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# Physicochemical and bioactive properties of cakes incorporated with gilaburu fruit (*Viburnum opulus*) pomace

**İ.T. Şeker[1], M.H. Ertop[2*] and M. Hayta[3]**

*[1]Cumhuriyet University, Zara Ahmet Çuhadaroğlu Vocational School, Department of Food Technology, 58000 Sivas, Turkey; [2]Gumushane University, Faculty of Engineering and Natural Sciences, Department of Food Engineering, 29000 Gümüşhane, Turkey; [3]Erciyes University, Faculty of Engineering, Department of Food Engineering, 38039 Kayseri, Turkey; muge.ertop@gumushane.edu.tr*

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**RESEARCH ARTICLE**

## Abstract

In this study the valorisation of a gilaburu (*Viburnum opulus*) fruit pomace, a waste product remaining after juice extraction, was investigated. The pomace was incorporated into cake formulation at the level of 0, 5, 10 and 15%, based on wheat flour weight. Results indicated that the batter viscosity increased and pH decreased by the increasing of the concentration of pomace level in cake formulation. Depending on incorporation level, reduction on the volume and height of the cake samples were observed. The hardness values increased whereas the chewiness and gumminess values of the cake samples decreased with an increasing of pomace incorporation level. Gilaburu pomace addition caused significant ($P$<0.05) changes on L*, a*, and b* values of crumb, whereas no significant differences have been determined on the L* and b* values of crust of the samples. In sensory analyses, 5% gilaburu pomace added cake sample had the highest overall acceptability score. The total phenolic content and radical-scavenging activity values of cake samples increased proportionally with the level of pomace incorporation. According to the study, evaluation of gilaburu pomace waste as ingredient in developing alternative functional and/or value-added products by the food industry could be suggested.

**Keywords:** antioxidant activity, bioactive properties, cake quality, gilaburu fruit

## 1. Introduction

There is growing interest in functional foods both by consumers and the food industry. Therefore, research and commercialisation activities on functional foods and/or ingredients are being carried out all over the world to satisfy the consumer demand. Interest in health promoting (reducing the risk of cancer, reducing cholesterol, regulating the digestive system, strengthening the mind) functional foods is rapidly increasing (Hasler, 2002; Isolauri *et al.*, 2002). In this context, positive health effects as a result of the consumption of plant-derived functional foods/ingredients have been established. The risk of cancer and coronary heart disease is reported to be reduced through fruit and vegetable consumption (Hasler, 2002; Isolauri *et al.*, 2002; Jones, 2002).

*Viburnum opulus*, locally called as 'gilaburu', is a fruit of a bush known also as 'European cranberry bush, cramp bark, snowball bush, guelder rose' in English. Gilaburu alone or mixed with honey, is traditionally used to treat ailments such as cough, colds, tuberculosis, shortness of breath, rheumatic aches, ulcers and to balance the blood pressure in Russia. It is also used in confectioneries and marmalades (Velioğlu *et al.*, 2006). The most remarkable feature of gilaburu fruit is its high antioxidant capacity. Total phenolic content of gilaburu was reported as 355.60 mg gallic acid equivalent/100 g dry sample (Çam*et al.*, 2007). A high amount of chlorogenic acid was also determined in gilaburu fruit (Velioğlu *et al.*, 2006). Cakes are among the commonly consumed bakery products. They are essentially made of wheat flour, sugar, egg, shortening, baking powder, salt and other ingredients depending on the specific formulation. Thus, different types of cakes in terms of structure, texture, taste and flavour can be developed (Stauffer, 1999). Cakes are potential bakery products which can be enriched with different functional ingredients. In this study, the pomace of gilaburu which is waste of the fruit juice processing was examined as a natural functional ingredient in cake making. The research was aimed to determine the effects of gilaburu pomace incorporation on the rheological properties of cake batter, sensory properties (colour, texture and taste) and bioactive properties (total phenolic contents, radical scavenging activity) of the cake samples.

## 2. Materials and methods

### Materials

The cake flour and other ingredients (shortening, sugar, egg, skimmed milk powder and baking powder) for cake making were purchased from Untad Food Co. Ltd. (Kayseri, Turkey). Gilaburu fruits were supplied from local market, Kayseri, Turkey, in September and stored in water-filled containers for fruit ripening for 3 months. The flour had 14.5% moisture, 0.60% ash, 27.5% wet gluten, 80% gluten index, and 26 ml sedimentation value.

### Preparation of gilaburu pomace

The gilaburu fruit juice was prepared by using a domestic fruit juicer (SJ-3137; Sinbo, Istanbul, Turkey). The remaining fruit pulp and seeds were freeze-dried (Labconco, Kansas City, MO, USA). Lyophilised samples were ground by using a coffee grinder (MK6000; Bosch, Stuttgart, Germany) and sieved through a 212 μm sieve.

### Preparation of cake samples

The method of Lin *et al.* (1994) was used for cake making. The formulation is shown in Table 1. Flour, baking powder and shortening were mixed (K5Ai; Kitchenaid, Benton Harbor, MI, USA) for 1 min at 65 rpm. Other ingredients were added and after egg and milk addition the mixing was continued for 1 min at 97 rpm and then for 4 min at 174 rpm. The cake batter was divided into cake pans (30 g each) and baked in a preheated oven (NW796; Kenwood, Shanghai, China P.R.) at 175 °C for 25 min.

**Table 1. Cake formulation.**

| Ingredients | g |
|---|---|
| Flour | 100 |
| Salt | 1 |
| Shortening[1] | 40 |
| Sugar | 100 |
| Baking powder[2] | 5 |
| Egg | 44 |
| Skimmed milk[3] | 71 |

[1] Hydrogenated.
[2] Double-acting.
[3] 7.1 g skimmed milk powder + 63.9 g water.

The gilaburu pomace was added to cake batter at the levels of 0, 5, 10, and 15% on wheat flour weight basis.

### Physicochemical properties of cake batters

A pH meter (WTW, Inolab, Weilheim, Germany) was used for pH measurement. The measuring probe was immersed into cake batter directly and the pH value was read. Specific density was determined as the ratio of the weight of 60 ml cake batter to the weight of pure water at the same volume. A viscometer (RVF-100; Brookfield, Middleboro, MA, USA) with no. 4 spindle attachment was used for viscosity measurement. After pouring cake batter (150 ml) into a 250 ml of beaker, the viscometer was operated at 10 rpm and the viscosity values were recorded.

### Physicochemical properties of cakes

The cake volume (ml) was measured using the rapeseed displacement method after cooling the cake sample to room temperature. The colour parameters (L*, lightness, a*, redness and b*, yellowness) of cake crumb and crust were determined using a colorimeter (RT; Lovibond, Amesbury, UK). For the calibration of the colorimeter, a white ceramic plate (L*=93.4, a*=1.8 and b*=4.4) was used as reference. Each measurement was conducted in three replicates.

### Sensory properties of cakes

Sensory analysis was conducted by 10 panellist 2 h after the baking. The cake samples were compared between each other for their odour, colour, porosity, chewiness, flavour and overall acceptance using a 6 point scale.

### Texture profile analysis

Texture profile analysis (TPA) was performed using a texture analyser (TA-XT2; Stable Micro System, Godalming, UK) with a cylindrical aluminium probe (50 mm diameter). All the measurements were repeated three times.

### Total phenolics content and antioxidant activity of cakes

#### Preparation of extracts

Soxhlet extraction with petroleum ether was used to remove the oil from the cake samples. The samples were divided into 0.5 cm thick pieces and extraction was continued for 6-8 h. 10 g of defatted cake sample was mixed with 100 ml of 80% methanol and the mixture was centrifuged

(Hettich-320; Hettich, Tuttlingen, Germany) at 200 rpm for 12 h and at 4,100 rpm for 15 min. The supernatant was filtered through Whatman No. 1 filter paper (Sigma Aldrich, Darmstadt, Germany) and used for determination of total phenolic content and antioxidant activity (Sudha *et al.*, 2007).

#### Determination of total phenolic content

The amounts of phenolic compounds in the cake samples were determined by the Folin-Ciocalteu colorimetric method (Singleton and Rossi, 1965). 0.25 ml of freshly diluted Folin-Ciocalteu reagent was added to 0.25 ml extract. The mixture was allowed to equilibrate for 2 min and mixed with 4 ml of pure water and 0.5 ml of $NaCO_3$ solution. The mixture was allowed to rest for 30 min at room temperature, keeping it away from direct sunlight. After the incubation it was centrifuged (Hettich) at 4,100 rpm for 10 min and the absorbance value of the mixture was measured at 725 nm by using a UV-Visible spectrophotometer (Agilent, Santa Clara, CA, USA). Total phenolic content was calculated as mg gallic acid equivalent/100 g dried matter (Baydar *et al.*, 2004)

#### DPPH radical scavenging activity

10 mg of α,α-diphenyl-α-picrylhydrazyl (DPPH) was dissolved in 25 ml of 80% methanol. 0.2 ml sample extract was mixed with DPPH solution and 4 ml of 80% methanol and it was kept in the dark at room temperature for 30 min. The absorbance ($A_{sample}$) was recorded at 517 nm through a UV-Visible spectrophotometer (Agilent). The blank was prepared using 0.1 ml of methanol and 3.9 ml of DPPH solution and its absorbance ($A_{control}$) was recorded. DPPH radical scavenging activity was calculated according to the formula:

$$\text{DPPH scavenging \%} = [1 - (A_{sample} / A_{control})] \times 100$$

### Statistical analysis

All experiments were carried out in triplicate. The average values of the measurements are reported together with standard deviations. Analysis of variance (ANOVA) was performed to evaluate the significant differences by using SPSS 18.0.0 software (SPSS Inc., Chicago, IL, USA). Tukey test was used to determine significant differences ($P<0.05$).

## 3. Results and discussion

### Physicochemical properties of cake batters

The pH of control sample was 7.36 and a gradual decrease has been observed by the increase of gilaburu pomace ratio in the formulation. At 15% pomace addition level, pH decreased to 7.11. The differences in pH values have been found to be statistically significant ($P<0.05$; Table 2). The decrease in pH values of the batters depended on pomace addition ratio and it is probably related to the chemical composition of gilaburu pomace (pH 3.9-4.2).

The incorporation of gilaburu pomace significantly ($P<0.05$) increased the viscosity of cake batter from 23.606 to 58.572 mPas. The cellulose content of gilaburu was determined as 180 g/kg by (Akbulut *et al.*, 2008). The plant fibres might affect batter viscosity due to their water absorption properties (Brockmole and Zabik, 1976). Masoodi *et al.* (2002) also observed an increase in the viscosity of cake batter supplemented with apple fibre. In another study, Lu *et al.* (2010) reported that green tea addition increased the sponge cake batter viscosity. The microcrystalline cellulose has also been reported to increase the viscosity of cake batters (Brockmole and Zabik, 1976; Lu *et al.*, 2010).

Gilaburu pomace addition did not have significant effects on the specific density values of the batters (Table 2). Masoodi *et al.* (2002) reported that the specific density of cake batter decreased by addition of apple fibre. They pointed out that the specific density of the cake batter could increase or decrease depending on the differences in the physicochemical properties of plant extracts and natural ingredients.

### Physicochemical and sensory properties of cake samples

#### The volume, height and weight

Depending on incorporation ratio, a statistically significant ($P<0.05$) reduction was observed in the cake volumes. The control cake had the highest (78.0 ml) volume, whereas 15% gilaburu pomace added cakes volume was 64.5 ml (Table 3). Fruit pomaces contain various compounds such as dietary fibres which cause important problems in the production of functional bakery products. The presence of fibres in the formulation results in adverse changes especially in the volume and structure of products.

**Table 2. The properties of cake batter.**[1]

| Gilaburu pomace (%) | pH | Viscosity (mPas) | Specific density (g/ml) |
|---|---|---|---|
| 0 (control) | 7.36±0.02a | 23.65±1.49a | 1.27±0.09a |
| 5 | 7.16±0.01b | 36.67±2.33b | 1.25±0.09a |
| 10 | 7.13±0.01bc | 47.42±5.59c | 1.29±0.01a |
| 15 | 7.11±0.01c | 58.57±9.09d | 1.30±0.01a |

[1] Values are means ± standard deviation (n=3). Mean values represented by the same letters within the same column are not significantly different ($P>0.05$).

**Table 3. The volume, height and weight valeus of cake samples.[1]**

| Gilaburu pomace (%) | Volume (ml) | Height (mm) | Weight (g) |
|---|---|---|---|
| 0 (control) | 78.00±0.81a | 31.71±0.23a | 21.62±0.26a |
| 5 | 67.00±0.95b | 30.61±0.57b | 23.65±0.16b |
| 10 | 65.50±1.29b | 30.49±0.10b | 24.08±0.35b |
| 15 | 64.50±0.81c | 29.67±0.65b | 24.98±0.17b |

[1] Values are means ± standard deviation (n=3). Mean values represented by the same letters within the same column are not significantly different ($P$>0.05).

**Table 4. The texture profile parameters of cake samples.[1]**

| Gilaburu pomace (%) | Hardness (g) | Chewiness (gmm) | Gumminess (g) |
|---|---|---|---|
| 0 (control) | 420.7±13.7a | 0.912±0.02a | 0.738±0.04a |
| 5 | 568.8±39.8b | 0.900±0.04ab | 0.730±0.01ab |
| 10 | 631.0±25.4b | 0.895±0.02b | 0.728±0.06ab |
| 15 | 985.4±38.6c | 0.886±0.02b | 0.715±0.01b |

[1] Values are means ± standard deviation (n=3). Mean values represented by the same letters within the same column are not significantly different ($P$>0.05).

The apple pomace and green tea addition has been reported to decrease the cake volume (Lu *et al.*, 2010; Masoodi *et al.*, 2002). Ronda *et al.* (2004) reported that, the sponge cakes produced by addition of sugar alcohols and indigestible oligosaccharides had lower volume, decreased height and increased weight as compared to the control sample.

## Texture profile analysis

The TPA results of cake samples; hardness (g), chewiness (gmm) and gumminess (g) are presented in Table 4. The effects of pomace addition on hardness and gumminess have been found to be strongly correlated. The hardness values of the cake samples increased with the addition of pomace and the values have been found to be significantly different ($P$<0.05) compared with control sample and 15% incorporation further increased the hardness value leading to a value of 985.4 g.

The chewiness and gumminess values decreased as the level of gilaburu pomace increased. A study on the sponge cakes produced with various polyols and resistant starch showed that the hardness of the samples increased with addition of mannitol, especially at 2, 3 and 4 days of storage (Ronda *et al.*,2004). The hardness values of the cake samples containing barley flour (Gupta *et al.*, 2009) and apricot fibre (Şeker *et al.*, 2006) were found to be increased depending on the level of addition. The increases in chewiness and gumminess values were reported for barley flour added cake samples (Gupta *et al.*, 2009), and the decrease in gumminess and the increase in chewiness for green tea extract incorporated cake samples (Lu *et al.*, 2010). Depending on the differences in the properties of ingredients used in cake formulation, the physicochemical properties of resulting cake samples may also be different.

## Colour

The L* and b* values of the crust of gilaburu pomace incorporated cake samples were not significantly different (Table 5) from those of the control sample. But the a* values of the crust of gilaburu pomace incorporated cakes were lower than that of the control sample possibly as a result of the colour formation on crust primarily due to caramelisation and Maillard reactions during baking and composition of the batter. The addition of pomace may result in alterations in the ratios of carbohydrates and proteins leading to a decrease in a* (redness) value of cake crust. Gilaburu pomace addition caused statistically significant changes in the L*, a*, b* values ($P$<0.05) in crumb. L* value decreased from 69.54 (0%) to 61.68 (15%). The crumb colour became darker (lower L* values) with the addition of pomace compared with the control samples. (Lebesi and Tzia, 2011) reported that the L* values of cake crumbs decreased significantly with the increased level of different dietary fibre incorporation. The crumb colour of bakery products is not only affected by heat treatment but also from the raw materials and additives used in the formulation. The a* value increased from -0.37 to 8.17 depending on the level of pomace addition. The b* value is very important for determining of crumb colour of cake samples. The increase was observed in b* value of crumb depending on the pomace ratio in the formulation. In this study the addition of gilaburu pomace changed the crumb colour towards more yellow and red (higher a* and b* values).

The colour change in the cakes might be attributed not only to colour pigments of outer layers/remains of gilaburu fruit, but also the browning reactions occurring during baking process.

**Table 5. The colour properties of cake samples.[1,2]**

| Gilaburu pomace (%) | Crust | | | Crumb | | |
|---|---|---|---|---|---|---|
| | L* | a* | b* | L* | a* | b* |
| 0 | 55.56±0.32a | 14.26±0.46a | 38.29±0.29a | 69.54±0.87a | -0.37±1.26c | 15.52±0.69c |
| 5 | 56.26±0.28a | 13.31±0.33b | 36.20±1.06bc | 67.10±0.64b | 1.13±0.01c | 16.03±0.30bc |
| 10 | 55.51±0.56a | 9.69±0.30c | 36.34±0.80c | 64.53±0.78c | 2.86±0.14b | 17.07±0.20b |
| 15 | 53.31±0.24b | 9.74±0.10c | 37.41±0.40ab | 61.68±0.67d | 8.17±0.32a | 21.07±0.22a |

[1] Values are means ± standard deviation (n=3). Mean values represented by the same letters within the same column are not significantly different ($P$>0.05).
[2] L = lightness (0 = black; 100 = white); a = red-green; b = yellow-blue.

**Table 6. Sensory properties of cake samples.[1]**

| Gilaburu pomace (%) | Chewiness | Flavour | Overall acceptance |
|---|---|---|---|
| 0 (control) | 5.6±0.50a | 5.0±0.15a | 5.2±0.05a |
| 5 | 5.5±0.05a | 4.5±0.05b | 4.7±0.09b |
| 10 | 4.8±0.04b | 4.2±0.05c | 4.7±0.09b |
| 15 | 4.5±0.05c | 3.4±0.18d | 4.1±0.13c |

[1] Values are means ± standard deviation (n=3). Mean values represented by the same letters within the same column are not significantly different ($P$>0.05).

### Sensory analysis

The control cake had 5.2 overall acceptance score and the addition 15% pomace resulted in cake samples with a score of 4.1 (Table 6). The chewiness and flavour properties of the cake samples were significantly ($P$<0.05) affected by gilaburu pomace incorporation. A significant decrease was observed in the sensory properties of gilaburu pomace added cake samples, and 5% fruit pomace incorporation seems to be the best level in terms of sensory properties (Table 6). Acun and Gul (2014) have reported that the cookies containing 5% grape seed flour were most appreciated in terms of sensorial properties. When the usage level of grape pomace flours (whole grape pomace flour, pomace flour without seeds, seed flour) exceeded 10% for cookie samples, general acceptability and affordability significantly decreased. In this study, similar usage level has been determined for sensory quality of cake.

**Table 7. Total phenolic content and DPPH radical scavenging activity (%) of cake samples.[1,2]**

| Gilaburu pomace (%) | Phenolic content (mg GAE/100 g DM) | Radical scavenging activity (%) |
|---|---|---|
| 0 (control) | 27.85±1.4d | 10.26±1.5d |
| 5 | 83.58±2.2c | 25.48±1.0c |
| 10 | 124.34±7.3b | 46.00±3.6b |
| 15 | 179.73±5.9a | 76.83±4.5a |

[1] Mean values represented by the same letters within the same column are not significantly different at $P$>0.05.
[2] DPPH = α,α-diphenyl-α-picrylhydrazyl; GAE = gallic acid equivalent; DM = dry matter.

### Total phenolic content and DPPH radical scavenging activity

Total phenolic contents of cake samples gradually increased with addition of gilaburu pomace (Table 7). High correlation ($r^2$=0.996) between total phenolic contents and the level of gilaburu pomace was determined (but it should be kept in mind that there were only 3 addition levels). While the total phenolic content of control cake was 27.85 mg gallic acid equvalent/100 g dry sample, the highest phenolic content (179.73 mg gallic acid equvalent/100 g dry sample) was determined in the sample supplemented with 15% pomace. A total phenolic content of 115 mg gallic acid equvalent/100 g water extract of gilaburu fruit has been previously reported (Burnaz, 2007).

Similarly, DPPH radical scavenging activity (%) of the cake samples increased with increasing gilaburu pomace addition levels (Table 7). The results showed that there were positive correlations ($r^2$=0.975) between the radical scavenging activity (%) results and the addition level of gilaburu pomace (there were only 3 addition levels). A high correlation was also reported between total phenolic content and radical scavenging activity of the samples (Fang *et al.*, 2008; Kilci and Göçmen, 2014).

## 4. Conclusions

Gilaburu is a regional fruit traditionally prepared and consumed in the form of naturally fermented juice in Kayseri, Turkey. Although, the fruit has a high potential to be used in functional food products by the food industry, there are no industrial gilaburu products available in the market. In this study, the gilaburu pomace affected some textural and physical properties of the cakes. The dietary fibre content of gilaburu pomace is also expected to be high, therefore, effects of gilaburu pomace addition on the soluble and insoluble dietary fibre content of food products should be investigated in further studies. High level of total phenolic content and antioxidant activity were observed in the cake samples incorporated with gilaburu pomace. From this point of view, gilaburu pomace might have the potential for use in cakes as a good source of polyphenols. Although some undesirable results related to sensory properties of cakes were obtained, their bioactive properties considerably increased. In terms of overall acceptability and sensory properties 5% level can be considered adequate for cake formulation. The results suggest that gilaburu pomace could be added to other bakery product formulations in accordance with preference of today's conscious consumers demanding health promoting functional foods. Further detailed investigations are required for exploring the beneficial properties of gilaburu fruit for other food industry applications.

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## References

Acun, S. and Gül, H., 2014. Effects of grape pomace and grape seed flours on cookie quality. Quality Assurance and Safety of Crops & Foods 6: 81-88.

Akbulut, M., Calısır, S., Marakoglu, T. and Coklar, H., 2008. Chemical and technological properties of European cranberry bush (*Viburnum opulus* L.) fruits. Asian Journal of Chemistry 20: 1875-1885.

Baydar, N., Özkan, G. and Sağdiç, O., 2004. Total phenolic contents and antibacterial activities of grape (*Vitis vinifera* L.) extracts. Food Control 15: 335-339.

Brockmole, C.L. and Zabik, M.E., 1976. Wheat bran and middlings in white layer cakes. Journal of Food Science 41: 357-360.

Burnaz, N.A., 2007. *Viburnum opulus* ve *Viburnum oriontale* bitki ekstraktlarının kimyasal bileşimi ve biyolojik aktiviteleri. MSc thesis, Karadeniz Technical University, Trabzon, Turkey, 89 pp.

Çam, M., Hışıl, Y. and Kuşçu, A., 2007. Organic acid, phenolic content and antioxidant capacity of fruit flesh and seed of *Viburnum opulus*. Chemistry of Natural Compounds 43: 460-461.

Fang, Z., Hu, Y., Liu, D., Chen, J. and Ye, X., 2008. Changes of phenolic acids and antioxidant activities during potherb mustard (*Brassica juncea*, *Coss.*) pickling. Food Chemistry 108: 811-817.

Gupta, M., Bawa, A.S. and Semwal, A.D., 2009. Effect of barley flour ıncorporation on the instrumental texture of sponge cake. International Journal of Food Properties 12: 243-251.

Hasler., C.M., 2002. Functional foods: benefits, concerns and challenges – a position paper from the American Council on Science and Health. Journal of Nutrition 132: 3772-3781.

Isolauri, E., Ribeiro, H.C. and Gibson, G., 2002. Functional foods and probiotics: working group report of the first world congress of pediatric gastroenterology hepatology and nutrition. Journal of Pediatric Gastroenterology and Nutrition 35: 106-109.

Jones, P.J., 2002. Clinical nutrition: 7. Functional foods – more than just nutrition. Canadian Medical Association Journal 166: 1555-1563.

Kilci, A. and Göçmen, D., 2014. Phenolic acid composition, antioxidant activity and phenolic content of tarhana supplemented with oat flour. Food Chemistry 151: 547-553.

Lebesi, D.M. and Tzia, C., 2011. Effect of the addition of different dietary fiber and edible cereal bran sources on the baking and sensory characteristics of cupcakes. Food and Bioprocess Technology 4: 710-722.

Lin, P.Y., Czuchajowska, Z. and Pomeranz, Y., 1994. Enzyme-resistant starch in yellow layer cake. Cereal Chemistry 71: 69-75.

Lu, T.M., Lee, C.C., Mau, J.L. and Lin, S.D., 2010. Quality and antioxidant property of green tea sponge cake. Food Chemistry 119:1090-1095

Masoodi, F.A., Sharma, B. and Chauhan, G.S., 2002. Use of apple pomace as a source of dietary fiber in cakes. Plant Foods for Human Nutrition 57: 121-128.

Ronda, F., Gomez, M., Blanco, C.A. and Caballero, P.A., 2004. Effects of polyols and nondigestible oligosaccharides on the quality of sugar free sponge cakes. Food Chemistry 90: 549-555.

Şeker, İ.T., Gökbulut, İ., Öztürk, S. and Özbaş, Ö.Ö., 2006. Kayısı lifinin kek üretiminde kullanımı. In: Proceedings of the Turkey 9$^{th}$ Food Congress, May 24-26, 2006, Bolu, Turkey.

Singleton, V.L. and Rossi, J.R., 1965. Colorimetry of total phenolics with phosphomolybdic–phosphotungstic acid. American Journal of Enology and Viticulture 16: 144-158.

Stauffer, C.E., 1999. Soya ununun unlu gıdalardaki özel kullanımları. Unlu Mamuller Teknolojisi 8: 16-22.

Sudha, M.L., Baskaran, V. and Leelavathi, K., 2007. Apple pomace as a source of dietary fiber and polyphenols and its effect on the rheological characteristics and cake making. Food Chemistry 104: 686-692.

Velioglu, Y.S., Ekici, L. and Poyrazoğlu, E.S., 2006. Phenolic composition of European Cranberrybush (*Viburnum opulus* L.) berries and astringency removal of its commercial juice. International Journal of Food Science and Technology 41: 1011-1015.