SİDAS MEDYA
Akademik Gıda®
ISSN Online: 2148-015X
https://dergipark.org.tr/tr/pub/akademik-gida

Akademik Gıda 21(4) (2023) 353-360, DOI: 10.24323/akademik-gida.1423429

Research Paper / Araştırma Makalesi

Effect of Persimmon (*Diospyros kaki* Thunb.) Powder and Quince (*Cydonia oblonga*) Seed Mucilage on Physical, Chemical, Textural and Sensory Properties of Turkish Noodles

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Received (Geliş Tarihi): 24.11.2022, Accepted (Kabul Tarihi): 12.11.2023
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ABSTRACT

In this study, persimmon powder (PP) was substituted in concentrations of 0, 5 and 10% per 100 g of einkorn flour (EF) in Turkish noodle production. Quince seed mucilage (QSM) was used as an egg replacer at levels of 20, 30 and 40%. The cooking properties, chemical composition, color values, texture characteristics, and sensory properties of Turkish noodles were determined. The lowest cooking time (8.33 min) was found in Turkish noodles substituted with 10% PP. When 40% QSM was added to the formulation, both volume increase and water absorption values increased. Turkish noodles produced with a higher concentration of PP resulted in increased ash, crude fiber, mineral contents, especially in potassium, and total phenolic content. The lowest firmness and work of shear were obtained when PP and QSM substitutions were increased up to 10% and 40%, respectively. The sensory evaluation indicated that Turkish noodles substituted with 10% PP were greatly appreciated by the panelists in terms of taste, odor, and overall acceptability.

Keywords: Turkish noodle, Einkorn, Total phenolic, Mineral

Eriştelerin Fiziksel, Kimyasal, Tekstürel ve Duyusal Özellikleri Üzerine Trabzon Hurması (*Diospyros kaki* Thunb.) Tozu ve Ayva Çekirdeği (*Cydonia oblonga*) Müsilajının Etkisi

ÖZ

Bu çalışmada, erişte üretiminde 100 g siyez unu (SU) %0, 5 ve 10 konsantrasyonlarında Trabzon hurması tozu (THT) ile ikame edilmiştir. Ayva çekirdeği müsilajı (AÇM) yumurta ikame maddesi olarak %20, 30 ve 40 seviyelerinde kullanılmıştır. Eriştelerin pişme özellikleri, kimyasal bileşimleri, renk değerleri, tekstürel ve duyusal özellikleri değerlendirilmiştir. En düşük pişirme süresi (8.33 dakika) %10 THT ikame edilen eriştelerde bulunmuştur. Formülasyona %40 oranında AÇM ilave edildiğinde hem hacim artışı hem de su absorpsiyonu değerleri artmıştır. Yüksek konsantrasyonda THT ile üretilen eriştelerde kül, ham lif, mineral madde (özellikle potasyum) ve toplam fenolik madde içeriğini artmıştır. En düşük sertlik ve kesme kuvveti, THT ve AÇM ikameleri sırasıyla %10'a ve %40'a kadar artırıldığında elde edilmiştir. Duyusal değerlendirme, %10 THT ile ikame edilen eriştelerin tat, koku ve genel kabul edilebilirlik açısından panelistler tarafından büyük ölçüde beğenildiğini göstermiştir.

Anahtar Kelimeler: Erişte, Siyez, Toplam fenolik, Mineral

INTRODUCTION

Turkish noodles (erişte) are traditional cereal products that contain soft wheat flour, salt, and egg. Mixing of ingredients, sheeting of the dough, cutting, and drying are the main production steps of Turkish noodles, respectively [1]. Traditional noodles are generally rich in starch but deficient in bioactive compounds, protein, vitamins, and minerals. Various studies have reported the use of different types of flour such as buckwheat flour [1], oat flour [2], quinoa flour [2], legume flour [3], and fruit seed flour [4], as well as other ingredients like legume hull [5], cereal bran [6], fiber [7], and vegetables [8, 9] to develop Turkish noodles.

Persimmon (*Diospyros kaki* Thunb.) is rich in ascorbic acid, dietary fiber, minerals, carotenoids, and polyphenols. Studies have shown that persimmon has antiatherogenic, antiobesity, antidiabetic, and antioxidant effects. The fruit is widely cultivated in both the Mediterranean and Black Sea regions of Türkiye [10, 11]. The antioxidant activity of cookies and rice cakes produced with the persimmon leave powder was evaluated by Kim et al. [12] and Lim and Lee [13], respectively. Moreover, immature persimmon juice and flour obtained from persimmon juice coproducts have been used to enrich spaghetti [11], rice noodles [14], and cakes [15].

Quince (*Cydonia oblonga*) seeds produce a sticky and tasteless liquid (mucilage) when soaked in water. The liquid has a gel structure formed by easily hydrolyzable polysaccharides [16]. In several studies, mucilage has been employed as a thickener, gelling agent, stabilizer, or edible film coating component. Researchers have focused on the addition of mucilage in yogurt [17], ice cream [18], and edible films [19]. This study attempts to enrich Turkish noodles with freeze-dried persimmon. Moreover, the investigation of the possibility of using quince seed mucilage instead of egg in Turkish noodle production was aimed. Thus, proximate compositions, cooking attributes, texture parameters, and sensory properties of the noodles were investigated.

MATERIALS and METHODS

Raw Materials and Chemicals

Einkorn flour (EF, Doğalsan, Türkiye) and table salt (Billur, Türkiye) were used in Turkish noodle production. The EF had the following characteristics: moisture content of 9.73 g/100 g, protein content of 22.03 g/100 g, lipid content of 2.99 g/100 g, ash content of 2.42 g/100 g, and fiber content of 1.94%. Persimmon and quince seeds were supplied by the local markets in Trabzon and Adana, respectively. All the chemicals were of high-purity grade and supplied by Sigma-Aldrich (Steinheim, Germany).

Preparation of Persimmon Powder and Quince Seed Mucilage

After the removal of the peel and seeds, the homogenized fruit flesh was frozen at -20°C for 12 h. Then, the homogenized flesh was freeze-dried (-90°C, 6x10-3 torr) to a water content of 10%. The dried samples were ground by a spice grinder (SCM 2934, Sinbo, Türkiye) and passed through a 0.15-mm sieve. Quince seed mucilage (QSM) was extracted according to Jouki et al. [16] with some modifications. First, 10 g of quince seeds were placed in a 1 L beaker and washed with the triple weight of ethanol solution (96% w/v) by stirring at 1000 rpm for 5 min. Afterwards, the solution was removed and the wet seeds were dried at 45±1°C. Then, distilled water was added in 30:1 proportion (v:w) and stirred at 1000 rpm and 45±1°C for 45 min. Later, centrifugation was performed at 4500 rpm and 26±1°C for 15 min.

Preparation of Noodles

Turkish noodle production was performed according to Bilgiçli [1] with some modifications. The control sample was produced with 100 g of einkorn wheat flour, 30 g of distilled water, 30 g of whole egg, and 1 g of salt. The formulation of the Turkish noodles is given in Table 1. The raw materials were mixed by a mixer (Prochef Xl, Schafer, Germany) for 5 min at medium speed and then rested in a polypropylene bag for 15 min at room temperature (26±1°C). Afterward, the dough was passed through two rollers (Atlas 150, Marcato, Italy) by reducing the sheeting gap gradually to get dough sheets 2 mm in thickness. The sheeted dough pieces were folded in half and sheeted twice at each stage to achieve homogeneity. Then, the sheet was cut into 6 mm in width and 4 cm in length. The Turkish noodle strips were dried for 17 h at 40°C in a drying oven (KD-200, Nüve, Türkiye). Later, the dried Turkish noodles were cooled to room temperature (26±1°C) for further analysis.

Table 1. Turkish noodle formulation with einkorn flour (EF), persimmon powder (PP), and quince seed mucilage (QSM)*

Sample Code	EF (g)	PP (g)	QSM (g)
1	100	0	20
2	100	0	30
3	100	0	40
4	95	5	20
5	95	5	30
6	95	5	40
7	90	10	20
8	90	10	30
9	90	10	40

*EF: einkorn flour; PP: persimmon powder; QSM: quince seed mucilage

Cooking Quality

Cooking time, cooking loss, water absorption, and volume increase were determined according to the AACC method 66-50.01 [20]. Turkish noodles (25 g) were cooked in boiling distilled water (250 mL) and cooking time was determined by crushing the cooked Turkish noodles between a pair of glass plates until the opaque central core in the Turkish noodle strand disappeared. Cooking loss was determined by drying 50 mL of cooking water at 105°C until a constant weight was obtained. Cooking loss was expressed as the percentage of dried solids in cooking water to the weight of uncooked Turkish noodles. Water absorption was calculated after cooked Turkish noodles were drained for 5 min to remove excess water. Water absorption was expressed as the weight ratio of cooked Turkish noodles (drained) to uncooked Turkish noodles. The volume increase was calculated by measuring the increase in water level after cooked and uncooked Turkish noodles were put into a graduated cylinder filled with a certain amount of distilled water. The volume increase was expressed as the percentage of difference in the volume of cooked and uncooked Turkish noodles.

Color Measurement and pH

Finely ground uncooked Turkish noodles (10 g) were mixed with 100 mL of distilled water and stirred at 1000 rpm for 5 min. The pH of the filtrate was measured using a pH meter (Jenco 6173, USA) [21]. Color values (L*: lightness; a*: redness; b*: yellowness) of two uncooked Turkish noodle strands were measured using a chroma meter (CR-400, Konica Minolta, Japan). Three readings were taken on each side of the uncooked Turkish noodles [22].

Proximate Composition

Moisture (ICC, 1976), ash (ICC, 1990), crude protein (ICC, 1994), fat (ICC, 1984), and crude fiber (ICC, 1972) contents were determined by ICC methods [23]. The oven drying at 100ºC (method 110/1), dry combustion at 550°C (method 104/1), Kjeldahl method (method 105/2), Soxhlet method (method 136) and gravimetric method (method 113) were applied to determine moisture, ash, crude protein, fat and crude fiber content of raw materials and uncooked Turkish noodles, respectively.

Total Phenolic Content

Total phenolic content was determined according to Menga et al. [24]. Finely ground uncooked Turkish noodles (1 g) were extracted with a mixture of methanol/distilled water/HCl (8 mL; 80:19:1 v/v/v) with stirring at 1000 rpm and 26±1°C for 30 min. Then, the extract was centrifuged at 4000 rpm for 15 min. After that, 200 µL of the supernatant was added to 1.5 mL of Folin-Ciocalteu reagent (10-fold diluted) and allowed to stand for 5 min at 26±1°C. Then, 1.5 mL of sodium carbonate solution (6%) was added and the mixture was allowed to stand for 90 min at 26±1°C. Later, the absorbance was measured at 725 nm. The acidified methanol solution was used as a blank. The results were expressed as mg gallic acid/g dry matter.

Mineral Content

Finely ground Turkish noodle samples (0.5 g) were digested by a microwave digestion system (Speedwave, Berghof, Germany) using a mixture of 4 mL of HNO_3 (65%), 1 mL of H_2O_2 (30%), and 3 mL of deionized water. Mineralization was carried out at 170°C for 30 min. After digestion, the samples were cooled to room temperature (26±1°C) and diluted up to 25 mL with deionized water. Mineral content (magnesium (Mg), potassium (K), iron (Fe), and zinc (Zn)) was determined by ICP-OES (Optima 7000 DV, Perkin Elmer, USA) [25].

Texture Analysis

The firmness and work of shear of the cooked Turkish noodles were determined according to the AACC Standard Method (66-50.01) by a texture analyzer (TA-XTPlus, UK) with a Knife Blade (A/LKB-F) probe and a 5 kg load cell. The texture analysis was carried out within 15 min after cooking and each Turkish noodle was cooked for the optimum cooking time. The test speed was 0.17 mm/s, the post-test speed was 10 mm/s, the distance was 4.5 mm, and the trigger type was button [20].

Sensory Evaluation

Sensory analysis was performed with 30 semi-trained panelists (15 females and 15 males, aged between 20 and 50) at Avrasya University. Cooked Turkish noodles were evaluated for color, appearance, taste, odor, hardness, chewiness, and overall acceptability using a five-point hedonic scale (1: very bad and 5: very good). The Turkish noodles were presented to panelists with three-digit codes in random order on white plastic dishes. Water was used as a palate cleanser between samples.

Statistical Analysis

The data was analyzed using SAS System Software (SAS Institute Inc., Cary, NC, USA). Analysis of variance (ANOVA) followed by Duncan's Multiple Range test was performed to evaluate significant differences ($p<0.05$) observed in the mean values of the results.

RESULTS and DISCUSSION

Cooking Quality

The cooking time, cooking loss, water absorption, and volume increase of the control were 15.5 min, 7%, 124%, and 139%, respectively. Generally, lower cooking losses and higher weight and volume gains are crucial attributes for high-quality noodles. The effects of PP incorporation and QSM addition on the cooking properties of the Turkish noodles are presented in Table 2. The addition of an increasing amount of PP resulted in a shorter cooking time ($p<0.05$). The authors reported the same results for the cooking time of noodles enriched with terebinth (*Pistacia Terebinthus*) fruit [26]. It could be due to the weakening of the network between gluten and starch due to higher fiber content [11]. The addition of PP and QSM at different ratios significantly affected ($p<0.05$) cooking loss, water absorption, and volume increase parameters. An increase in the PP content resulted in an increased cooking loss. This fact might be due to the high fiber content of the noodles that was responsible for weakening the starch network in the noodle strings [27]. Similar results were observed by Köten and Ünsal [26]. Moreover, both water absorption and volume increase values decreased as the PP level increased. These values were in agreement with the results reported by Lucas-González et al. [11] that persimmon flour decreased water absorption in spaghetti samples. The results indicated that QSM had a significant effect ($p<0.05$) on the cooking properties except for cooking time. The Turkish noodles produced with mucilage instead of egg showed significantly higher ($p<0.05$) cooking loss than the control sample. However, the cooking loss of the Turkish noodles considerably decreased as the concentration of QSM decreased. Additionally, when the interaction between PP incorporation and QSM addition was considered, the lowest cooking loss was observed as the Turkish noodles were produced with 0% PP and 20% QSM. These findings were similar to studies on adding mucilaginous seeds into noodle or pasta formulations [27-29], whereas noodles produced with cassava mucilage had lower cooking loss [30]. A significant increase ($p<0.05$) in both the weight and volume values of the Turkish noodles was observed with increasing QSM concentration. Similar results were reported by Kasunmala et al. [27], Kishk et al. [28], and Naji-Tabasi et al. [29].

Table 2. Effects of PP and QSM levels on cooking time (min), cooking loss (%), water absorption (%), and volume increase (%) of Turkish noodles

Cooking time	EF:PP	100:0	95:5	90:10
		$11.17^a \pm 0.17$	$9.67^b \pm 0.21$	$8.33^c \pm 0.21$
Cooking loss	EF:PP	90:10	95:5	100:0
		$12.22^a \pm 0.24$	$8.70^b \pm 0.68$	$6.50^c \pm 0.23$
	QSM	40	30	20
		$10.13^a \pm 1.03$	$9.13^b \pm 1.13$	$8.16^c \pm 1.09$
Water absorption	EF:PP	100:0	95:5	90:10
		$127.17^a \pm 0.60$	$124.67^b \pm 2.19$	$123.33^c \pm 0.56$
	QSM	40	30	20
		$126.67^a \pm 0.92$	$125.83^b \pm 1.14$	$122.67^c \pm 1.75$
Volume increase	EF:PP	100:0	95:5	90:10
		$155.33^a \pm 2.77$	$151.33^b \pm 0.62$	$136.33^c \pm 4.29$
	QSM	40	30	20
		$155.50^a \pm 2.74$	$142.83^b \pm 5.35$	$142.67^b \pm 5.29$

*EF: einkorn flour; PP: persimmon powder; QSM: quince seed mucilage. **Results are presented as the mean ± standard deviation result of ANOVA performed on data obtained by analysis of duplicate samples taken from two replications. ***Means not sharing a common letter within the same row are significantly different at $p<0.05$.

Color Measurement and pH

The L*, a*, and b* values of the control sample were 52.25, 8.62, and 20.96, respectively. We observed that the L*, a*, and b* values of the uncooked Turkish noodles were lower than those of the control sample (data not shown). L* values ranged from 50.69 to 51.55, a* values ranged from 7.02 to 7.09, and b* values ranged from 17.49 to 18.04 depending on the PP concentration. Lucas-González et al. [11] reported that persimmon flour addition decreased L* values but increased a* and b* values in spaghetti samples produced with durum wheat semolina. Similar results were also observed by Han et al. [14] in rice noodles. However, in our study, there was no significant difference between the Turkish noodles produced with different PP and QSM concentrations. This fact is due to the darker flour color of einkorn instead of durum wheat or rice which could cause a suppression of PP during dough formation. The effects of PP incorporation on the pH value of the Turkish noodles are given in Table 3. The pH values of EF, PP, QSM, and the control sample were 6.55, 6.08, 5.40, and 5.80. In the presence of PP, the pH value of the Turkish noodles increased from 5.95 to 6.12 ($p<0.05$) due to the pH value of PP.

Proximate Composition

The moisture, ash, protein, lipid, and crude fiber content of the control sample were 8.81%, 2.96%, 23.30%, 5%, and 2.57%, respectively. Moreover, PP had 10.76% moisture, 2.20% ash, 5.98% protein, 0.18% lipid, and 3.04% crude fiber, respectively. The QSM addition into the noodle formulation did not show significant differences among the Turkish noodles in terms of proximate composition. The effects of PP incorporation on the proximate composition of the Turkish noodles are presented in Table 3. Ash and crude fiber contents of the Turkish noodles increased ($p<0.05$) as the amount of PP increased. In contrast, the protein content of the Turkish noodles containing PP was found to be lower ($p<0.05$) than those of the control sample. The protein content of the Turkish noodles ranged from 17.00% to 18.78%, but PP incorporation at different levels did not influence the protein content of the Turkish noodles significantly. As expected, a decrease in the lipid content of the Turkish noodles was observed related to the lower lipid content of PP. Similar results were observed for cake [15] and spaghetti [11] production with persimmon.

Total Phenolic Content

The total phenolic content (TPC) of EF, PP, QSM, and the control sample was 1.18 mg GAE/g, 9.83 mg GAE/g, 0.05 mg GAE/mL, and 0.82 mg GAE/g, respectively. As shown in Table 3, the substitution of PP provided a significant increase ($p<0.05$) in the TPC value of the Turkish noodles (maximum 32%). Similar results were observed by Yeşilkanat and Savlak [15], Lucas-González et al. [31], Abdallah et al. [32], and Hosseininejad et al. [33] for cake, spaghetti, cupcake, and muffin production with persimmon, respectively. Furthermore, persimmon was utilized for the improvement of non-cereal-based foods such as beer [34], yogurt [35], and ice cream [36] with enhanced phenolic content. Several studies have shown that persimmon is rich in antioxidants including phenolic compounds and carotenoids [31, 37, 38].

Mineral Content

The mineral composition of the control sample in terms of Mg, K, Fe, and Zn was 0.169 g/100 g, 0.569 g/100 g, 0.129 g/100 g, and 0.082 g/100 g, respectively. The Mg, K, Fe, and Zn contents of PP were 0.065 g/100 g, 1.062 g/100 g, 0.005 g/100 g, and 0.012 g/100 g, whereas those of EF was 0.212 g/100 g, 0.544 g/100 g, 0.123 g/100 g, and 0.105 g/100 g, respectively. The results indicated that the highest increase among minerals was observed in the K content of the Turkish noodles (max 59%) due to a rich source of persimmon in terms of K [39] (Table 3). In addition, Mg content increased by 26% with the addition of persimmon to the Turkish noodle formulation. Similar results were observed when persimmon was used to enrich cake [15], beer [34], yogurt [35], and ice cream [36].

Table 3. Effects of PP levels on proximate composition (%), pH, total phenolic (mg GAE/g), and mineral (mg/100 g, dry basis) contents of uncooked Turkish noodles

Dry matter	EF:PP	100:0	95:5	90:10
		91.88^{a}±0.13	91.04^{b}±0.30	89.88^{c}±0.21
Ash	EF:PP	90:10	95:5	100:0
		3.09^{a}±0.03	2.90^{b}±0.19	2.83^{b}±0.05
Lipid	EF:PP	100:0	95:5	90:10
		2.25^{a}±0.09	2.16^{ab}±0.07	1.91^{b}±0.05
Crude fiber	EF:PP	90:10	95:5	100:0
		2.26^{a}±0.05	2.14^{a}±0.09	1.64^{b}±0.05
pH	EF:PP	90:10	95:5	100:0
		6.12^{a}±0.12	5.97^{b}±0.10	5.95^{b}±0.12
Total phenolic content	EF:PP	90:10	95:5	100:0
		1.09^{a}±0.03	1.00^{b}±0.04	0.83^{c}±0.02
Mg	EF:PP	90:10	95:5	100:0
		0.254^{a}±0.011	0.229^{b}±0.017	0.202^{c}±0.002
K	EF:PP	90:10	95:5	100:0
		0.834^{a}±0.027	0.686^{b}±0.057	0.524^{c}±0.011
Fe	EF:PP	100:0	95:5	90:10
		0.139^{a}±0.003	0.126^{b}±0.000	0.121^{c}±0.001
Zn	EF:PP	90:10	95:5	100:0
		0.091^{a}±0.001	0.080^{b}±0.003	0.075^{c}±0.001

*EF: einkorn flour; PP: persimmon powder; Mg: magnesium; K: potassium; Fe: iron; Zn: zinc. **Results are presented as the mean ± standard deviation result of ANOVA performed on data obtained by analysis of duplicate samples taken from two replications. ***Means not sharing a common letter within the same row are significantly different at $p<0.05$.

Texture Analysis

The firmness and work of shear values of the Turkish noodles are also shown in Table 4. The firmness and work of shear values of the control sample were 1233.72 g and 126.90 g.cm, respectively, which were higher than the Turkish noodles produced with PP and QSM. The texture of the cooked noodles is one of the most important attributes in evaluating the noodle quality. A firm texture was obtained in the egg noodles due to egg albumin protein [40]. Texture parameters were significantly affected ($p<0.05$) by both PP incorporation and QSM addition. As shown in Table 5, a significant reduction in firmness and work of shear was observed when the level of PP increased. Texture attributes are primarily influenced by the structural network between starches and glutens. These may either weaken or strengthen the formation of hydrogen bonds within the noodle structure network [41]. Additionally, Solta Civelek [42] reported that higher fiber content in pasta had a destructive effect on the protein matrix; therefore, the weakened protein structure caused the pasta to have a softer texture. In this study, lower firmness and work of shear in Turkish noodles produced with PP incorporation indicated that PP could not have a function to fortify the network structures of the noodles. Texture parameters were also significantly affected ($p<0.05$) by QSM levels in the formulation. Turkish noodles with the highest level of QSM showed the lowest firmness and work of shear. These findings were similar to studies reported by Kasunmala et al. [27] and Charles et al. [30] that found cassava, *Neolitsea* *cassia*, and *Dillenia retusa* mucilage addition resulted in lower firmness of noodles.

Table 4. Effects of PP and QSM levels on firmness (g) and work of shear (g.cm) of cooked Turkish noodles

Firmness	EF:PP	100:0	95:5	90:10
		1007.94^a±37.95	870.93^b±32.69	797.62^c±39.70
	QSM	20	30	40
		987.78^a±41.16	882.95^b±46.82	805.77^c±37.67
Work of shear	EF:PP	100:0	95:5	90:10
		94.52^a±3.57	71.95^b±3.59	69.01^b±5.24
	QSM	20	30	40
		88.06^a±2.81	74.00^b±8.19	73.42^b±5.35

*EF: einkorn flour; PP: persimmon powder; QSM: quince seed mucilage. **Results are presented as the mean ± standard deviation result of ANOVA performed on data obtained by analysis of duplicate samples taken from two replications. ***Means not sharing a common letter within the same row are significantly different at p<0.05.

Sensory Evaluation

The results of the sensory evaluation performed by the panelists are presented in Figure 1. According to the sensory analysis, as the level of PP increased, higher scores in sensory attributes were given by the panelists. Color values were recorded as 4.25 for the control sample and 4.33 for the Turkish noodles containing 10% PP. Additionally, there was no significant difference between the Turkish noodles produced with and without PP in terms of appearance. Among the Turkish noodles, the noodles containing 10% PP received the highest taste score (3.73) followed by the noodles containing 5% PP (3.45), whereas the lowest score (3.03) was recorded in the control sample. Similar to our findings, Hosseininejad et al. [33] reported that the addition of persimmon flour caused a significant increase ($p < 0.05$) in sweetness, fruity taste, and caramel taste in gluten-free muffins. A higher ratio of sugars to organic acids in the fruit composition is responsible for the sweet taste of the fruit which plays an important role in terms of sensory acceptability [43]. The odor scores were in accordance with the taste scores. Turkish noodles with an increasing level of PP had higher firmness and chewiness scores with significant differences ($p<0.05$) compared to the control sample or the Turkish noodles produced without PP. No significant differences were observed in the overall acceptability between the control sample (3.48) and the Turkish noodles produced without PP (3.51). Additionally, overall acceptability was positively influenced ($p<0.05$) by the increasing PP level in the Turkish noodles. These results were in accordance with those reported by Dipti et al. [44] where the addition of Persimmon sauce resulted in improved sensory evaluation of the cake. Further, Abdallah et al. [32] reported that cupcakes containing 33.3% persimmon puree were perceived the highest scores in terms of sensory parameters.

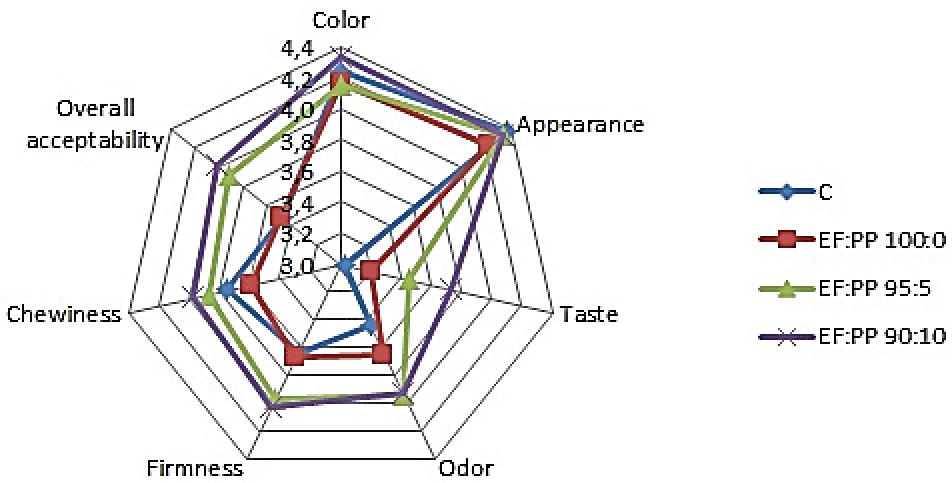

Figure 1. Spider plot of sensory evaluation of cooked Turkish noodles (C: control sample; EF: einkorn flour; PP: persimmon powder; QSM: quince seed mucilage)

CONCLUSION

In conclusion, it was observed that PP substitution enriched the nutritional quality of the Turkish noodles in terms of ash, dietary fiber, minerals (Mg, K, and Zn), and phenolic content. However, increasing the PP substitution level resulted in inferior quality in terms of cooking properties. The Turkish noodles produced with increasing level of QSM resulted in higher weight and volume gain. Moreover, the cooking loss of the Turkish noodles produced with 20% QSM was found to be similar to that of the control sample. Therefore, QSM could be used as an egg replacer in Turkish noodle production. The Turkish noodles containing high PP had a softer texture with a lower work of shear. The highest scores in sensory attributes were obtained with 10% PP substitution. Further studies can be conducted to investigate the antidiabetic effect of Turkish noodles produced with persimmon and quince seed mucilage.

ACKNOWLEDGMENTS

This work was supported by the Scientific and Technological Research Council of Türkiye (TÜBİTAK, Ankara, Türkiye) [Grant number: 1919B012003901].

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