed powder on batter rheology properties:

Changes in rheological properties of the flour are indicative of the quality end use product and also help in understanding the handling proper- ties of dough during processing. Moreover, they may even predict the quality of the bakery products (Sollars and Rubenthaler 1975). The effects of ground date seeds addition (2.5, 5.0, 7.5, and 10%) on batter rheology were summarized in Tables (3 and 4). Comparing to control, water absorption was decreased by increasing addition of date seeds powder. This might to be due to the decrease of the gluten content in the dough when wheat flour was

substituted by date seed powder. It could be expected that the presence of fibers will increase the water absorption value. But, based on these results, they probably do not completely absorb water during dough mixing but in some later stage, maybe during baking (Nikolic *et al.*, 2011).

Batter stability (BS) is given by time from the Farinograph trace touches the 500 BU line up to the break time. Batter stability decreased when date seed powder was added. Therefore, addition of date seeds powder negatively affected batter stability comparing to the control sample. Also, the time required for batter development or time necessary to reach 500 BU of batter consistency. Dough mixing time values showed that the addition of date seed powder impacted the time the batter maintain its best consistency at the 500 BU line. This may be due to increasing of fiber content. Chen *et al.*, (1988) suggested there is a possible interaction between fiber and gluten that prevents their complete hydration resulting in poor gluten development during mixing. Michniewicz *et al.*, (1991) found increased mixing time of dough with 1–2% added wheat and rye pentosans, which was attributed to their effects on the aggregation and disaggregation of high molecular weight protein in wheat.

Time to breakdown is shown by the drop of the farinograph curve from the 500 BU line. Batter time to breakdown decreased when date seed powder was added (Fig.1).

Data in Table (4) show that the addition of date seed powder decreased the beginning of gelatinization (transition temperature, BG) comparing to control sample. Moreover, the addition of date seed powder to the flour decreased gelatinization temperature (GT) and gelatinization maximum (G Max) (Fig. 2).

Physical properties of butter cake as affected by date seed powder addition:

The physical properties of unfortified cake and fortified cake with date seed powder addition (2.5, 5.0, 7.5, and 10%) are presented in Table (5). Weight, height, volume and index to volume in unfortified cake were 863.6 gm, 5.6 cm, 1511 cm³ and 8.66 cm, respectively. Fortification of cake with date seed powder caused a parallel increase in physical properties with increasing the level of ground date seed. However, no statistical difference in index to volume was noticed. Best results, in all physical properties, for the cake were achieved at the fortification level of 2.5% ground date seeds. In view of the fact that the characteristics of a cake quality are highly dependent on ingredients present in the formulation, chemical characteristics of these ingredients and of their possible interactions (Baik *et al.*, 2000), thus, changes in the amount and type of ingredients can cause changes in quality parameters of the final product (Moscatto *et al.*, 2006).

Sensory evaluation of butter cake as affected by date seed powder addition:

Table (6) illustrates sensory evaluation scores of fortified cake with date seed powder. The mean scores for color, taste, texture, odor, appearance and overall acceptability of unfortified cake (control) were 8.66,

8.8, 8.7, 8.83, and 8.73, respectively. The results of the statistical analysis in this table showed no significant difference between unfortified cake (control sample) and cake fortified with 2.5% ground date seeds. However, comparing with control, fortification of cake with 5%, and 7.5% ground date seeds resulted in significant decrease ($P<0.05$) in all sensory evaluation

parameters. This may be due to changes in the chemical composition, fiber content in particular. Competition for water between date seed fiber and other ingredients in the mix as flour and sugars resulting in a significant factor in the contribution of these ingredients to overall cake flavor in some formulations (Jasberg, *et al.*, 1989).

Table (1): Proximate chemical composition of date seed powder (dry weight bases).

Components	%
Protein	6.0
Fat	6.6
Fiber	29.8
Ash	1.1
Total carbohydrates ^a	56.5

^aCarbohydrate calculated by difference.

Table (2): Proximate butter cake composition as affected by date seed powder addition (wet weight bases).

Components	Ash (%)	Moisture	Protein	Fat	Fiber	Carbohydrates
Samples						
Control	0.73	17.81	7.50	1.30	0.30	72.36
2.5%	0.71	14.16	7.10	1.30	0.42	76.31
5%	0.94	13.34	6.50	1.40	0.61	78.11
7.5%	0.65	16.51	6.30	1.45	1.01	74.08
10%	0.72	15.86	6.00	1.45	1.37	74.60

Table (3): Effect of added date seed powder on farinograph properties of cake batter.

Flour blends	WA %	DS (min)	DDT (min)	TBD (min)
Control*	64.3	14.1	7.3	17.1
Control +2.5% date seeds	62.0	9.6	5.4	9.6
Control +5% date seeds	61.0	6.0	1.4	1.5
Control +7.5% date seeds	59.8	6.6	1.7	1.9
Control +10% date seeds	58.5	9.5	1.2	1.3

*Control: wheat flour (72% extraction), WA: water absorption, DS: dough stability, DDT: dough development time, TBD: Time to breakdown.

Table (4): Effect of added date seed powder on amylograph properties of cake batter.

Flour blends	BG (°C)	GT (°C)	G Max (AU)
Control*	70.8	88.5	1001
Control +2.5% date seeds	61.9	87.0	829
Control +5% date seeds	58.8	87.1	804
Control +7.5% date seeds	59.4	87.0	761
Control +10% date seeds	59.4	86.9	769

*Control: wheat flour (72% extraction), BG: Begin of gelatinization, GT: Gelatinization temperature, G Max: Gelatinization maximum.

Table (5): Physical properties of butter cake as affected by date seed powder addition.

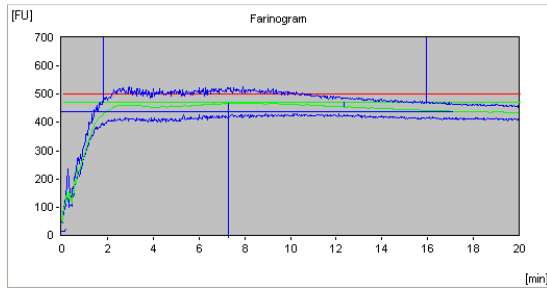
Samples	Weight (gm)	Height (cm)	Volume cm ³	Index to Volume (cm)
Control*	863.6±13.05 ^c	5.6±0.10 ^c	1511±20 ^c	8.66±0.73 ^a
Control +2.5% date seeds	865.6±10 ^c	5.4±0.90 ^d	1506.6±44 ^c	8.2±0.10 ^a
Control +5% date seeds	858.3±7.6 ^c	6.19±0.10 ^b	1553.3±10 ^b	9.8±0.98 ^a
Control +7.5% date seeds	885.0±5 ^{ab}	5.56±0.70 ^c	1566.6±18 ^{ab}	8.46±1.06 ^a
Control +10% date seeds	895.0±5 ^a	6.53±0.11 ^a	1586.6±2 ^a	9.16±0.49 ^a

Control: wheat flour (72% extraction). Means followed by different superscripts within columns are significantly different ($P<0.05$).

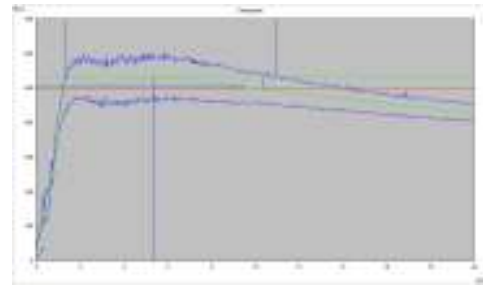
Table (6): Sensory evaluation of butter cake as affected by date seed powder addition.

Samples	Color	Taste	Texture	Odor	Appearance	Overall acceptability
Control*	8.66±0.15 ^a	8.8±0.10 ^a	8.7±0.10 ^a	8.83±0.05 ^a	8.73±5.76 ^a	8.63±0.25 ^a
Control +2.5% date seeds	8.40±9.99 ^a	8.4±0.10 ^a	8.73±0.15 ^a	8.32±0.26 ^a	8.59±0.10 ^a	8.63±0.15 ^a
Control +5% date seeds	5.8±1.30 ^b	5.8±1.12 ^b	5.67±1.7 ^b	5.46±1.18 ^b	5.53±1.15 ^b	7.93±0.15 ^{ab}
Control +7.5% date seeds	5.53±0.15 ^b	5.6±0.43 ^b	5.8±0.17 ^b	5.3±0.99 ^b	5.53±0.37 ^b	7.03±0.86 ^c
Control +10% date seeds	4.3±9.99 ^c	3.56±5.7 ^c	4.06±0.05 ^c	3.62±0.17 ^c	3.7±0.10 ^c	7.53±0.32 ^{bc}

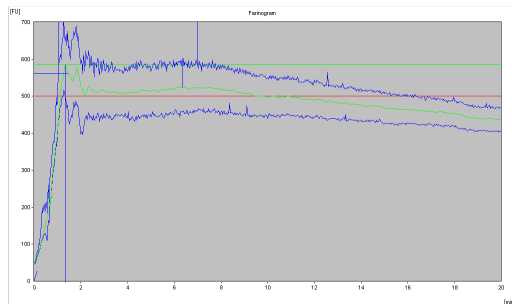
*Control: wheat flour (72% extraction). The average of total score was converted to a descriptive category as follows: Judging scale: very good (9-8), Good (6-7), Fair (4-5), Poor (2-3) and Very Poor (1). All results are expressed as mean ± SD. Means followed by different superscripts within columns are significantly different ($P < 0.05$).



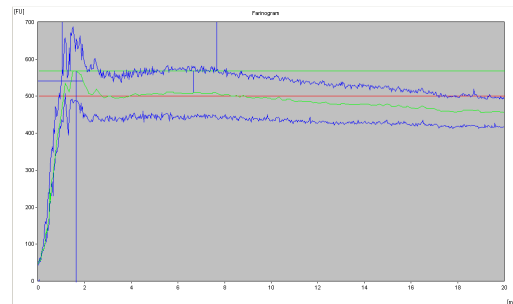
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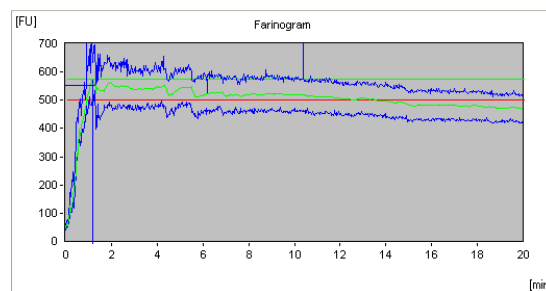
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3



4



5

Fig. (1): The farinograms of the different blends of wheat flour and date seed powder: 1: control (wheat flour 72%), 2: control+2.5% date seed powder, 3: control+5% date seed powder, 4: control+ 7.5% date seed powder, and 5: control+ 10% date seed powder.

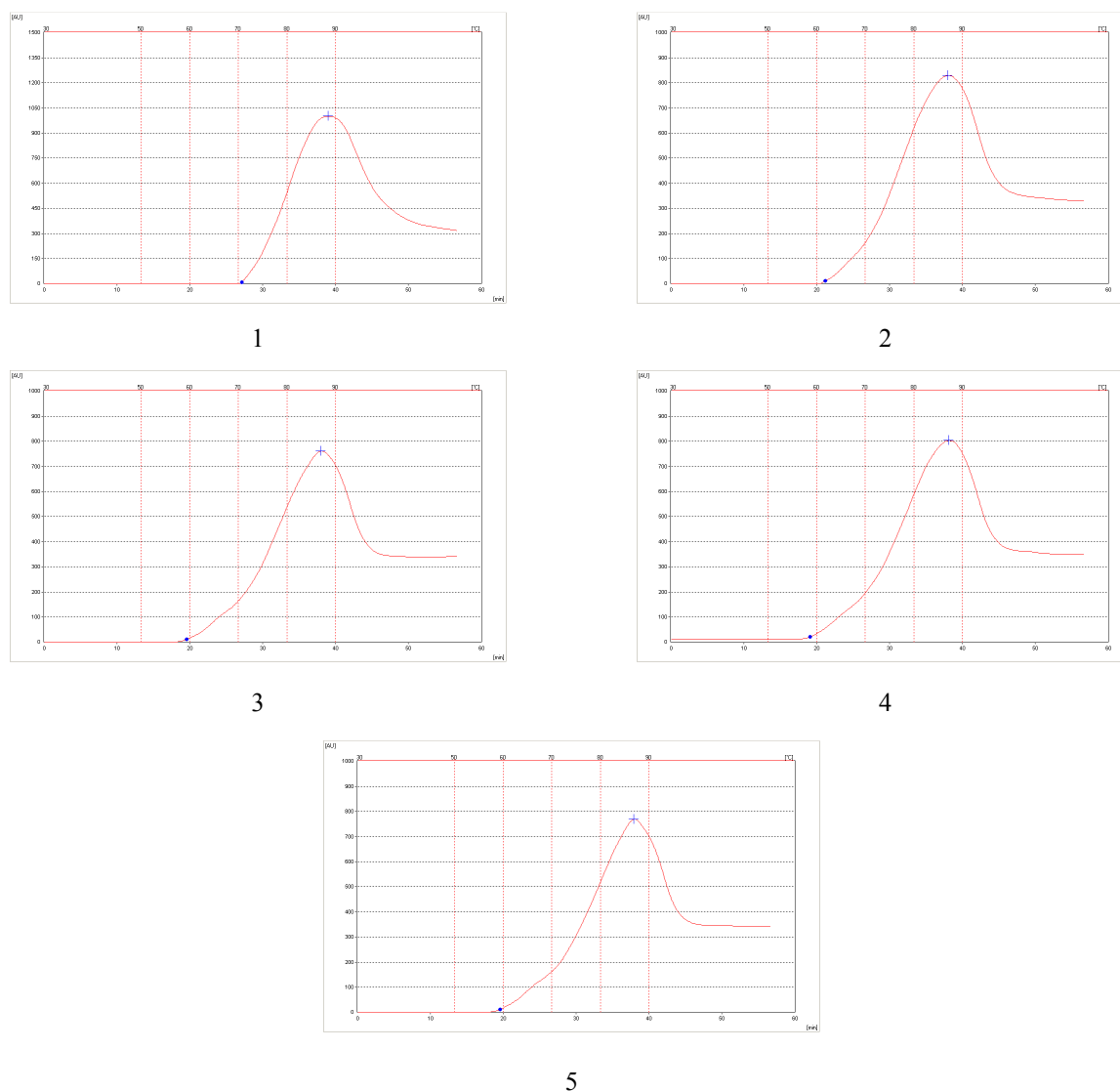


Fig. (2). The amylograms of the different blends of wheat flour and date seed powder: 1: control (wheat flour 72%), 2: control+2.5% date seed powder, 3: control+5% date seed powder, 4: control+ 7.5% date seed powder, and 5: control+ 10% date seed powder.

CONCLUSION

From the above results it could be concluded that fortification of the bakery products such as cake with date seed powder at 2.5 % is recommended.

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الخصائص الكيميائية والريولوجية للكيك الدسم المضاف له مسحوق نوى التمر

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في هذه الدراسة تم إضافة مسحوق نوى التمر لدقيق القمح المستخدم في صناعة الكيك الدسم بنسبة 2.5%، 5%، 7.5% و10%، وتم دراسة تأثير إضافة مسحوق نوى التمر على الخصائص الريولوجية للعجائن، والخصائص الفيزيائية والكيميائية والحسية للكيك. أشارت الدراسة إلى أن إضافة مسحوق نوى التمر للدقيق اثر سلبي على الخصائص الريولوجية للعجين، كما لوحظ أن هناك علاقة عكسية بين نسبة إضافة مسحوق نوى التمر وكمية الماء الممتص. ولقد أظهرت النتائج أن إضافة مسحوق نوى التمر المستخدم لعمل الكيك الدسم أدى إلى زيادة ملحوظة في محتوى الكيك من الألياف. كما أوضحت الدراسة أن التدعيم بمسحوق نوى التمر بمستويات عالية 7.5% و10% أثر على التقييم الحسي، خاصة اللون حيث اكتسب الكيك الدسم اللون البني وازدادت كثافة اللون. وتوصى الدراسة بإمكانية إضافة مسحوق نوى التمر بنسبة 2.5% إلى بعض منتجات المخازن مثل الكيك الدسم.