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EFFECTS OF APRICOT KERNEL FLOUR AND FIBER-RICH APRICOT POWDER ON THE QUALITY OF REDUCED-FAT WIRE-CUT COOKIES

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In this study, shortening content in a wire-cut cookie formulation was reduced at 30% and replaced with apricot kernel flour (AKF). Utilization of AKF as fat replacers in cookies was examined and effects of apricot powder (APR-P) at the levels of 10, 20, 30 and 40% (w/w) on the quality of low-fat cookies were investigated. Reducing fat in every-day's diet is a public health issue and a concern for most consumers. It is recommended that dietary fat consumption must be cut to 30% or less of total caloric intake. The baking industry has responded to the demands of consumers by developing low- or reduced-fat products, defined as those foods that have at least one-third fewer calories than an equivalent serving of a normal counterpart. Low-fat products normally contain fat substitutes and are produced using formula or processing modifications. Several fat replacers have been in use in bakery products. Carbohydrate-based substitutes incorporate water into a gel-type structure, resulting in lubricant or flow properties similar to those of fats in some food systems. Apricot (*Prunus armeniaca L.)* is one of the most popular stone fruits grown in some regions of Turkey which is the biggest apricot producer (795,768 metric tons/yr). Low in fat and high in fiber, apricots are loaded with vitamins and minerals essential for a healthy diet. A new form of apricot as freeze dried powder retaining all important nutrients and flavor of fresh apricot might be promising alternative for the utilization of apricots. As a by-product, apricot kernel offers an exciting new potential as a food ingredient especially in cereal. Results indicated that APR-P supplemented cookies generally had a gradual increase in spread ratio values above 10% level ($p<0.01$). The hardness values of the cookies generally increased significantly ($p<0.01$) with increasing APR-P levels up to 30% addition level and the hardness value for the 40% addition level was not detected. Overall sensory scores of the cookies supplemented with APR-P were not significanly different from those of the control until 30% addition level. Total dietary fiber contents of the cookies increased with increasing APR-P powder supplementation (from 10.71% to 17.48%). APR-P supplemented cookies generally had higher L* and lower a* and b* values as the addition levels increased. With the production of high-fiber and low-fat cookies by the usage of AKF and APR-P especially in cereal products are offered.

Keywords: Apricot kernel flour, Apricot powder, Cookie quality, Dietary fiber.

Introduction

Since, fat consumption by western populations has been shown to be associated with an increased risk of obesity, atherosclerosis, coronary heart disease, elevated blood pressure, and tissue injury diseases associated with lipid oxidation, this association has created an increased awareness and a dramatic increase in the demand and supply for, low-fat foods. Health specialists recommend that it should not exceed 30% of the total calories in a diet (Giese, 1996).

Texture, flavor and appearance are the main quality attributes of cookies. Fat is a very important ingredient of cookies because it contributes texture and pleasing mouthfeel and positively impacts flavor intensity and perception (Drewnowski *et al.,* 1998). Fat mimetics are substances of carbohydrate or protein origin which can be used in some foods to imitate the functional and sensorial properties of fat, but provide considerably less calories. Several research studies were conducted for the usages of fat replacers in bakery products (Bath *et al.,* 1992; Champbell *et al*., 1994; Inglett *et al*., 1994; Drewnowski *et al.,*1998; Zoulias *et al*., 2002; O' Brien *et al*., 2003; Jacob & Leelavathi, 2007; Martinez-Cervera *et al*., 2015).

Dietary fiber intake provides many health benefits. Hence, inadequate fiber intake has been found to be associated with diseases like diverticulosis, atherosclerosis, colonic cancer and appendicitis (Trowell, 1972; Painter & Burkitt, 1977; Anderson *et al*., 2009). An increase in level of dietary fiber in the daily diet has been recommended (25-30 g/day) (Anonymous, 2010).

Apricot (*Prunus armeniaca* L.) is one of the most popular stone fruits grown in some regions of Turkey which is the biggest apricot producer (795,768 metric tons/yr) (FAO, 2012). 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. 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 & Hayta, 2006). Apricot kernels are rich in lipid and protein.

The objective of this paper was to study the effects of APR-P addition on the low-fat cookie quality. To determine the effects of fiber-rich fruit powder on cookie quality and total dietary fiber content of the cookies, APR-P was used to replace wheat flour in the formulation of cookies at the levels of 10, 20, 30 and 40% (w/w) with 30% 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 (Nx5.7), 0.65% ash (d.b.), 28% wet gluten and, 1.6% total dietary fiber. Apricots and apricot kernels (cv: Hacıhaliloğlu) were obtained from Malatya province during the summer season of 2003 and they were non-sulphited. Only reagent-grade chemicals were used.

Preparation of Apricot Kernel Flour and Fiber-Rich Apricot Powder

Apricot kernel flour (AKF) was produced from apricot *(Prunus armenica* L.) according to Seker *et al.* (2010). Fiber-rich apricot powder (APR-P) was produced according to Seker *et al.* (2009).

Analytical Methods

Soft wheat flour was analyzed for moisture, protein, ash and wet gluten contents according to standard method (AACC, 2000). Apricot kernel flour was analyzed for moisture, protein (Nx6.25), ash and lipid

contents (AOAC, 1998). Total dietary fiber (TDF) contents of soft wheat flour, AKF, APR-P and cookies were determined by using AACC Method (2000). APR-P were analyzed for moisture, protein (Nx6.25, d.b.) and ash (d.b.) contents by using AOAC methods (1998), and for water-holding capacity (Mongeau & Brasard, 1982) and bulk density (Michel *et al.,* 1988). Antioxidant properties of APR-P was evaluated by determining total phenolic content, assessed by Folin method (Durmaz & Alpaslan, 2006).

Cookie Formulation and Evaluation

The cookie qualities of AKF including apricot powder (APR-P) supplemented flours were determined by AACC Method No: 10.54; Baking Quality of Cookie Flour-Micro Wire-Cut Formulation (AACC, 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 30 (w/w) in the formulation. A control sample including 30% AKF was also prepared. APR-P was used to replace wheat flour in the formulation of cookies at the levels of 10, 20, 30 and 40% (w/w) with 30% 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). 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 & Özboy, 1999). 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) and apricot powder (APR-P) in cookie formula

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

[a] F, flour; S, shortening

Results and Discussion

Properties of Apricot Kernel Flour

The results of various properties of 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). The lipid content of the apricot kernel sample generally agreed with the previously published data (Kamel & Kakuda, 1992). 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 Apricot Powder

The results of the properties of apricot powder were given in our previously published paper in detail (Seker *et al.,* 2009). 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 APR-P was found to be 21.1% which is lower than the value reported by Li & Cardozo (1994). Total phenolic content of APR-P was found to be 0.763 µg GAE/g db. The data revealed that APR-P sample is both rich in terms of total dietary fiber content and antioxidant power.

Effects of Apricot Powder on the Quality of Low-Fat Cookies

In order to investigate the effects of fruit powder addition on the low-fat cookie quality, apricot powder (APR-P) was used to replace wheat flour in the formulation of cookies at the levels of 10, 20, 30 and 40% (w/w) with 30% AKF to replace shortening. Spread ratio and hardness values, sensory properties and total dietary fiber contents of the APR-P supplemented low-fat cookies are presented in Table 3.

Results indicated that APR-P supplemented cookies generally had a gradual increase in spread ratio values above 10% level ($p<0.01$). Increasing fiber addition generally reduces the spread ratio values of the high-fiber cookies (Özboy & Köksel, 1997) and similar results were also obtained in cookies supplemented with brewer's spent grain and sugar beet fiber (Köksel & Özboy, 1999; Öztürk *et al*., 2002).

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

APR-P level (%)	Spread Ratio	Hardness (N)	Overall Sensory Score	TDF (%)
0	7.10[b]	47.12[d]	3.82[a]	1.86[e]
10	7.44[b]	98.24[a]	3.75[ab]	10.71[d]
20	8.00[c]	83.67[b]	3.38[ab]	13.54[c]
30	8.78[a]	70.09[c]	2.83[bc]	15.32[b]
40	8.48[a]	-	2.31[c]	17.48[a]
LSD	0.45	5.68	0.94	0.11

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

The hardness values of the cookies increased significantly ($p<0.01$) with APR-P level up to 10% and started decreasing with the increasing of APR-P addition level. Similar results for hardness values were also reported by Zoulias *et al*. (2002). The hardness value for the 40% addition level was not detected. Overall sensory scores of the cookies supplemented with APR-P were not significanly different from those of the control until 30% of addtion level. 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 APR-P increased significantly ($p<0.01$) as the addition level increased (from 10.71% to 17.48%).

CIE color values (L*, a*, and b*) of 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.

Table 4. Effects of apricot powder (APR-P) on color values of the low-fat cookies.

APR-P level (%)	L*	a*	b*
0	70.39[a]	8.35[d]	36.66[d]
10	65.36[b]	12.01[c]	42.10[c]
20	61.19[c]	14.34[b]	45.88[b]
30	55.90[d]	17.48[a]	50.84[a]
40	54.20[d]	18.07[a]	51.13[a]
LSD	3.38	1.85	1.96

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

Although the Lightness (L*) of the cookies supplemented with APR-P decreased significantly ($p<0.01$), cookies supplemented with APR-P generally gave higher a* values at all levels. Similar results for color values were also reported by Özboy & Köksel (1997), Köksel & Özboy (1999) and Öztürk *et al*. (2002).

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 apricot powder on the quality of low fat cookies produced by replacing the fat with AKF (30%). The data revealed that APR-P is 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. Overall sensory scores of the cookies supplemented with APR-P were not different from those of the control until 30% addition level. TDF contents of the cookies increased with increasing APR-P supplementation level. As a result, the replacement of flour by APR-P 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 suitable replacer up to 30% level.

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References

1. AACC, 2000. Approved Methods of the American Association of Cereal Chemists, 10th Ed., The Association: St. Paul, MN, USA.
2. Alpaslan, M., Hayta M., 2006. Apricot kernel: Physical and chemical properties. *Journal of the American Oil Chemists' Society,* 83: 469-471.
3. Anderson, J.W., Baird, P., Davis, R.H., Ferreri, S., Knudtson, M., Koraym, A., Waters, V., Williams, C.L. 2009. Health benefits of dietary fiber. *Nutrition Reviews,* 67: (4) 188–205.
4. Anonymous, 1988. User's Guide to MSTAT-C, A Software Program for the Design, Management and Analysis of Agronomic Research Experiments. Michigan State University, East Lansing, MI, USA.
5. Anonymous, 2010. U.S. Department of Agriculture and U.S. Department of Health and Human Services. *Dietary guidelines for Americans,* (7th ed.). Washington, DC: U.S. Government Printing Office. Retrieved April 22, 2013, from http://www.cnpp.usda.gov/Publications/DietaryGuidelines/2010/PolicyDoc/PolicyDoc.pdf.
6. AOAC, 1998. Official Methods of Analysis of the Association of Official Analytical Chemists, Association of Official Chemists, Inc., Virginia, USA.
7. Aydemir, T., Yılmaz, I., Özdemir, I., Arıkan, N., 1993. Kayısı çekirdeği yağının fiziksel ve kimyasal özelliklerinin incelenmesi. *Doğa Türk Kimya Dergisi*, 17: 56-61.
8. Bath, D.E., Shelke, K., Hoseney, R.C., 1992. Fat replacers in high-ratio layer cakes. *Cereal Foods World*, 37: 495-500.
9. Champbell, L.A., Ketelsen, S.M., Antenucci, R.N., 1994. Formulating oatmeal cookies with calorie-sparing ingredients. *Food Technology*, 48: 98-105.
10. Drewnowski, A., Nordensten, K., Dwyer, J., 1998. Replacing sugar and fat in cookies: Impact on product quality and preference, *Food Quality and Preference*, 9: 13-20.
11. Durmaz, G., Alpaslan, M., 2007. Antioxidant properties of roasted apricot (*Prunus armeniaca* L.) kernel. *Food Chem.* 100: 1177-1181.

12. El-Adawy, T.A., Rahma, A.H., El-Badawey, A.A., Gomaa, M.A., Lasztity, R., Sarkadi, L., 1994. Biochemical studies of some non-conventional sources of proteins. Part 7. Effect of detoxification treatments on the nutritional quality of apricot kernels. *Nahrung*, 38: 12-20.
13. FAO, 2012. Production year book.
14. Femenia. A., Rossello, C., Mulet, A., Canellas, J. 1995. Chemical composition of bitter and sweet apricot kernels. *Journal of Agric. and Food Chemistry*, 43: 356-361.
15. Giese, J., 1996. Fats and fat replacers: Balancing the health benefits. *Food Technol*. 50: 76-78.
16. Inglett, G.E., Warner, K., Newman, R.K., 1994. Sensory and nutritional evaluations of oatrim. *Cereal Foods World*, 39: 755-759.
17. Jacob, J., Leelavathi, K., 2007, Effect of fat-type on cookie dough and cookie quality, *Journal of Food Eng*., 79: 299-305.
18. Kamel, B.S., Kakuda, Y., 1992. Characterisation of the seed oil and meal from apricot, cherry, nectarine, peach and plum. *J. of Am. Oil Chemists' Society*, 69: 493-494.
19. Köksel, H., Özboy, Ö., 1999. Effects of Sugar Beet Fiber on Cookie Quality. *ZuckerIndustri,* 124: 542-544.
20. Lazos, E.S., 1991. Composition and oil characteristics of apricot, peach and cherry kernel. *Grasas Y Aceites*, 42: 127-131.
21. Li, B.W., Cardozo, M.S., 1994. Determination Total Dietary Fiber in Foods and Products with Little or No Starch, Nonenzymatic-Gravimetric Method, Collaborative Study. *J. AOAC Int*. 77: 687-689.
22. Martinez-Cervera, S., Salvator, A., Sanz, T., 2015. Cellulose ether emulsions as fat replacers in muffins: Rheological, themal and textural properties. *LWT- Food Science and Technology.* 63: 1083-1090.
23. Michel, F., Thibault, J.F., Barry, J.L., De Baynast, R., 1988. Preparation and characterisation of DF from sugar beet pulp. *J. Sci. Food. Agric*. 42:77- 85.
24. Mongeau, R., Brasard, R., 1982. Insoluble dietary fiber from breakfast cereals and brans: bile salt binding and water-holding capacity in relation to particle size. *Cereal Chem*. 59: 413-417.
25. O'Brian, C.M., Mueller, A., Scannell, A.G.M., Arendt, E.K., 2003. Evaluation of the effects of fat raplacers on the quality of wheat bread, *Journal of Food Eng*., 56: 265-267.
26. Özboy, Ö., Köksel, H., 1997. Comparison of the Effects of Two Wheat Cultivars on the Quality of High Fiber Bran Cookies. *Gıda*, 22: 9-14.
27. Özboy-Özbaş, Ö., Şeker, I.T., Gökbulut, I., 2010. Effects of Resistant Starch, Apricot Kernel Flour, and Fiber-rich Fruit Powders on Low-fat Cookie Quality. *Food Sci. Biotechnol.* 19 (4): 979-986.
28. Özcan, M., 2000. Composition of some apricot (*Prunus armenica L*.) kernels grown in Turkey. *Acta Alimentaria*, 29: 289-293.
29. Özkal, S.G., Yener, M.E., Bayındırlı, L., 2005. Mass transfer modeling of apricot kernel oil extraction with supercritical carbon dioxide. *Journal of Supercritical Fluids*, 35: 119-127.
30. Öztürk, S., Özboy, Ö., Cavidoglu, I., Köksel, H., 2002. Effects of Brewer's Spent Grain on the Quality and Dietary Fiber Content of Cookies. *Journal of the Institute of Brewing,* 108: 23-27.
31. Painter, N.S., Burkitt, D.P., 1977. A deficiency disease of western civilization. *Brit. Med. Journal*, 2: 450-456.
32. Şeker, I.T., Özboy –Özbaş, Ö, Gökbulut, I., Öztürk, S., Köksel, H., 2010. Utilization of apricot kernel flour as fat replacers in cookies, *J. of Food Proc. and Preser*. 34: 15-26.
33. Şeker, I.T., Özboy –Özbaş, O., Gökbulut, I., Öztürk, S., Köksel, H., 2009. Effects of fiber-rich apple and apricot powders on cookie quality, *Food Sci. Biotechnol*. 18 (4): 948-953.
34. Trowell, M,. 1972. Crude fiber, dietary fiber and atherosclerosis. *Atherol*. 16: 138-143.
35. Zoulias, E.I., Oreopoulov, V., Tzia, C., 2002. Textural properties of low-fat cookies containing carbohydrate- or protein based fat replacers. *Journal of Food Eng*., 55: 337-342.