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Using apricot seed kernels for the development of supplemented cakes

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ABSTRACT
Apricot seed is a nutrient-dense by-product of apricots that is frequently wasted. The aim of this study was to determine the best way to use apricot seed kernels (ASK). For the manufacture of supplemented cakes, apricot seed kernels were processed and powder (flour) was produced. One control sample and four experimental samples were constructed by mixing 2.5 - 10 % level of apricot seed kernel powder (ASKP) and organoleptic evaluation. The nutritional composition of control and acceptable experimental samples was determined. The addition of ASKP in cakes at a concentration of 7.5 % was shown to be organoleptically acceptable. When compared to control samples, developed cakes had significantly higher energy, crude fiber, crude fat, and total ash content ($p < 0.01$). Minerals (calcium, iron, and magnesium) were found to have increased significantly ($p < 0.01$) in developed cakes. Antioxidant activity in ASKP supplemented cakes was found to be considerably greater ($p < 0.01$), with a 2.5 to 7.5 % increase in antioxidant activity. As a result, the use of apricot seed kernel powder can improve the nutritional value of meals.

Keywords: Apricot seed kernel Powder, Cake, Antioxidant activity, Organoleptic evaluation, Nutritional composition.
Article type: Research Article.

INTRODUCTION
Apricot, *Prunus armeniaca* L. is a major horticultural crop in Egypt, due to its importance in export and many uses in the food industry. In Egypt, apricot tree farming covers around 6070.28 ha, yielding 102,300 tons of fruit each year, containing roughly 7000 tons of seeds (Agricultural statistics 2017). The apricot seed is an essential component of the fruit. After consumption and industrial processing of apricot, considerable amount of the seeds is discarded as waste. However, nutritionally, fruit seed is the most enriching part of fruit, since it acts as a storage site of nutrients. Apricot seed kernels are nutrient-dense, containing crude oil (48.70%), protein (17.38%), P (1.06 ppm), Na (3.68%), K (0.58 ppm), Mg (0.24 ppm), Ca (0.11 ppm), Fe (42.8 ppm), Mn (1.10 ppm), Zn (42.35 ppm), Cu (2.09 ppm), and vitamins A; C; and B_{17} (Hazbavi, 2013). Antioxidant and antimicrobial activities have also been observed for the kernel (Yigit *et al.* 2009). Plant cyanogenic glycoside levels vary depending on plant species and environmental factors. Amygdalin contains (also known as laetrile or vitamin B_{17}) a cyanide group between a glycoside and a benzene ring that can be released after hydrolysis (Cho *et al.* 2006). Apricot seed kernels are utilized in a variety of applications, including medicine, cosmetics, oil manufacturing, and active carbon. Furthermore, the ostensibly discarded cake is used to feed livestock (Yildirim *et al.* 2016). The antioxidant activities of peeled, defatted, and roasted apricot kernel flours were assessed using radical anti-lipid peroxidative activity (ALPA), scavenging power (RSP), total phenolic content (TPC), and reducing power measurements (RP). RSP, RP, and TPC did not grow in a linear fashion and peaked after 10 min of roasting. ALPA values were reduced by roasting; hence, unroasted samples had the greatest ALPA value (Durmaz & Alpaslan 2007). Consumer demand for foods with health advantages and acceptable sensory attributes has risen in recent years as interest in healthy eating has grown. Many readily available foods that are high in antioxidants and phytonutrients

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have been made accountable. The goal of this study was to explore if it was possible to make a value-added cake using varied ratios of wheat flour and apricot seeds kernel powder.

MATERIALS AND METHODS

Experiments were conducted at the Agricultural Research Station in Kafer El-Hamam Village, El-Sharkia Governorate, Egypt, between 2017 and 2021 to test the possibility of developing a value-added cake using various ratios of wheat flour, apricot seeds kernel powder, and other materials.

Materials

Wheat flour and apricot seeds

Wheat flour was bought at a local market in Zagazig, Egypt, with a 72% extraction rate. Apricot seed (variety: Canino) were gotten from Misr-Italy Company for Concentrates and Food Industries, Egypt.

Ingredients for baking

Fresh whole eggs, shortening, dry milk, vanilla, salt, sugar, and all other baking components were purchased locally in Zagazig, Egypt.

Use of chemicals

All analytical chemicals utilized in this investigation were procured from Al-Gomhourya Chemical Company in Egypt.

Methods

Powdered apricot seed kernels preparation

Apricot seeds were dried in an air circulation oven, and the kernels were separated from the hard shell using a machine prototype. The kernels were then diced and dried for 12 h in an air circulation oven at 40 ºC. The dried kernels were crushed into a fine powder, sieved using a 110-mesh sieve, then kept in polyethylene bags at -18 ºC until needed.

Producing composite flour mixtures

By partially substituting wheat flour with 2.5, 5.0, 7.5, and 10% apricot seed kernel powders, several composite flour samples were created.

Processing of cakes

According to Table 1, the cake was made with the components (Bent *et al.* 2013) including 100 g flour, 85 g sucrose, 85 g whole fresh egg, 3 g dry milk, 55 g shortening, 1.0 g salt, 3.8 g baking powder, and 0.6 g vanilla were used to make the cake batter.

Table 1. The cake formula prepared in the current study.

	Control sample	Apricot seed kernel powder			
Substitution level		**2.5**	**5.0**	**7.5**	**10.0**
Wheat flour (72% ext.) (g)	100	97.5	95.0	92.5	90.0
Powdered baking (g)	3.8	3.8	3.8	3.8	3.8
Sugar (g)	85	85	85	85	85
Salt (g)	1.0	1.0	1.0	1.0	1.0
Dry milk (g)	3	3	3	3	3
Shortening (g)	55	55	55	55	55
Fresh whole egg (g)	85	85	85	85	85
Vanilla (g)	0.6	0.6	0.6	0.6	0.6

A kitchen machine (Braun Multiquick 5 K7000) was used to cream together shortening, egg, vanilla, and sucrose powder for 5-10 min. Dry milk, flour, and baking powder were combined in a mixing bowl. This mixture was gradually added to the previously produced cream and mixed for 3 min on low speed with a mixer (Braun Multiquick 5 K7000). The batter was scaled at 100 g into baking pans, baked at 180 °C for 35 min, and let to cool at room temperature for 1.0 h before examination.

Analytical methods

Chemical analyses (Composition chemical)

The contents of moisture, protein, ash, crude fiber, and crude lipids (%) were determined using the AOAC (2010). A carbohydrate was computed using the following formula:

Total carbohydrate = 100 - % (protein + fat + ash + moisture)

Mineral content determination

Mineral contents (Na, Ca, K, Fe, P, Mg, Zn, and Mn) were determined at the Central Laboratory, Faculty of Agriculture, Zagazig University, Egypt, using atomic absorption spectrophotometry (ICAP 6500 Duo, England Multi-element certified standard solution 100 mg L^{-1} Merck, Germany) according to the AOAC (2010) method.

Dietary fiber measurement

The total dietary fiber in the samples were determined using the AOAC (2010). The soluble and insoluble dietary fibers were evaluated using the technique of Prosky *et al.* (1988).

Total phenolic content determination

Total phenolic compounds were assessed using the Folin-Ciocalteau reagent according to the method of Szydłowska-Czerniak *et al.* (2008).

Total flavonoids content determination

The content of total flavonoids was measured using the method described by Jia *et al.* (1998).

Phenolic and flavonoid compound fractionation and identification

The experiment was carried out using a high-performance liquid chromatography system with a variable wavelength detector (Agilent Technologies, Germany, 1200 series). An auto-sampler, quaternary pump degasser, and column compartment set at 35 °C were also included in the HPLC. A C18 reverse-phase (BDS 5 m, Labio, Czech Republic), and packed stainless-steel column (4250 mm i.d.) was used for the analysis. To measure phenolic acids and flavonoids, samples were produced using the technique of Atawodi *et al.* (2011).

Cakes for sensory evaluation

The cake was reviewed by 10 panelists from the Food Industries Department, Faculty of Agriculture, Zagazig University, using the procedure specified by AACC (2000).

After baking, the cake samples were allowed to cool for an hour at room temperature. It was then cut with a sharp knife and put through a panel test. Cells received a score of 30 (uniformity 10, cell size 10, and cell wall thickness 10), grain received a score of 20, texture received a score of 30 (moistness 10, tenderness 10, and softness 10), crumb color received a score of 10, flavor received a score of 10, and overall acceptability received a score of 100 degrees.

Analytical statistics

The data were evaluated using analysis of variance (ANOVA) and the General Linear Model (GLM) technique, as described by Snedecor & Cochran (1980). Duncan's test was used to differentiate the means at a level of significance ($p \leq 0.05$). The SAS software system application was used to conduct statistical analysis (SAS 1997).

RESULTS AND DISCUSSION

Chemical components of the materials

The chemical components of wheat flour (72% ext.), and apricot seed kernel flour are illustrated in Table 2. The results showed that the apricot seed kernel powder had more crude protein (16.16%), crude fiber (2.07%), crude fat (43.19%), and total ash (3.43%) than wheat flour (72 % ext.). Table 2 depicts that substituting wheat flour (72

% ext.) by apricot seed kernel powder enhances the protein, fat, fiber, and ash content of goods. These findings are in agreement with those of Sharoba *et al*. (2013), and Alpaslan & Hayta (2006).

Minerals content of the materials

The minerals content of apricot seed kernel powder and wheat flour (72 % ext.) can be found in Table 2. The former contained the highest content of zinc (Zn), iron (Fe), magnesium (Mg), potassium (K), sodium (Na), and manganese (Mn), compared to wheat flour, recording 2.83, 2.37, 250.32, 530.71, 35.32, and 2.13 mg/100 g, respectively. These results are consistent with those obtained by Abd-Elaziz (2018), Romelle *et al*. (2016), Khedr *et al*. (2016) and Nour *et al*. (2015).

Dietary fiber (total, soluble, and insoluble) in the materials

According to Table 2, the apricot seed kernel powder contained the highest percentage of total dietary fiber, which amounted to 35.14. These findings are similar to those obtained by Khedr *et al*. (2016), Mosa & Kalil (2015), and Thannoun & Younis (2013). However, wheat flour (72 % ext.) contained 3.12% TDF, 1.11% SDF, and 2.01% IDF. Gill & Johnson (2002) reported that wheat flour (72 % extract) had 2.28 % SDF, 4.19 % TDF, and 1.91 % IDF (on dry weight basis).

Compounds total phenolic and flavonoid in the materials used

Based on Table 2, the apricot seed kernel powder contained higher TPC and TFC with 187.18 (mg of Gallic acid/g) and 84.35 (mg of quercetin/g), respectively. These findings are consistent with those reported by Abdel-Aty *et al*. (2018), Dorta *et al*. (2014), Sogi *et al*. (2013), Ribeiro & Schieber (2010), and Abdalla *et al*. (2007). In addition, it contained WF with 33.05 (mg of Gallic acid/g) and 23.30 (mg of quercetin/g). These findings are consistent with those previously published by Yu & Beta (2015).

Properties of cake

Chemical composition of produced cake

Table 3 depicts that adding apricot seed kernel powder to cakes boosted their chemical composition percentages (moisture, crude protein, lipids, ash, and crude fiber) as compared to a control cake sample. However, total carbohydrates dropped, once the substitution amount was raised. The same trend of chemical composition was observed in cake treatments by adding the apricot seed kernel powder. These results are consistent with those obtained by Das *et al*. (2019), Topkaya & Isik, (2019), and Isik & Topkaya (2016).

The cake mineral content

Table 4 shows that partial replacement of wheat flour with apricot seed kernel powder increased mineral content (%) (i.e., K, Mg, Ca, Mn, Na, Fe, and Zn) of cake samples as compared to control, based on upraise in the level of substitution. Mineral content was found to be similar in cake treatments with apricot seed kernel powder. These results are consistent with those obtained by Das *et al*. (2019), Topkaya & Isik (2019), and Isik & Topkaya (2016).

Dietary fiber (total, soluble, and insoluble) in the prepared cake

Table 5 depicts that partial replacement of wheat flour with apricot seed kernel powder enhanced dietary fiber rate (%; total, soluble, and insoluble dietary fiber) of cake samples, compared to the control group. Cake treatments containing apricot seed kernel powder have also recorded the same trend of dietary fiber. These results are in line with those obtained by Das *et al*. (2019), Topkaya & Isik (2019) and Isik & Topkaya (2016).

The total amount of phenolic and flavonoid in the cake

Table 6 illustrates that when wheat flour was partially replaced by apricot seed kernel powder, the total phenolic and flavonoid content of cake samples increased in tandem with the extent of substitution, compared to control. These results are in accordance with those obtained by Das *et al*. (2019), Topkaya & Isik, (2019), and Isik & Topkaya (2016).

Table 2. Chemical composition, dietary fiber, minerals content, and antioxidant properties of apricot seeds kernel powder and wheat flour.

Components	**Wheat flour**	**Apricot seeds kernel powder**
Chemical composition (dry weight basis, g/100g)		
Moisture (%)	12.62	9.21
Crude protein (%)	10.01	16.16
Crude Fat (%)	1.80	43.19
Ash (%)	0.39	2.07
Crude Fiber (%)	0.83	3.43
Carbohydrate (%)	86.97	35.15
Content of Minerals (mg/100g on a dry weight basis)		
Ca	36.02	2.1
Zn	0.19	2.83
Fe	0.91	2.37
Mg	16.26	250.32
K	28.30	530.71
Na	34.98	35.32
Mn	1.35	2.13
Dietary fiber (g/100g on a dry weight basis)		
Total dietary fiber (TDF)	3.12	35.14
Soluble dietary fiber (SDF)	1.11	13.55
Insoluble dietary fiber (IDF)	2.01	21.45
Antioxidant properties		
Total phenolic content (mg /g)	33.05	187.18
Total flavonoids content (mg/g)	23.30	84.35

Table 3. Proximate chemical composition of cake samples produced (%; on a dry weight basis).

	***Control sample**	**Samples of cakes Substitution level (%)**			
Chemical composition (%)		**2.5**	**5.0**	**7.5**	**10.0**
Moisture	22.13	22.65	23.5	24.44	25.26
Crude protein	16.07	15.72	15.99	16.19	16.12
Lipids	21.01	20.59	20.82	21.06	21.29
Ash	1.51	1.64	1.70	1.76	1.83
Crude fiber	4.24	4.63	4.76	4.90	5.03
** Total carbohydrates	57.17	57.43	56.73	56.09	55.73

* 100 % wheat flour (72 % ext. rate). ** Calculated using the difference method.

Table 4. Mineral composition of cake samples produced (mg/100 g on a dry weight basis).

Content of minerals (%)	*Control sample	Cake samples Substitution level (%)			
		2.5	**5.0**	**7.5**	**10.0**
K	23.15	26.45	30.29	34.13	37.97
Ca	39.86	40.80	41.56	42.35	42.99
Mg	14.11	14.52	14.95	15.51	15.95
Na	68.42	69.88	71.24	72.60	73.92
Mn	0.24	0.52	0.84	1.15	1.47
Fe	0.92	1.00	1.05	1.10	1.15
Zn	0.13	0.16	0.19	0.22	0.26

* 100 % wheat flour (72 % ext. rate).

Table 5. Dietary fibre content of produced cake samples (g / 100 g dry basis).

Dietary fiber	*Control sample	Samples of cakes Substitution level (%)			
		2.5	**5.0**	**7.5**	**10.0**
Total dietary fiber	2.58	3.53	4.41	5.29	6.17
Soluble dietary fiber	0.83	1.05	1.23	1.41	1.60
Insoluble dietary fiber	1.75	2.48	3.18	3.88	4.57

* 100 % wheat flour (72 % extr. rate).

Table 6. Total phenolic and flavonoid content of cake samples made with apricot seed kernel powder instead of wheat flour.

	*Control sample	Samples of cakes Substitution level (%)			
		2.5	**5.0**	**7.5**	**10.0**
Total phenolic	73.01	83.84	95.33	106.53	118.66
Total flavonoid	51.67	57.64	63.87	69.96	76.35

* 100 % wheat flour (72 % extraction rate).

Sensory evaluation of produced cake

Table 7 depicts that when apricot seed kernel powder is substituted, there is no significant difference in all sensory evaluation characters, including cells, grain, texture, crumb color, flavor, and overall acceptability, between the control sample and treatments containing 2.5, 5 and 7.5 % apricot seed kernel powder, which are consistent with those obtained by Das *et al*. (2019), Topkaya & Isik (2019), Isik & Topkaya (2016) and Sharoba *et al*. (2013).

CONCLUSION

The use of apricot seed kernels, a by-product of the fruit industry, in the cake formulation had a significant impact on the physicochemical and sensory qualities of biscuits. According to the findings, incorporating apricot seed kernel flour up to a level of 2.5 to 7.5 % in wheat flour can produce biscuits with acceptable sensory properties, high antioxidant activity, increased fat, ash, dietary fiber, calcium, iron, and magnesium content, and enhanced fat, ash, dietary fiber, calcium, iron, and magnesium content. Apricot seed kernel flour could be used as a possible source for various bakery items and functional food ingredients, especially since the usage of composite flours is the latest trend in the bread sector.

Table 7. Sensory evaluation of cake samples.

	Sensory evaluation	*Control sample	Samples of cake Substitution level (%) 2.5	5.0	7.5	10.0
Cells (30)	Uniformity (10)	9.90^{A}	9.00^{AB}	8.80^{BC}	8.30^{BCD}	8.03^{DEF}
	Size of cells (10)	9.70^{A}	8.87^{BC}	8.63^{BC}	8.10^{CD}	7.80^{DE}
	Thickness of walls (10)	9.90^{A}	9.03^{AB}	8.47^{BC}	8.20^{CDE}	7.90^{C}
	Grain (20)	19.80^{A}	18.40^{AB}	17.97^{AB}	17.53^{B}	17.30^{B}
Texture (30)	Moistness (10)	10.00^{A}	8.80^{BC}	8.50^{C}	8.30^{CD}	7.83^{DE}
	Tenderness (10)	10.00^{A}	8.80^{BC}	8.63^{BC}	8.27^{C}	8.00^{C}
	Softness (10)	9.70^{A}	8.60^{BCD}	8.43^{BCD}	8.20^{CD}	7.83^{DE}
	Crumb color (10)	10.00^{A}	8.35^{BC}	7.95^{CD}	7.67^{DE}	7.20^{EFG}
	Flavor (10)	10.00^{A}	8.63^{BC}	8.38^{BCD}	8.17^{CD}	7.90^{CDE}
	Overall acceptability (100)	99.00^{A}	88.58^{BC}	85.77^{BC}	82.73^{C}	79.80^{CD}

* Duncan's multiple tests show that means followed by different letters in the same column are significantly different ($p < 0.05$).
** 100 % wheat flour (72 % ext. rate).

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