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A Study on the Potential of Using Melon Wastes in Biscuit Production

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ABSTRACT
In this research, melon peel flour (MPF) (0, 2.5 and 5%) and melon seed flour (MSF) (0, 1.25 and 2.5%) as nutritionally and functionally valuable flours of food industry by-products were replaced by wheat flour in cookie formulation for producing value added products. Some physical, chemical and sensory properties of cookie samples were investigated. The results showed that the addition MPF could significantly decreased lightness, redness and increased in yellowness, while MSF addition gave higher lightness of cookie. MSF and MPF addition in cookie samples increased in diameter, decreased in thickness, which increased the spread rate values. Ash, protein, fat, energy total phenolic content, antioxidant activity, phytic acid, and minerals of cookie samples increased with MSF level, while carbohydrate and hardness values showed a reverse trend. Also cookies containing MSF and MPF had more desirable sensorial attributes than of control cookies.

Araştırma Makalesi

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Anahtar Kelimeler
Waste products
Value added products
Melon peel
Melon seed
Cookie

Kavun Atıklarının Bisküvi Üretiminde Kullanım Potansiyeli Üzerine Bir Araştırma

ÖZET
Bu araştırmada, bisküvi formülasyonunda buğday unu yerine besinsel ve fonksiyonel değeri yüksek gıda endüstrisi yan ürünleri olan kavun kabuğu unu (KKU) (% 0, 2.5 ve 5) ve kavun çekirdeği unu (KÇU) (% 0, 1.25 ve 2.5) kullanılmıştır. Bisküvi örneklerinin bazı fiziksel, kimyasal ve duyusal özellikleri incelenmiştir. Bisküvi örneklerinde KKU kullanımı ile parlaklık ve kırmızılık azaldığı, sarılık değerlerinin arttığı gözlenirken, KÇU ilavesi ile daha yüksek parlaklık değerleri elde edilmiştir. KKU ve KÇU ilavesi ile bisküvi örneklerinin çap ve yayılma değerlerinde artış, kalınlık değerlerinde bir azalış belirlenmiştir. Artan oranda KÇU ilavesi ile bisküvi örneklerinin kül, protein, yağ, enerji, toplam fenolik içerik, antioksidan aktivite, fitik asit ve mineral değerleri artış sağlarken, karbonhidrat ve sertlik değerlerinin düşmesine yol açmıştır. Duyusal analiz sonuçlarına göre, KKU ve KÇU içeren bisküvi örnekleri kontrol örneklerinden daha arzu edilebilir duyusal özellikler göstermiştir.

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INTRODUCTION

Increased food consumption with world population growth leads to an increase in food waste. Food waste is defined as the loss of edible parts of the raw material during its production and processing (Plazzotta et al., 2017). Food waste is the second-largest source of waste after household sewage. Food waste constitutes at least one-third of (about 1.3 billion tons) the world's food according to the Food and Agriculture Organization (FAO, 2014). The largest portion of food waste represented fruit and vegetable wastes, estimated at 0.5 billion tons. Therefore, the emergence of a significant amount of edible qualified foodstuffs as waste and the fact that this large amount of waste represents an economic and environmental problem raises worldwide concern. Despite these drawbacks, fruit and vegetable wastes are a valuable source of biomass and nutrients. Fruit and vegetable wastes and by-products have vitamins, minerals, organic acids, oils, dietary fiber, carotenoids and phenolic compounds that have a wide range of activities such as antitumor, antiviral, antibacterial, cardio protective and

antimutagenic (Sonja et al., 2009).

Nowadays, consumers who are nutrition awareness demand that foods should be not only safe and nutritional but also natural, organic and healthy. This has increased the search for functional components and demand for functional products. Cheap and easily accessible fruit and vegetable wastes are an important source for the development of novel functional foods. Fruit and vegetable wastes contain peels, rinds, seeds and unused flesh that commonly wasted or discarded (Mallek-Ayadi et al., 2018). Peels and seeds are potential sources of phytochemicals that have an important role in preventing diseases such as cancer and cardiovascular disorders by antioxidant activity properties which prevents oxidation of lipids and other molecules (Vella et al., 2010).

Melon (*Cucumis melo* L.) is an important horticultural crop in the world and according to FAO 2016 data (FAO, 2018). Throughout the food supply chain, melon has a utilization rate of 38 to 42%, while 58 to 62% is disposed of as waste (Miguel et al., 2008). Approximately 738 thousand tons of this waste amounts are composed of melon seeds (FAO, 2015). Melon seeds have rich content in terms of minerals (magnesium, phosphorus, sodium, and potassium), polyunsaturated fatty acids (especially linoleic and linolenic), and essential amino acids (isoleucine, methionine, tyrosine, phenylalanine and valine) (Umar et al., 2016). Also melon peels mainly contain carbohydrates, protein and fiber. Thanks to rich content, various forms of fruit wastes can be used as new additives in bakery products.

In this study, cookies are made with melon peel flour (MPF) and melon seed flour (MSF) at different ratios for the purpose of converting waste products into high value-added products.

MATERIALS and METHODS

Material

Wheat flour, shortening, powdered sugar, salt, vanilla and sodium bicarbonate were purchased from local markets in Konya for cookie production. Melons were purchased from the local bazaar in Konya (Turkey) and cleaned; peels were separated from the flesh, cut into 0.5 cm slices and put to dry in the sun. Melon seeds were separated from the fibers, cleaned and dried in the sun. Dried peels and seeds were ground with a grinder (Alveo, AHE.OG.01, Konya, Turkey), sieved through 300 µm sieve to obtain MSF and MPF and stored at 25°C in sealed plastic containers until further analyses. All chemicals were of the highest analytical grade.

Production of cookies

The cookie dough was prepared in a laboratory mixer Kenwood mixer (Kenwood, Chef KMC010, Canada) for 10 min at 125 rpm with a following standard formulation (100 g wheat flour [according to 14% moisture content], 40 g shortening, 40 g powdered sugar, 2 g sodium metabisulphite, 1.25 g salt, 1 g milk powder and 0.5 g vanillin) using the standard method AACCI 10.54.01 (AACCI, 1990). Eighteen types of cookies were produced: control (100% wheat flour) and enriched with increasing percentages (0, 2.5 and 5%) of melon peel and melon seed (0, 1.25 and 2.5%) flours. The cookie dough was sheeted to 5.0 mm thickness with a rolling pin and shaped with a dough cutter (50 mm diameter) and baked on aluminum trays in an oven (Vestel SF 8401) at 170˚C for 20 min.

Physical characteristics

After 3 hours of cooling at room temperature, diameter (mm) and thickness (mm) measured with a digital micrometer (0.001mm, Mitutoyo, Minoto-Ku, Tokyo, Japan) (AACCI, 1990). Spread ratio was calculated as diameter divided by thickness of the cookies (Singh and Mohamed, 2007). The hardness and fracturability of the cookies were measured using the standard method AACCI 74-09.01 (AACCI, 2010) by texture analyzer (TA-XT plus, Stable Microsystems, England). (Pretest speed: 1.0 mms^{-1}, test speed: 3.0 mms^{-1}, posttest speed: 10 mms^{-1}, distance: 5 mm).

Color measurements

The color was measured using Konica Minolta Chroma Meter (Model CR-400, Konica Minolta Sensing, Inc., Osaka, Japan). Five different point of surface color of cookie samples. a* and b* values were used to calculate the chroma (SI) ($SI = \sqrt{a*^2 + b*^2}$) and hue angle ($H = \tan^{-1}(b*/a*)$) values (Francis, 1998).

Proximal composition

Chemical composition of melon seed, melon peel and wheat flour as raw materials and cookie samples were determined following AACCI methods (AACCI, 2010) for moisture (AACCI method 44-19.0.1), ash (AACCI method 08-01.01), protein (AACCI method 46-12.01) and crude fat (AACCI method 30-10.01). Carbohydrates contents of cookies were calculated according to following formula; 100 – (moisture + protein + ash + crude fat content of cookies) (Karaağaoğlu et al., 2008). Water activity (Aw) was measured using a water activity analyzer (Novasina AG, CH-8863 Lachen, Switzerland) at room temperature (25°C).

Nutritional analysis

Potassium (K), magnesium (Mg), calcium (Ca), phosphorus (P), iron (Fe), and zinc (Zn) contents were determined in cookies using wet digestion with closed system according to Skujins (1998) and results were expressed in mg/100 g^{-1} sample.

Phytic acid content of cookie samples was measured by colorimetric method according to Haug and Lantzsch (1983) using spectrophotometer (Biochrom, Libra S22, England). Results were expressed in mg/100 g^{-1} sample.

TPC and DPPH assay

Four gram of a sample was put into test tube and 10 ml of methanol solution (HCl: Methanol: deionized water; 1:80:10 ml v/v) was added, then the mixture was kept in shaking water bath for 2 h. The mixture was centrifuged at 3000 rpm for 10 min and the supernatant was separated. Total phenolic content was determined by the Folin-Ciocalteu spectrophotometric method (Gao et al., 2005) with slight modifications. The total phenolic content was measured with spectrophotometer (Biochrom, Libra S22, England) at 760 nm. The results were expressed as mg gallic acid equivalents per g (mg/GAEg^{-1}) of sample (Slinkard and Singelton, 1977; Gamez-Meza et al., 1999). Antioxidant capacity of cookie samples was determined with DPPH method according to procedure of Gyamfi et al. (1999) and Beta et al. (2005) with some modifications. The antioxidant capacity of the cookie samples was evaluated on the basis of the radical scavenging effect of the stable 1,1-diphenyl-2-picrylhydrazyl radicals (DPPH·) was estimated. The DPPH scavenging capacity was evaluated spectrophotometrically (Biochrom, Libra S22, England) by measuring the decrease in absorbance at 517 nm. DPPH method of antioxidant activity was calculated as percent discoloration.

Sensorial evaluation

Prepared cookies were subjected to sensory analysis by twenty (20) semi-trained panelists (45% male, 55% female) who familiar with the quality aspects of baked products. The sensorial properties of cookies such as color, appearance, texture, taste, odor, crispness and overall acceptability were screened by panel members by using a 5-point hedonic scale (1-5, lowest and highest acceptance, respectively).

Statistical analysis

The tests were performed in duplicate and the results were expressed as mean ± standard deviation. The significance of the variations observed among cookie samples was tested according to three-way analysis and raw materials were tested according to one-way analysis of variance (ANOVA) using software program (JUMP, version 5.0).

RESULTS and DISCUSSION

Color properties of cookie samples

The physical structure, odor and color characteristics of the cookie determine the allure of the product and the main target for the producers is that the components used in cookie production to increase the product variety, do not disrupt the allure. The addition of melon peel decreased the lightness and increased yellowness and chroma (Table 1). The highest lightness values were determined in cookie samples produced without melon peel. Conformable results that b* and chroma values of cake samples were increased with the increased utilization ratio of melon peels compared to control samples were reported by Al-Sayed and Ahmed (2013). These results could be explained by the type and color of the added powder when a different powder used instead of flour in the formula. With the increase in the proportion of melon seed, lightness values increased, while the melon peel addition resulted in a decrease in lightness value.

Table 1. Color properties of cookie samples enriched with melon seed and peel flour
Çizelge 1. Kavun çekirdeği ve kabuğu unu ile zenginleştirilmiş bisküvi örneklerinin renk özellikleri

Melon seed flour *Kavun çekirdeği unu* (%)	**Melon peel flour** *Kavun kabuğu unu* (%)	***L****	***a****	***b****	**SI (chroma)**	**Hue angle**
0	**0**	77.49±0.52 aA	0.97±0.03 bA	24.57±0.13 cA	24.58±0.14 cA	87.74±0.05 bC
	2.5	72.97±0.01 bC	0.69±0.03 bA	26.86±0.07 bB	26.87±0.07 bB	88.53±0.06 aC
	5	69.54±0.03 cC	1.64±0.10 aA	30.16±0.03 aA	30.20±0.03 aA	86.89±0.18 cB
1.25	**0**	78.12±0.01 aA	0.22±0.01 bC	23.55±0.04 bB	23.55±0.04 bB	89.48±0.02 bA
	2.5	73.34±0.02 bB	0.39±0.03 aB	27.84±0.08 aA	27.84±0.09 aA	89.21±0.06 cB
	5	72.92±0.02 cA	-0.83±0.01 cB	27.56±0.09 aC	27.57±0.09 aC	91.71±0.02 aA
2.5	**0**	78.05±0.03 aA	0.38±0.01 aB	24.28±0.04 cA	24.28±0.04 cA	89.10±0.03 cB
	2.5	74.70±0.03 bA	-0.70±0.02 bC	25.85±0.01 bC	25.86±0.01 bC	91.54±0.05 bA
	5	71.93±0.28 cB	-0.97±0.01 cB	28.71±0.02 aB	28.72±0.02 aB	91.94±0.03 aA

Values followed by different superscript letters (series "a-c") within each column (indicating differences among average of cookie samples with melon peel flours at same usage levels of melon seed flours), by different uppercase letters (series "A-C") within each column (indicating differences among average of cookie samples with melon seed flours at same usage levels of melon peel flours) are significantly different at $p < 0.05$.

Haghayegh and Zaveh (2017) reported that melon seed flour in the cookie effected in a decrement of lightness and increment of yellowness.

The found results are in concordance with the study of

Toledo et al. (2019) who determined lightness (L^*), chroma and hue angle value of MPF. Both MSF and MPF addition showed lower redness values than control cookie sample.

Physical and textural properties of cookie samples

Table 2 shows the physical properties of cookies prepared with different levels of melon seed and melon peel flours. Diameter, thickness and spread ratio values were significantly affected by MSF and MPF addition. The addition of MSF and MPF caused an increase in cookie diameter. This result could be explained with the high-fat content of melon seed flour and diluted gluten content of flour blends compared to the control that increases the diameter. Other studies that have used food by-products reported an increase in diameter, with use of sunflower seed flour (Grasso et al., 2019) and mandarin peel powder (Ojha and Thapa, 2017). Spread ratio plays important role for measuring cookie quality. Higher spread ratio values are desirable for better cookies (Barak et al., 2013). It was observed that the spreading ratio of cookie samples increased with decreasing in thickness. The highest spread ratio value (8.48) was observed in cookie sample prepared with 2.5% MSF and 5% MPF. All the levels of MSF and MPF increased spread ratio values compared to the control cookie (5.85). Hooda and Jood (2005) stated that increased hydrophilic groups due to the presence of seed proteins with high water holding capacity affect the spread factor of the cookie positively. The increase in the spread factor of cookies fortified with melon waste is in agreement with the studies on enriched with mango waste (Ashoush and Gadallah, 2011) and sunflower waste (Grasso et al., 2019). Hardness is the main sensorial characteristic of cookies (Gaines et al., 1992). Control cookie sample gave the highest hardness value and cookie samples became softer by the addition of MSF and MPF. This decrease in the hardness values with use of melon waste in cookies was related to the increasing content of dietary fiber. Dietary fiber gives a softer cookie texture due to its high water holding capacity. According to Aslam et al. (2014), the hardness of cookies is affected by the development of gluten network formed as a result of the interaction of gluten protein with water molecules and thus the decrement of hardness value may be caused by reducing the amount of gluten. Supplementation of MSF or MPF had no significant effect on fracturability of cookie samples. Statistically similar results ($p>0.05$) were observed in fracturability values of cookies.

Table 2. Physical properties of cookie samples enriched with melon seed and peel flour
Çizelge 2. Kavun çekirdeği ve kabuğu unu ile zenginleştirilmiş bisküvi örneklerinin fiziksel özellikleri

Melon seed Flour (*Kavun çekirdeği unu*(%))	Melon peel Flour(*Kavun kabuğu unu* (%)	Diameter *Çap* (mm)	Thickness *(Kalınlık* (mm))	Spread ratio *(Yayılma Oranı)*	Hardness *(Sertlik* (g))	Fracturability *(Kırılganlık* (mm))
0	**0**	54.83±0.39aB	9.35±0.07aA	5.86±0.09bC	6933.30±31.86aA	42.21±0.69 aA
	2.5	55.00±0.28aB	8.00±0.14 bA	6.88±0.09aC	4437.80±167.05bA	40.32±0.88 aA
	5	55.45±0.21aC	7.75±0.07 bA	7.16±0.04aA	4157.81±4.94 bAB	40.62±0.07 aA
1.25	**0**	54.93±0.04cB	7.55±0.07 aB	7.28±0.07bB	4354.32±204.70aB	40.39±0.23 aA
	2.5	55.55±0.13bAB	7.23±0.04 bB	7.69±0.06aB	4194.94±69.03aAB	42.13±0.96 aA
	5	56.28±0.18aB	7.18±0.04 bA	7.84±0.01aA	4369.68±120.77aA	39.98±0.95 aA
2.5	**0**	56.19±0.06cA	7.15±0.21 aB	7.86±0.24bA	2401.41±11.32bC	40.86±0.02 aA
	2.5	56.66±0.06bA	6.80±0.14 aC	8.33±0.18abA	4098.54±95.04aB	39.67±0.93 aA
	5	57.60±0.14aA	6.80±0.28 aA	8.48±0.37aA	3880.04±17.61aB	40.23±0.50 aA

Values followed by different superscript letters (series "a-c") within each column (indicating differences among average of cookie samples with melon peel flours at same usage levels of melon seed flours), by different uppercase letters (series "A-C") within each column (indicating differences among average of cookie samples with melon seed flours at same usage levels of melon peel flours) are significantly different at $p < 0.05$.

Nutritional evaluation

Table 3 presents moisture, ash, water activity, protein, fat, carbohydrate and energy values in the analyzed cookie samples. The moisture content of the cookie samples ranged between 4.16 and 5.51%, and the lower moisture content of the cookie sample is more desirable due to high storage stability. The lowest moisture content of the cookie samples was in the cookie supplemented 5% melon peel flour without melon seed flour. Moisture content of cookies depends on high water binding capacity of flours used in formulations. The results obtained from the present study showed similar findings with Ho and Latif (2016) and Al-Sayed and Samed (2013). The addition of melon peel flour to cookie had a positive impact on the ash content. The highest ash content was observed with cookies prepared with 5% melon peel flour. An increase of about 25% in the ash content was observed, compared to the control cookie sample. This result explained with higher ash content of MPF than wheat flour (about 10-fold). This is similar to the earlier findings of Ojha and Thapa (2017) who reported that an increase in ash content of cookies with the replacement of mandarin peels powder. Water activity values were varied between 0.337 and 0.342. Addition of melon peel flour without melon seed to cookies showed higher water

activity values. This might be due to the higher water binding capacity of melon peel flour than melon seed flour. A similar result was reported by de Toledo et al. (2017) who found the water activity between 0.39 and 0.41 in cookie samples containing from 5 to 15% of melon by-products. Protein content ranged between 9.11 and 11.57% of dry weight, supplementation of melon seed and melon peel flours had significant influence on protein content. A higher addition of melon seed flour caused a marked increase in protein content but melon peel addition caused a slight decrease in protein content (on average from 9.24% for control cookie to 11.57% for the cookie with 2.5% of melon seed flour without melon peel flour). The data obtained for the protein of cookies were in agreement with findings of Ifesan and Franca (2017) who reported that an increase in the protein content gradually cookie containing watermelon seeds. Also, results related to MPF were relatively comparable with the present data by Badr (2015) in cookie samples enriched with watermelon rind. Replacement of wheat flour with MSF in different cookie formulations resulted in a significant increase of fat content but supplementation of MPF in cookie formulation had no significant influence on fat content. Similar increase in fat content was observed for pumpkin seed enriched cookies by Kaur and Sharma (2017). As the amount of MSF increased, carbohydrate content decreased significantly ($p<0.05$), on the contrary, a slight increase was observed with MPF addition to cookies. These results are consistent with previous studies by Ho and Latif (2016) who observed higher carbohydrate content of cookie enriched with pitaya peel flour and by Islam et al. (2015) who determined lower carbohydrate content of biscuit containing with jackfruit seed flour. The energy values of cookies ranged from 457.83 to 482.87 kcal and the highest energy value was observed from 2.5% of melon seed flour without melon peel flour. From Table 3, it is evident that MSF and MPF could be used for improving nutritional value of cookie samples. Similarly, the energy values of cookies prepared using 0 - 30% level of pumpkin seed flour increased from 482.11 up to 498.35 kcal was reported by Kaur and Sharma (2017).

Table 3. Chemical properties of cookie samples enriched with melon seed and peel flour
Çizelge 3. Kavun çekirdeği ve kabuğu unu ile zenginleştirilmiş bisküvi örneklerinin kimyasal özellikleri

Melon seed flour *Kavun çekirdeği unu* (%)	**Melon peel flour** *Kavun kabuğu unu* (%)	**Moisture** *Nem* (%)	**Ash** (*Kül*) (%)	**Water activity** *Su aktivitesi* (aw)	**Protein** *Protein* (%)	**Fat** *Yağ* (%)	**Carbohydate** *Karbonhidrat* (%)	**Energy** *Enerji* (kcal)
0	**0**	4.83±0.01bB	0.571±0.00bC	0.340±0.00aA	9.24±0.03aC	16.43±0.33 aC	68.93±0.36bA	460.56±1.59aC
	2.5	5.11±0.01aA	0.655±0.01aB	0.341±0.00aA	9.20±0.03bC	16.18±0.11 aC	68.86±0.13bA	457.83±0.55aC
	5	4.16±0.01cB	0.680±0.02aA	0.342±0.00aA	9.11±0.04cC	16.11±0.10 aB	69.94±0.12aA	461.18±0.54aB
1.25	**0**	5.51±0.01aA	0.589±0.00cB	0.341±0.00aA	10.36±0.01aB	18.15±0.10 aB	65.40±0.10bB	466.35±0.45aB
	2.5	4.44±0.08cB	0.685±0.00bAB	0.337±0.00bA	10.34±0.01aB	18.13±0.05 aB	66.41±0.14aB	470.13±0.05aB
	5	5.20±0.09bA	0.713±0.00 aA	0.341±0.00aAB	10.17±0.02bB	17.63±0.25 aB	66.30±0.14aB	464.47±1.60aB
2.5	**0**	4.41±0.08bC	0.606±0.00 bA	0.341±0.00aA	11.57±0.05aA	20.59±0.11 aA	62.84±0.24aC	482.87±0.20aA
	2.5	5.34±0.02aA	0.701±0.00 aA	0.337±0.00aA	11.50±0.03aA	20.43±0.13 aA	62.03±0.14aC	477.99±0.70bA
	5	5.16±0.07aA	0.716±0.01 aA	0.334±0.00aB	11.38±0.03bA	19.82±0.39 aA	62.93±0.48aC	475.58±1.70bA

Values followed by different superscript letters (series "a-c") within each column (indicating differences among average of cookie samples with melon peel flours at same usage levels of melon seed flours), by different uppercase letters (series "A-C") within each column (indicating differences among average of cookie samples with melon seed flours at same usage levels of melon peel flours) are significantly different at $p < 0.05$

The effect of supplementation of cookies with melon seed flour (MSF) and melon peel flour (MPF) on the total phenolic content (TPC) and antioxidant activity is presented in Table 4. As expected, the addition of MSF and MPF affected the total phenolic content positively. In comparison to the control, the total phenolic content of cookies significantly higher about 66.18% enriched with 2.5% MSF and 5% MPF addition. Significant variation in the TPC of biscuit was also demonstrated by Ashoush and Gadallah (2011) who produced biscuit using different levels of mango peel and seed powder instead of wheat flour. Acun and Gül (2013) claimed that total dietary fiber and TPC content of cookie samples produced with whole grape pomace flour increased with rising level of pomace.

Antioxidant activity values decreased significantly with MPF addition, but MSF addition gave slight increase in antioxidant activity values of cookies. This increase was due to its inherent higher (174 and 314%) antioxidant activity of MSF than wheat flour and MPF. Melon by-product extracts demonstrate high antioxidant activity thanks to iron and copper ions chelating activity and have an effect on growth inhibition of human tumor cell lines (Rolim et al., 2018). In a study conducted by Moon and Choi (2014) reported that cookies with bitter melon powder contributed to high antioxidant capacity as compared to control cookie sample. Acun and Gül (2013) stated that the antioxidant activity of cookies containing 10% grape seed flour was found to be higher than other samples. The phytic acid content of cookie samples ranged between 218 and 262 mg/100 g of dry weight. Furthermore, supplementation of MPF had

no significant influence on phytic acid content of cookie samples

but MSF addition in cookie resulted in a significant increase (Table 4). These results are supported by Egbuonu (2015) and Bello et al. (2008) who claimed that the phytate content in the seed was higher than the peel. The results for cookie mineral content were shown in Table 5. Minerals such as Ca, P and Mg (on structures for our bones); Na and K (on blood pressure); Fe (as a part of hemoglobin and myoglobin); Cu and Zn (on the metabolism of carbohydrates, fats and proteins) have important effects on health benefits. The addition of MPF resulted in an increase in Ca, Mg, K, P and Fe values compared to the control cookie sample containing only wheat flour. This might be due to MPF containing 25 times more Ca, 10 times more Mg, 6.8 times more K, 2.4 times P and 2.35 times Fe than wheat flour. Mallek-Ayadi et al. (2018) described that melon peels contained significant amounts of calcium, magnesium and potassium; also fruit peels demonstrated more mineral content than other parts. These parameters of cookies increased with increasing levels of MSF. The average daily intake of minerals are as follows: calcium 1000 mg, magnesium 400 mg, potassium 3500 mg, phosphorus 1000 mg, iron 18 mg, zinc 15 mg (Anonymous, 1998). 100 grams of cookies made with 2.5% MSF and 5% MPF supplies 4.4% of the daily calcium content, 9.2% of the magnesium content, 5.5% of the amount of potassium, 36.4% of the phosphorus content, 10.2% of the amount of iron and 6.9% of the zinc content.

Table 4. Nutritional properties of cookie samples enriched with melon seed and peel flour
Çizelge 4. Kavun çekirdeği ve kabuğu unu ile zenginleştirilmiş bisküvi örneklerinin besinsel özellikleri

Melon seed flour Kavun çekirdeği *unu* (%)	**Melon peel flour** *Kavun kabuğu unu (%)*	**TPC**** *Toplam Fenolik İçerik (mg GAE/kg)*	**Antioxidan activity** *Antioksidan Aktivite (%)*	**Phytic acid** *Fitik Asit (mg/100g)*
0	**0**	103.5±3.54 cC	0.069±0.00 aA	224±2.83 aB
	2.5	122.5±0.71 bA	0.052±0.00 abB	222±5.66 aB
	5	150.5±3.54 aA	0.032±0.01 bA	218±5.66 aC
1.25	**0**	113±4.24 cB	0.071±0.00 aA	241±2.83 aB
	2.5	129±4.24 bA	0.048±0.00 bB	231±0.00 aB
	5	157±7.07 aA	0.047±0.00 bA	230.5±6.36 aB
2.5	**0**	124.5±4.95bA	0.069±0.00 aA	262±2.83 aA
	2.5	137±4.24 bA	0.063±0.00 bA	252±0.00 aA
	5	172±1.41 aA	0.054±0.00 cA	251.5±6.36 aA

Values followed by different superscript letters (series "a-c") within each column (indicating differences among average of cookie samples with melon peel flours at same usage levels of melon seed flours), by different uppercase letters (series "A-C") within each column (indicating differences among average of cookie samples with melon seed flours at same usage levels of melon peel flours) are significantly different at $p < 0.05$.

Table 5. Mineral composition of cookie samples enriched with melon seed and peel flour
Çizelge 5. Kavun çekirdeği ve kabuğu unu ile zenginleştirilmiş bisküvi örneklerinin mineral kompozisyonu

Melon seed flour *(Kavun çekirdeği unu (%))*	**Melon peel flour** *(Kavun kabuğu unu (%))*	**Ca (mg/100g)**	**Mg (mg/100g)**	**K (mg/100g)**	**P (mg/100g)**	**Fe (mg/100g)**	**Zn (mg/100g)**
0	**0**	28.52±0.54 bB	28.45±0.18cB	141.26±1.07cC	213.41±4.11 cC	1.61±0.01 cB	0.86±0.01aB
	2.5	31.28±0.40 bB	30.74±0.19bB	155.56±0.35bC	434.51±1.57 bA	1.67±0.00 bB	0.89±0.00aB
	5	39.54±0.47 aC	32.42±0.27aB	179.54±0.09aC	582.60±8.78 aA	1.73±0.01 aB	0.92±0.02aA
1.25	**0**	30.36±0.16 cB	30.61±0.16bA	152.52±0.25cB	234.21±1.55 cB	1.65±0.01 bB	0.87±0.01cB
	2.5	32.53±0.25 bB	33.37±0.16abA	163.59±0.16bB	377.78±0.53 bB	1.71±0.01 aB	0.90±0.00bB
	5	58.36±0.35 aA	34.28±0.83aAB	184.52±0.54aB	515.51±1.82 aB	1.74±0.00 aB	0.95±0.01aA
2.5	**0**	33.64±0.34 bA	31.36±0.16cA	169.32±0.02cA	261.61±3.68 bA	1.72±0.01 cA	0.93±0.01bA
	2.5	41.24±0.48 aA	33.49±0.21bA	177.98±0.17bA	360.38±1.24 aC	1.78±0.02 bA	0.97±0.01bA
	5	43.83±0.38 aB	36.64±0.38aA	192.51±0.13aA	364.35±2.33 aC	1.83±0.01 aA	1.04±0.02aA

Values followed by different superscript letters (series "a-c") within each column (indicating differences among average of cookie samples with melon peel flours at same usage levels of melon seed flours), by different uppercase letters (series "A-C") within each column (indicating differences among average of cookie samples with melon seed flours at same usage levels of melon peel flours) are significantly different at $p < 0.05$.

Sensorial properties of cookies

The sensorial evaluations for appearance, crispness, taste, odor and general acceptability of cookies are displayed in Table 6. In cookies, more than 2.5% level of MPF addition decreased crispness and taste scores slightly. This decrease in taste value can be related to the high polyphenol content that lead to the slight bitterness and acidity present in fruit peels (Naknaen et al., 2016). Appearance is the first effect on the

assessment of food feature by the consumer. Supplementation of MSF in cookie had no significant effect on crispness scores but appearance scores improved with increasing level of MSF in cookie formulation. In a study made by Kaur and Sharma (2017), both color and appearance values were improved by using pumpkin seed powder in cookie samples. According to general acceptability scores of cookies, the most desirable cookie samples were chosen as 1.25% MSF and 2.5% MPF added cookie samples by the panelists.

Table 6. Sensorial evaluation of cookie samples enriched with melon seed and peel flour
Çizelge 6. Kavun çekirdeği ve kabuğu unu ile zenginleştirilmiş bisküvi örneklerinin duyusal sonuçları

Melon seed flour *(Kavun çekirdeği unu (%))*	**Melon peel flour** *(Kavun kabuğu unu(%))*	**Appearance** *Görünüş*	**Cripsness** *Gevreklik*	**Taste** *Tat*	**Odor** *Koku*	**General acceptability** *Genel kabul edilebilirlik*
0	0	3.55±0.07 bB	4.40±0.14 aB	4.20±0.00 aC	4.55±0.07 aA	4.06±0.08 aB
	2.5	4.65±0.21 aA	4.45±0.07 aA	4.50±0.00 aA	4.35±0.21 aAB	4.44±0.11 aAB
	5	4.45±0.07 aA	3.50±0.71 aA	3.10±0.14 bB	4.60±0.14 aA	4.06±0.25 aA
1.25	0	3.65±0.07 bB	4.65±0.21 aA	4.50±0.00 aB	4.10±0.14 aB	4.35±0.13 aA
	2.5	4.90±0.14 aA	4.10±0.14 bB	4.80±0.28 aA	4.55±0.07 aA	4.54±0.17 aA
	5	4.80±0.28 aA	4.25±0.07 abA	4.45±0.35 aA	3.50±0.71 aA	4.20±0.28 aA
2.5	0	4.40±0.14 aA	4.10±0.14 aC	4.75±0.07 aA	4.00±0.00 aB	4.18±0.08 aB
	2.5	4.85±0.07 aA	4.10±0.14 aB	4.10±0.14 bA	4.10±0.14 aB	4.29±0.13 aB
	5	4.54±0.09 aA	4.05±0.07 aA	4.30±0.00 bA	4.40±0.14 aA	4.41±0.04 aA

Values followed by different superscript letters (series "a-c") within each column (indicating differences among average of cookie samples with melon peel flours at same usage levels of melon seed flours), by different uppercase letters (series "A-C") within each column (indicating differences among average of cookie samples with melon seed flours at same usage levels of melon peel flours) are significantly different at $p < 0.05$.

CONCLUSION

The MSF and MPF are alternative sources in cookie formulation for nutritional enrichment. In this study, chemical, nutritional and sensorial properties of cookies enriched with MSF and MPF were investigated. The addition of MSF improved the nutritional quality such as ash, protein, fat, energy, total phenolic content, minerals, in contrast to these parameters MPF addition resulted in a decrease in protein content. High spread ratio value is a desirable quality feature of cookie samples, and MSF and MPF addition resulted in an increase in diameter and decrease in thickness values, so MSF and MPF added cookie samples showed a spread that the consumer would prefer. MSF added cookies showed harder cookie texture compared to control cookie, while cookies became softer by the addition of MPF. According to sensorial evaluation, the addition of MSF at 1.25% level and MPF at 2.5% level resulted in highest scores in appearance, taste, odor and general acceptability in all cookie samples. Result of this study revealed that more nutritious cookies can be produced by up to 2.5% addition level of MSF and up to 5% addition level of MPF and this formulation of cookie can beneficially affect the nutritive composition and also does not impair sensorial attributes of cookies due to the higher general acceptability scores than control cookie sample.

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