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Effects of Apricot Kernel Flour and Fiber-Rich Fruit Powders on Low-Fat Cookie Quality

[a]Özen ÖZBOY ÖZBAŞ*, [b]İbrahim Tuğkan ŞEKER, [c]İncilay GÖKBULUT

[a] Department of Food Engineering, Faculty of Engineering, Aksaray University, Aksaray, Turkey
[b] Department of Food Technology, Zara Ahmet Çuhadaroğlu Vocational School, Cumhuriyet University, Sivas, Turkey
[c] Department of Food Engineering, Faculty of Engineering, İnönü University, Malatya, Turkey
*Corresponding author: ozenozboy@yahoo.com

Abstract

Reducing fat in diet has become a public health concern for consumers. Several fat replacers have been in use in bakery products. Apricot kernels are rich in lipid. The apricot kernel is generally added to bakery products and also consumed as appetizers. Apricots and apples among the most promising foods with the physiologically important constituents such as dietary fiber. In order to investigate the effects of fruit powders addition on low-fat cookie quality, apple or apricot powder (APL-P and APR-P) were used to replace wheat flour in the formulation of cookies at the levels of 10, 20, 30 and 40% (w/w) with 15% apricot kernel flour to replace shortening. Results indicated that there were no significant differences between spread ratio values of the cookies supplemented with different levels of APL-P up to 30% and control and they were all acceptable. However, APR-P supplemented cookies generally had a gradual increase in spread ratio values compared to the APL-P supplemented cookies above 10% level ($p<0.01$). The hardness values of the cookies generally increased significantly ($p<0.01$) with increasing APL-P levels. APL-P supplemented cookies generally had lower hardness values than APR-P supplemented ones. Overall sensory scores of the cookies supplemented with APR-P were not significanly different from those of the control. APL-P supplemented cookies generally had higher L* and lower a* than APR-P supplemented ones. Total dietary fiber contents of the cookies increased with increasing fruit powder supplementation level. APR-P appeared to be a more suitable replacer than APL-P up to 30% level.

Keywords: Apricot kernel flour, apple powder, apricot powder, cookie quality, dietary fiber

Kayısı Çekirdeği Unu ve Lifce Zengin Meyve Tozlarının Düşük Yağlı Bisküvi Kalitesine Etkileri

Özet

Diyetteki yağ miktarını azaltmak, tüketiciler için halk sağlığı konusu haline gelmiştir. Çeşitli yağ ikame edici madde (fat replacer) fırıncılık ürünlerinde kullanılmaktadır. Kayısı çekirdeği lipitçe zengindir. Kayısı ve elma, fizyolojik olarak önemli olan besinsel lif gibi bileşenler içeren umut verici gıdalar arasındadır. Meyve tozlarının düşük yağlı bisküvi kalitesine etkilerini araştırmak için elma ve kayısı tozu (APL-P ve APR-P) bisküvi formülasyonunda buğday unu ile %10, 20, 30 ve 40 (w/w) oranında yer değiştirerek kullanılmıştır. Bu formülasyonda yağın yerine %15 kayısı çekirdeği unu ilavesi yapılmıştır. Sonuçlar göstermiştir ki, değişik oranlarda APL-P içeren bisküvilere %30 ilave oranına kadar ve kontrol bisküvilerinde yayılma oranı değerleri bakımından önemli bir fark bulunamamıştır ve bütün bisküviler kabul edilebilir niteliktedir. Ancak, APR-P ilave edilen bisküvilerde genellikle yayılma oranı değerlerinde APL-P ilave edilmiş bisküvilere göre %10 ilave oranı üzerinde giderek artan bir yükseliş gözlenmiştir ($p<0.01$). Genel olarak bisküvilerin sertlik değerleri APL-P arttıkça önemli düzeyde artmıştır ($p<0.01$). APL-P ilave edilmiş bisküviler genellikle APR-P ilave edilmişlere göre daha düşük sertlik değerleri vermiştir. APR-P ilave edilmiş bisküvilerde toplam duyusal değerler, kontrol örneğinden önemli bir farklılık göstermemiştir. APL-P ilave edilmiş bisküviler, APR-P ilave edilmişlere göre genel olarak daha yüksek L* ve daha düşük a* değeri vermişlerdir. Toplam besinsel lif içerikleri, ilave edilen meyve tozları miktarına bağlı olarak artmıştır. APR-P, %30 ilave oranı değerine kadar APL-P' a göre daha iyi bir yağ ikame edici olarak görülmüştür.

Anahtar Kelimeler: Kayısı çekirdeği unu, elma tozu, kayısı tozu, bisküvi kalitesi, besinsel lif

Introduction

Dietary fat intake has been implicated in the causation of major diseases including coronary heart disease and cancer. Hence, current recommendations to improve health emphasise the reduction of fat intake. However, fat is one of the ingredients that affect cookie texture, and contributes pleasing mouthfeel and positively impacts flavour intensity and perception. In the USA and Europe, daily fat consumption represents about 40% of total calory intake. Health specialists recommend that it should not exceed 30% of the total calories in a diet (Giese, 1996).

Several fat replacers have been in use in bakery products. Carbohydrate-based fat replacers have been reported to imitate fat by binding water and to provide lubricity, body and a pleasing mouth sensation (Bath et al., 1992). According to the Champbell et al. (1994), substitution of fat had a greater impact on textural attributes of cookies than substituton of sugar or flour. Inglett et al. (1994) also concluded that replacement of 50% of fat by β-glucan and amylodextrins derived from oat flour resulted in cookies not significantly different from the full-fat ones, but at higher substitution levels overall quality was decreased.

Inadequate fiber intake has been found to be associated with diseases like diverticulosis, atherosclerosis, colonic cancer and appendicitis (Trowell, 1972; Painter and Burkitt, 1977; Walker et al., 1973). An increase in level of dietary fiber in the daily diet has been recommended (25-30 g/day).

The chemical and nutritional properties of apricot kernel were studied by various investigators (Lazos, 1991; Aydemir et al., 1993; El-Adawy et al., 1994; Femenia et al., 1995; Ozcan, 2000; Ozkal et al., 2005; Alpaslan and Hayta, 2006). Apricot kernels are rich in lipid and protein (Femenia et al., 1995; Alpaslan and Hayta, 2006). Durmaz and Alpaslan (2007) mentioned that the apricot kernel is added to bakery products and also consumed as appetizers.

Apricot (*Prunus armeniaca* L.) is one of the most popular stone fruits grown in some regions of Turkey which is the biggest apricot producer (538.000 metric tons/yr) (FAO, 2002). Apricots among the most promising foods with the physiologically important constituents (dietary fiber, sorbitol, potassium, copper, and phenolic compouns). Since fresh apricot fruits have limited shelf-life, various dried forms of apricots are widely used. A new form of apricot as freeze dried powder retaining all important nutrients and flavor of fresh apricot might be promising alternative for the utilisation of apricots.

Apple (*Malus domestica*) is usually consumed in fresh form. Commercially apple is used mostly for extracton of apple juice. It is also well known that apples are good sources of fiber (Gorinstein et al., 2001). Fresh apples are very convenient for storage, transportation and consumption. However, there is a demand for new apple products such as freeze-dried apple powder which retains all nutrients (dietary fiber, antioxidants etc.) and flavor of fresh apple.

The objective of this paper was to study the effects of fruit powders addition on the low-fat cookie quality. To determine the effects of fiber-rich fruit powders on cookie quality and total dietary fiber content of the cookies, apple or apricot powder (APL-P and APR-P) were used to replace wheat flour in the formulation of cookies at the levels of 10, 20, 30 and 40% (w/w) with 15% AKF to replace shortening.

Materials And Methods

Materials

The commercial soft wheat flour (Örnek Flour Inc., Nevşehir, Turkey) used in this study consisted of 9.8% protein, 0.65% ash, 28% wet gluten and, 1.6% total dietary fiber. Only reagent-grade chemicals were used. Apricots and apricot kernels (cv: Hacıhaliloğlu) were obtained from Malatya province during the summer season of 2003 and they were non-sulphited. Golden delicious type apples were purchased from local market.

Preparation of Apricot Kernel Flour

Apricot *(Prunus armenica* L.) pits were obtained from non-sulphited apricot fruits. The pit consists of kernel and its encasing shell. The kernel is the edible part inside the pit and has a texture similar to almonds. The apricot pits were washed with tap water and air-dried at 30°C for about two weeks. The kernels were obtained by manual cracking and stored at −10°C in sealed plastic bags. The apricot kernels were soaked in warm distilled water for an hour and kernel coats were removed manually. Then the apricot kernels were placed on a sheet of filter paper and dried on the bench for two hours and ground in a coffee grinder (Arzum, Turkey) for 1 min. The apricot kernels were again ground in a mortar and pestle and the ground apricot kernels were identified as (AKF) and used in the proximate analysis and the cookie production. To prevent the apricot kernel flour from possible ransidity and oxidation which may occur during the storage, the AKF was prepared fresh within an hour before the cookie production (Seker et al., 2010).

Preparation of Fruit Powders

Apricots and apples were first washed with tap water. The central part of the apples, containing the seeds and the kernels of the apricots were removed manually. After chopping, the samples were immediately dipped in a 1% citric acid solution for an hour to avoid enzymatic browning. Fruit samples were frozen at -30°C and freeze-dried (Armfield Inc., England-Model HA-3083/2) for the preparation of fiber-rich apple and apricot powders (APL-P and APR-P, respectively). Freeze-dried apple and apricot samples were ground by using a Waring blender to a particle size of 212-325 µm and stored in glass jars at −10 °C until analysis (Seker et al., 2009).

Analytical Methods

Moisture, protein (Nx5.7), ash (d.b.) and wet gluten contents of the soft wheat flour were determined by using AACC Approved Methods (AACC International, 2000). Apricot kernel flour was analyzed for moisture, protein (Nx6.25), ash and lipid contents (AOAC, 1998). Fruit powders (apple powder: APL-P and apricot powder: APR-P) were analyzed for moisture, protein (Nx6.25) and ash contents by using AOAC methods (AOAC, 1998), and for water-holding capacity (Mongeau and Brasard, 1982) and bulk density (Michel et al., 1988). Antioxidant properties of APL-P and APR-P were evaluated by determining total phenolic content, assessed by Folin method (Durmaz and Alpaslan, 2007). Total dietary fiber (TDF) contents of soft wheat flour, APL-P, APR-P and the all supplemented cookies were determined by using AACC Approved Methods (AACC, International 2000).

Cookie Preparation and Quality Determination

The cookie qualities of AKF including fruit powders (APL-P and APR-P) supplemented flours were determined by AACC Method No: 10.54; Baking Quality of Cookie Flour-Micro Wire-Cut Formulation (AACC International, 2000). The formulation of the cookies are shown in Table 1 (control) and Table 2. AKF was used to partially replace shortening at the level of 15 (w/w) in the formulation. A control sample including 15% AKF was also prepared. Fruit powders (APL-P and APR-P) were used to replace wheat flour in the formulation of cookies at the levels of 10, 20, 30 and 40% (w/w) with 15% AKF to replace shortening. Four cookies were prepared per bake. The baked cookies were cooled at room temperature (30 min) and then they were wrapped in aluminum foil and allowed to stand at room temperature until analysis.

The quality parameters of the cookies were evaluated in terms of width (W), thickness (T), spread ratio (W/T), color and texture values. After cooling of the cookies for 30 min, width and thickness measurements of the cookie samples were taken using a caliper. CIE color values (L*, a* and b*) were measured with a Minolta Spectrophotometer CM-3600d (Japan). The L* value indicates the lightness, 0-100 representing dark to light. The a* value gives the degree of the red-green colour. The b* value indicates the degree of the yellow-blue colour. A texture analyzer (TA Plus, Lloyd Instruments, UK) equipped with a three-point bending jig was used for texture analysis and the maximum force (Newtons) required to break the cookie sample was determined 24 h after baking. The span between the supports was 40 mm. A load cell of 1,000 N was used. The sensory characteristics of the cookies were screened by a six-member panel that was well aware of the purpose of the investigation. The panel members individually evaluated appearance and taste of the cookies by giving scores ranging between 1 to 5, 5 being the most desirable. Then, the overall sensory scores were calculated as the mean of the appearance and taste scores for each bake (Köksel and Özboy, 1999).

Statistical Evaluation

Data were analyzed for variance using the MSTAT statistical package (Anonymous, 1988). When significant differences were found, the LSD (Least Significant Difference) test was used to determine the differences among means.

Table 1. Formulation of cookies.

Ingredients[a]	Weight (g)
Sucrose (fine granulating)	25.6
Brownulated granulated sucrose	8.0
Nonfat dry milk	0.8
Salt	1.0
Sodium bicarbonate	0.8
All-purpose shortening (fat)	32.0
High-fructose corn syrup	1.2
Ammonium bicarbonate	0.4
Deionized water	variable
Flour[b]	80.0

[a] Ingredients at 21±1 °C
[b] 13% moisture basis

Table 2. Addition levels of apricot kernel flour (AKF), apple powder (APL-P), and apricot powder (APR-P) in cookie formula.

AKF (15%) with APL-P Formula [a]		AKF (15%) with APR-P Formula	
APL-P/ F	AKF/S	APR-P/F	AKF/S
0/100	15/85	0/100	15/85
10/90	15/85	10/90	15/85
20/80	15/85	20/80	15/85
30/70	15/85	30/70	15/85
40/60	15/85	40/60	15/85

[a] F, flour; S, shortening

Results And Discussion

Properties of Apricot Kernel Flour

The results of various properties of apricot kernel flour (AKF) were given in our previously published paper in detail (Seker et al., 2010; Özboy-Özbaş et al., 2010). The protein and lipid contents of the AKF were found to be 21.8% and 40.2%, respectively. The protein content reported in this study generally agreed with the previously published data (Lazos, 1991; Aydemir et al., 1993; Femenia et al., 1995; Özcan, 2000). However, the protein content determined in this study was lower than the one reported by El-Adawy et al. (1994) and higher than the one reported by Asma (2000). The lipid content of the apricot kernel sample generally agreed with the previously published data (Kamel and Kakuda, 1992). However, the lipid content obtained in this study was lower than the ones reported by Femenia et al. (1995), Asma (2000), Özkal et al. (2005) and higher than the one reported by Lazos (1991). The ash content of the AKF was found to be 2.71%, which is sligtly higher than the one determined by Femenia et al. (1995), and almost equal to the one reported by Özcan (2000). The TDF content of AKF used in this study was found to be 35.8%.

Properties of Fruit Powders

The results of the properties of fruit powders were given in our previously published paper in detail (Seker et al., 2009). The protein and ash contents of apple powder (APL-P) were found to be 3.4% and 3.08%, respevtively. The water holding capacity (WHC) and bulk density values of APL-P were found to be 6.6 g/g and 355 mg/cm^3, respectively. Apricot powder (APR-P) had a protein content of 2.8%, ash content of 3.23%, bulk density of 386 mg/cm^3 and WHC of 6.7 g/g. The TDF content of APL-P was found to be 22.8%, which is higher than the value reported by Li and Cardozo (1994), and within the range of the one reported by Lentowicz et al. (2003). The TDF content of APR-P was found to be 21.1% which is lower than the value reported by Li and Cardozo (1994). Total phenolic contents of APL-P and APR-P were found to be 1.327 and 0.763 µg GAE/g db, respectively. Total phenolic content of whole apple was reported to be 1.2 mg/100 g fresh fruit by Gorinstein et al. (2001). The data revealed that APL-P and APR-P samples are both rich in terms of total dietary fiber content and antioxidant power.

Effects of Fruit Powders on the Quality of Low-Fat Cookies

In order to investigate the effects of fruit powders addition on the low-fat cookie quality, apple or apricot powder (APL-P and

APR-P) were used to replace wheat flour in the formulation of cookies at the levels of 10, 20, 30 and 40% (w/w) with 15% AKF to replace shortening. Spread ratio and hardness values, sensory properties and total dietary fiber contents of the APL-P and APR-P supplemented low-fat cookies are presented in Table 3.

Results indicated that there were no significant differences between spread ratio values of the cookies supplemented with different levels of APL-P up to 30% and control and they were all acceptable. However, APR-P supplemented cookies generally had a gradual increase in spread ratio values compared to the APL-P supplemented cookies above 10% level (p<0.01). Increasing fiber addition generally reduces the spread ratio values of the high-fiber cookies (Özboy and Köksel, 1997) and similar results were also obtained in cookies supplemented with brewer's spent grain and sugar beet fiber (Köksel and Özboy, 1999; Özturk et al., 2002).

The hardness values of the cookies generally increased significantly (p<0.01) with increasing APL-P levels up to 30% addition level and the hardness value for the 40% addition level was not detected. APR-P supplemented cookies generally had lower hardness values than APL-P supplemented ones except 30% level.

Table 3. Effects of fruit powders (APL-P and APR-P) on spread ratio, hardness value, overall sensory score and total dietary fiber contents of the low-fat cookies.

Fruit powder level (%)	Spread Ratio		Hardness (N)		Overall sensory score		TDF (%)	
	APL-P	APR-P	APL-P	APR-P	APL-P	APR-P	APL-P	APR-P
0	7.10ab	7.10e	47.12d	47.12d	3.82a	3.82a	1.86a	1.86a
10	7.18a	7.68d	95.58b	78.85c	3.76a	3.90a	8.91b	8.02b
20	7.25a	8.97c	105.22a	79.27c	3.47a	3.82a	11.38c	10.45c
30	7.25a	10.28b	84.72c	102.30a	2.93ab	3.35a	16.27d	13.11d
40	6.77b	11.18a	-	96.14b	2.27b	2.82a	19.87e	14.28e
LSD	0.36	0.58	5.28	4.75	1.07	1.15	0.12	0.08

Means followed by the different letter are significantly different using the LSD test (p<0.01)
TDF: Total dietary fiber; APL-P: Apple powder; APR-P: Apricot powder

Table 4. Effects of fruit powders (APL-P and APR-P) on color values of the low-fat cookies.

Table 4. Effects of fruit powders (APL-P and APR-P) on color values of the low-fat cookies.

Fruit powder level (%)	L*		a*		b*	
	APL-P	APR-P	APL-P	APR-P	APL-P	APR-P
0	70.39a	70.39a	8.36d	8.35e	36.10d	36.56d
10	63.84b	62.75b	12.08c	11.99d	41.18c	43.83c
20	56.77c	60.67b	15.08b	15.32c	43.89b	49.13bc
30	56.77c	55.83c	15.34b	17.37b	45.30a	51.93ab
40	51.67d	49.39d	17.45a	20.24a	46.51a	56.58a
LSD	2.63	3.00	1.04	1.24	1.33	5.37

Means followed by the different letter are significantly different using the LSD test (p<0.01)
L*:Lightness; a*: Redness; b*:Yellowness; APL-P: Apple powder; APR-P: Apricot powder

Overall sensory scores of the cookies supplemented with APR-P were not significanly different from those of the control and they were all acceptable. The effect of incorporation of high-fiber fruit powders on total dietary fiber content of low-fat cookies was investigated for the first time.

Total dietary fiber (TDF) contents of the cookies supplemented with APL-P and APR-P increased significantly (p<0.01) as the addition level increased. The TDF contents of the APL-P supplemented cookies were slightly higher than those supplemented with APR-P for all addition levels.

CIE color values (L*, a*, and b*) of APL-P and APR-P supplemented low-fat cookies are presented in Table 4. The color of the cookies is one of the characteristics which are firstly perceived by the consumer and affect the acceptability of the product.

Although the Lightness (L*) of the cookies supplemented with both fruit powders decreased significantly ($p<0.01$), APR-P supplementation resulted in higher decreases in L* values. Cookies supplemented with APR-P generally gave higher a* values as compared to APL-P supplemented cookies at all levels. The replacement of flour by apple and apricot powders in wire-cut cookie formulation showed that the physical characteristics, total dietary fiber contents and textural properties of the cookies were significantly affected ($p<0.01$) and that APR-P appeared to be a more suitable replacer than APL-P up to 30% level.

Conclusion

One of the purpose of this study was to investigate the effects of AKF on the quality of low fat cookies. AKF is rich in terms of dietary fiber (35.8%). Thus, it can be used to supplement cereal based foods such as cookies and cakes.

Another objective of this study was to determine the effects of fiber-rich fruit powders (apricot and apple powders) on the quality of low fat cookies produced by replacing the fat with AKF (15%). The data revealed that APL-P and APR-P are both rich in terms of total dietary fiber content and antioxidant power thus, they can be used to supplement cereal based foods such as cookies. APR-P supplemented cookies generally had higher spread ratio than the APL-P supplemented ones. Overall sensory scores of the cookies supplemented with APR-P were not different from those of the control and they were all acceptable. TDF contents of the cookies increased with incresing fruit powder supplementation level. Cookies supplemented with APR-P generally gave lower L* and higher a* values as compared to APL-P supplemented ones. As a result, the replacement of flour by apple and apricot powders in wire-cut cookie formulation showed that the physical characteristics, total dietary fiber contents and textural properties of the cookies were significantly affected ($p<0.01$) and that APR-P appeared to be a more suitable replacer than APL-P up to 30% level.

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