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Potential Use of Capsicum Pepper Powder and Natural Cheese Aroma in Turkish Delight (Lokum) Production

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ABSTRACT

Turkish delight, which is produced from sugar, starch and water as raw materials and can be enriched with different flavors and aromas, is a traditional dessert widely consumed around the world. Although there are many types of Turkish delight, capsicum pepper powder (CPP) and natural cheese aroma (NCA) added Turkish delights are not consumed in Turkey. In this study, the potential use of CPP and NCA in the production of flavored Turkish delights was studied to obtain a unique taste, flavor and color, and also the physical, chemical and sensorial properties of Turkish delights containing three different ratios of CPP and NCA were determined. For this purpose, capsicum pepper was dried and powdered, and commercial natural Cheddar cheese flavor was used to provide cheesy characteristic to Turkish delights. In capsicum pepper and cheese flavored Turkish delights, the ratios of CPP were 0.1, 0.3 and 0.5% (w/w) while the ratios of NCA were 6.5, 10.0 and 12.5% (w/w). The physicochemical properties such as color, dry matter and ash contents, total phenolic content (TPC), total flavonoid content (TFC) and antioxidant activities and the sensory properties of Turkish delight samples were determined. The highest L* values were found in Turkish delights with 6.5% and 10.0% NCA concentrations ($p<0.05$), and L* values generally decreased with an increase in NCA concentration. As the ratio of CCP and NCA increased, the TPC values of samples increased. The highest TPC and antioxidant activity values were found as 27.59 mg GAE/100g dm and 6.11 µmol TE/100g dm for Turkish delights containing 0.5% CPP, respectively. There were statistically insignificant differences among TFC values ($p>0.05$). Sensory analysis results indicated that Turkish delights containing 12.5% NCA had a high acceptability score, and CPP added Turkish delights were equally liked by panelists. In conclusion, CPP and NCA flavorings could be used in the production of Turkish delights for the development of a novel dessert product with a high consumer acceptability, and might provide health beneficial functional components.

Keywords: Lokum, Capsicum pepper, Antioxidant, Sensory, Phenolic

Çeşnili Lokum Üretiminde Kapsikum Biber Tozu ve Doğal Peynir Aromasının Kullanım Potansiyeli

ÖZ

Lokum, hammaddeleri olan şeker, nişasta ve suyun kullanımıyla üretilen, farklı tat ve aroma maddeleriyle zenginleştirilebilen, Türklere özgü bir tatlıdır. Lokumun birçok çeşidi olmasına rağmen ülkemizde kapsikum biber tozu (CPP) ve doğal peynir aroması (NCA) içeren lokum çeşitlerinin üretimi ve tüketimi mevcut değildir. Bu çalışmada, çeşnili lokum üretiminde CPP ve NCA'nın lokuma farklı bir tat, lezzet ve renk verilmesi amacıyla kullanım potansiyeli belirlenmiş; üç farklı oranda CPP ve NCA içeren lokumların fiziksel, kimyasal ve duyusal özellikleri araştırılmıştır. Bu

amaçla, kapsikum cinsi acı kırmızıbiberler kurutularak toz hale getirilmiş ve peynir aromalı lokum üretimi için ise doğal Çedar peynir aroması temin edilmiştir. Kapsikum biber tozlu lokuma ağırlıkça %0.1, 0.3 ve 0.5 oranlarında CPP, peynir aromalı lokuma ise %6.5, 10.0 ve 12.5 oranlarında NCA ilave edilmiştir. Ardından, elde edilen lokumların renk (CIELAB), kuru madde, toplam fenolik madde içeriği (TPC) ve toplam flavonid içeriği (TFC) ile antioksidan aktivite gibi fizikokimyasal özellikleri ile duyusal özellikleri belirlenmiştir. En yüksek açıklık-koyuluk (L*) değerleri %6.5 ve 10.0 oranında NCA içeren çeşnili lokum örneklerinde saptanmış ($p<0.05$), NCA çeşnili lokumlarda konsantrasyon artışı ile L* değerleri genel olarak azalmıştır. Peynir aromalı ve biber tozlu lokumlarda CPP ve NCA konsantrasyonu arttıkça TPC değerlerinin arttığı belirlenmiştir. En yüksek TPC ve antioksidan aktivite değerleri %0.5 CPP içeren lokum için sırasıyla 27.59 mg GAE/100g km ve 6.11µmol TE/100g km olarak bulunmuştur ($p<0.05$). TFC değerleri arasında istatistiksel olarak farklılık saptanmamıştır ($p>0.05$). Duyusal analiz sonuçlarına göre, %12.5 NCA içeren lokumların kabul edilebilirlik skoru yüksek bulunmuş ve CPP çeşnili lokumlar ise panelistler tarafından eşit derecede beğenilmiştir. Sonuç olarak, CPP ve NCA çeşnilerinin, yüksek tüketici kabulüne sahip yeni bir tatlı ürününün geliştirilmesi için lokum üretiminde kullanılabileceği ve sağlığa yararlı fonksiyonel bileşenler sağlayabileceği belirlenmiştir.

Anahtar Kelimeler: Lokum, Kırmızıbiber, Antioksidan, Duyusal, Fenolik

INTRODUCTION

Turkish delight, a traditional dessert, has existed in Anatolia and Ottoman lands since the 15th century when its name was announced to the world as “lokum”, and has been widely consumed by many people with a great pleasure. Various types of lokum products have been developed since then. Originally, flour and honey were used to flavor Turkish delight products; however, starch, sugar and various flavorings are widely used in their production. Depending on the type of Turkish delight, dried and chopped fruits or nuts such as peanuts, hazelnuts, almonds, flower petals or food grade pine resin can be added to these main ingredients. Sometimes, natural colorants or essences specific to foodstuffs may be included in lokum formulations. Besides being attracted by the consumers and being the leading gift on special days or occasions, lokum may be good for health especially in curing or relieving various diseases like sore throat [1-3].

Capsicum pepper (*Capsicum annuum* L.) is a produce native to the tropical and subtropical countries of America, and in addition to its widespread use as a spice, it has a wide range of physiological and pharmacological effects on human health [4, 5]. Nadeem et al. [6] reported that the polyphenols of capsicum pepper may protect the body from oxidation caused by free radicals and reactive oxygen while its consumption stimulates the formation of bile and increases the secretion of bile acids that are important for the elimination of cholesterol from the body. They stated that besides being an excellent source of vitamin C and vitamin A, it is a good source of vitamin B6, folic acid, beta-carotene and fiber, and it contains an anticoagulant that prevents blood coagulation and reduces the risk of heart attack. Its lycopene content is important in reducing the risk of some types of cancer [6]. The red color of capsicum pepper comes from a mixture of carotenoid group color substances especially from the capsanthin and others carotene, capsorubin, zeaxanthin, cryptoxanthin and lutein, and the amount of color substances in the fruit is between 0.3 and 3.8% [7]. Many varieties of capsicum pepper exist, and it is an important vegetable in global cuisines, with plenty of vitamin C [5]. Capsaicin, which is known as an appetizer enhancer and diuretic, has many pharmacological effects including analgesic, antigenotoxic, antioxidant, antimitogenic and anticarcinogenic, and it may reduce the plasma lipid concentration while stimulating digestive secretions and facilitating digestion [8].

Gelling agents (e.g. starch), sugar, acidity regulators and water are used in the production of Turkish delight. Starch is one of the most important components used in lokum production due to its high water holding capacity and by giving Turkish delight products their desired consistency. In order to eliminate the risk of synerisis (water release), some gelling agents can be added to starch [1, 9]. Also, sugar is one of the most important raw materials used in Turkish delight production. Sugar contributes to the formation of gel structure as well as adding sweet taste and structure to lokum products [10, 11]. Acidity regulators in Turkish delight production are used to hydrolyze sucrose and provide the appropriate pH for gel formation. Citric acid is widely used and preferred as an acidity regulator in lokum production. Incorporation of ground hazelnuts, peanuts, walnuts and dried fruit pieces into Turkish delight products for the development of unique consistency and natural flavor are called seasoning or flavoring. Seasonings are generally added to the Turkish delight at the last stage. Seasonings such as ground hazelnuts, coconuts, pistachios and walnuts can also be used as coating materials in Turkish delight [3, 10, 12].

To the best of our knowledge, there is no study in the literature on the physical, chemical and sensory properties of Turkish delight flavored with CPP or NCA. In this study, it was aimed to develop innovative Turkish delights that are naturally colored and healthy with high bioactive properties by using CPP or NCA as flavorings and to determine the physicochemical and sensorial properties of lokum products developed.

MATERIALS AND METHODS

Materials

Fresh capsicum peppers (strongly hot) used in the production of CPP flavored Turkish delights were obtained from a local producer in Şanlıurfa (Turkey),

and natural cheddar cheese aroma (Boğaziçi Kimya ve Gıda San. Tic. Ltd. Şti., Tekirdağ, Turkey) was used for the NCA added Turkish delights. Also corn starch (İnci, Emin Gıda Pazarlama San. ve Tic. Ltd. Şti., Istanbul, Turkey), sugar and powdered sugar (Petek, Nar Gıda Maddeler San. ve Tic. Ltd. Şti., Konya, Turkey) and drinking water (Nazli, Aydin, Turkey) were used in the production of Turkish delights. Lemon juice is obtained by squeezing the juice of fresh lemons obtained from a national market in Burdur (Turkey).

Chemicals used in analyses were Trolox®, diammonium salt of ABTS, sodium acetate.$3H_2O$, Folin-Ciocalteu reagent, gallic acid, catechin, $AlCl_3.6H_2O$, NaOH from Sigma-Aldrich (Darmstadt, Germany) and sodium carbonate from Riedel-de Haen (Germany). $NaNO_2$ and ethanol (HPLC grade) were supplied from Merck (Darmstadt, Germany).

Methods

Turkish Delight Production

For capsicum pepper powder production, peppers were washed, separated from foreign materials and unwanted parts prior to drying. Then, capsicum peppers were cut into four equal pieces longitudinally and placed on an aluminum foil. Pieces of capsicum peppers were dried by natural convection in a preheated oven (FN 500, Nüve, Ankara, Turkey) for 5 hours at 85°C. Dried capsicum peppers were powdered by a coffee grinder and were sieved with a 0.250 mm mesh opening sieve.

For the production of Turkish delights, table sugar (400 g) and drinking water (400 mL) were mixed by mixer (Arzum AR1069 Cust Mix Stand Mixer, Istanbul, Turkey). After corn starch (60 g) was dissolved in drinking water (50 mL), fresh lemon juice (10 mL) was added. Preliminary studies indicated that for the CPP flavored Turkish delight production, 0.1, 0.3 and 0.5% concentration of CPP were required for the development of desired hot character in lokum products, and it needed to be included into the mixture at the last 3 min until it reached a homogeneous consistency. Initially, the mixture of sugar, water and lemon juice was transferred to a fryer (Tefal Actifry Express, France) and subjected to heat treatment at 180°C for 50 min to produce the final Turkish delight dough. Cooking time and aroma ratios were decided according to the pre-sensory determinations by a laboratory group to get acceptable levels of taste and consistency. After each Turkish delight dough sample was ready in the frier, it was poured into a glass square bowl, previously covered with a mixture of corn starch and powdered sugar (1:1, w/w). Then, the surface of lokum products was smoothed and covered with this mixture, cooled and molded.

The same production procedure was used for the cheese flavored Turkish delights. In the preliminary tests for cheese flavored Turkish delight production, freeze-dried fresh white cheese powder was used but cheese flavor was unable to be detected sensorily in a final product because of the evaporation of aromatic substances at a high temperature during production. As the ratio of freeze-dried cheese powder was increased, undesired cheese flavor (similar to spoiled cheese) was detected. Unfortunately, any desired lokum product could not be obtained because of high temperatures used during lokum production. Since trials with freeze-dried cheese powder were unsuccessful, fat-free fresh cheese was included into lokum formulation at the first stage of production, but lokum sample had a taste and consistency similar to “hosmerim” dessert, which is widely consumed in the Balikesir region of Turkey. It was concluded that the production of Turkish delight with natural cheese aroma would be more appropriate. Natural Cheddar cheese aroma was used in the following trials, and cheese aroma was added at the last 3 min of the process since the cheese aroma was significantly lost during production. The ratio of cheese aroma was adjusted to be felt in mouth at an acceptable level in the final product during preliminary trials. In NCA flavored Turkish delight experiments, with the addition of 6.5, 10.0 and 12.5% cheese aroma, the desired cheese flavor was achieved and these concentrations were considered as acceptable.

Determination of Dry Matter and Ash Contents

Since Turkish delight contains sugar, and water molecules are formed during drying at temperatures higher than 100°C, drying was carried out at 70°C for the determination of dry matter content. Drying continued until a constant weight was obtained [13]. For the ash content determination, Turkish delights were divided into small pieces and approximately 10 g were weighed into each porcelain mortars. In order to prevent samples from foaming, pre-drying process was applied in an oven at 150°C. Then, temperature was increased gradually at an hour interval, and the samples were burned at 550°C. Ash contents of samples were determined gravimetrically [13].

Color Analysis

Color analysis was performed by a colorimeter device (Konica Minolta Chroma Meter, CR-400, Japan) in CIELAB system (L*, a*, b*). Color measurements were achieved for each sample before it was covered by corn starch and powdered sugar in a glass square bowl. In the color measurements of products, L*, a* and b* color parameters were determined by taking the average of at least three measurements from the top and middle parts of the samples.

Preparation of the Extracts

In order to prepare the extracts, Turkish delight samples (10 g) were weighed, cut in small pieces by a sharp knife. Samples were put into a volumetric flask and 70% (v/v) aqueous ethanol solution (50mL) was added (1:5, w/v). Then, the top of each flask was sealed with parafilm and aluminum foil. In order to obtain a homogeneous mixture, it was mixed in the orbital shaker (Widhshake, Daihan Scientific Co. Ltd., Korea) for 90 min at 250 ppm, followed by ultrasonication in an ultrasonic water bath (WUCD06H, Daihan Scientific Co.

Ltd., Korea) for 30 min. Homogeneous mixture was then transferred into Eppendorf® tubes, and micro-centrifuged (WiseSpin, CF-10, Daihan Scientific Co. Ltd., Korea) at 13,500 rpm for 2 min. Supernatants were used in following analyses.

Total Phenolic Content (TPC)

"Micro-adapted Folin-Ciocalteu" method was used in the determination of total phenolic content [13]. For this purpose, supernatants (0.5 mL) were put into test tubes and Folin Ciocalteu agent (2.5 mL) was added into each tube. 3 min after the reaction started, 2 mL of 20% Na_2CO_3 solution was added and the mixture was kept in the dark for 2 h. At the end of this period, the absorbance values of samples were obtained at 760 nm wavelength by a spectrophotometer (Optizen Pop, Mecasys Co., Ltd., Daejeon, Korea), and results were expressed as mg gallic acid equivalent (GAE) per 100 g Turkish delight samples.

Total Flavonoid Content (TFC)

Total flavonoid content was determined according to the method of Zhishen et al. [14]. In this assay, catechin solution was prepared at 20, 40, 60, 80 and 100 mg/L concentrations and used to obtain a calibration curve. The extract or standard (1 mL) was mixed with distilled water (4 mL) and 5% $NaNO_2$ (0.3 mL) was added. After 5 min, 0.3 mL of 10% $AlCl_3$ was added to the mixture and waited for a min. Then, 2 mL of 1M NaOH added. Immediately after, 2.4 mL of distilled water was added to the mixture and it was shaken vigorously. The resulting pink color was read at 510 nm wavelength by a spectrophotometer, and results were expressed as mg catechin equivalent (CE) per 100 g Turkish delight sample [13].

Antioxidant Activity (ABTS)

Antioxidant activity was determined with the ABTS (2,2'-azinobis- (ethylbenzothiazoline-6-sulfonic acid)) method of Miller et al. [15]. This method is based on the principle of determining the color of the $ABTS^{\cdot}+$ radical formed as a result of the oxidation of $ABTS^{\cdot}+$ at a certain wavelength, and the result is expressed as the "TEAC value" (Trolox® equivalent antioxidant capacity) [15]. Specifically, 7 mM ABTS diammonium salt was solved in water and treated with 2.45 mM potassium persulfate, and the mixture was left at room temperature for about 12-16 hours until it became a dark blue color (stock solution). Stock solution was added with ethanol until the absorbance value of 1.10±0.05 was obtained. 150 µL of supernatant was added with 2850 µL of working solution and left in the dark for 30 min. Absorbance values were read in a spectrophotometer at a wavelength of 734 nm. The linear calibration curve was obtained with Trolox® solution, and results were expressed as µmol Trolox® equivalents (TE) per 100 g Turkish delight samples.

Sensory Analysis

In sensory analysis, Turkish delight samples containing three different concentrations of CPP and NCA were subjected to the ranking test [16]. Students (n=12) at the Department of Food Engineering in Burdur Mehmet Akif Ersoy University (Burdur, Turkey) were used as panelists. During the analysis, samples were presented to panelists in white plastic plates coded each by a random three-digit number. The panelists were asked to rank the samples according to their liking as stated by Altuğ Onoğur and Elmacı [16].

Statistical Analysis

Each experiment was run in triplicates while chemical and physical analyses in this study were performed in duplicates for each sample. For statistical evaluation, analysis of variance (ANOVA) was applied to the data by SAS package program (The SAS System for Windows 9.0, Chicago, USA) and statistical differences were determined. The statistical difference of means was obtained by the Duncan multiple comparison test at the level of α=0.05. Results were expressed as mean±standard deviation.

RESULTS AND DISCUSSION

In this study, CPP and NCA flavored Turkish delights were produced (Figure 1) and dry matter, ash, color, total phenolic, total flavonoid contents and antioxidant activities of the Turkish delights were determined. The results of the analyses are presented below.

Color Analysis

The color parameters (L*, a* and b*) of Turkish delights produced with CPP and NCA are presented in Table 1. According to Table 1, the color L* values of CPP flavored Turkish delights changed insignificantly by CPP concentration ($p>0.05$). Inverse relationship between the L* values and the NCA concentration in Turkish delights were observed. Among the NCA added Turkish delights, the lowest L* value was determined for the samples added with 12.5% NCA (31.02) ($p<0.05$). The highest L* value of the Turkish delight was determined for the samples containing 6.5% of cheese aroma (40.41); however, its difference from the L* value of 10% NCA added sample was found statistically insignificant ($p>0.05$).

The highest a* value was found in Turkish delights containing 0.3% of CPP (9.12) ($p<0.05$) while it reduced slightly in samples containing 0.5% of CPP (8.21). Higher a* values are indicator for an increase in red colored pigments of Turkish delight samples. The a* values of NCA added Turkish delights were generally low than those of CPP added Turkish delights ($p<0.05$). The highest b* value (4.90) was determined for the Turkish delights containing 0.3% of CPP. Like the a* values, the b* values of NCA added Turkish delights were generally lower than those of CPP added samples ($p<0.05$). By an increase in NCA concentration, the color

of samples turned from yellow to blue based on decreased b* values.

Hayoğlu et al. [17] demonstrated that the addition of 17-19% pomegranate arils was ideal for the production of Sultan-type Turkish delights. They reported the L* value of pomegranate aril added Sultan Turkish delights as 79.55, while the color a* and b* values were 0.11 and 7.61, respectively. Adding cornelian cherry as a natural coloring agent to Turkish delights during storage, Akpunar [18] found the L* values of samples as between 30.70-62.3. Also, the color a* values ranged from -1.7 to 14.10 and b* values from 5.0 to 13.5. Adding black grape and sour cherry fruit syrups into Turkish delights, Batu and Arslan [19] reported that the L* values of samples varied from 24.43 to 41.10, a* values from -4.08 to 4.37, and b* values from 1.63 to 3.20 while the a* value decreased as the concentration of sour cherry syrups increased from 2.5 to 7.5%.

In a study by Ozen et al. [20], traditional Turkish delights were colored by the concentrate of black carrot juice, and L* values from 26.02 to 27.13, a* values from 4.8 to 6.4 and b* values from -1.20 to -0.28 were reported during storage (0-15 day) at different temperatures (12-30°C). Kaya et al. [21] produced Turkish delights with pomegranate juice, and reported that the L* values of samples varied from 27.43 to 43.94, the a* values from -0.66 to 14.45 and b* values from -1.67 to 4.08. According to literature studies, it can be said that the color values of Turkish delights with different flavorings vary in a wide scale, and color values generally have a good agreement with the results of the current study.

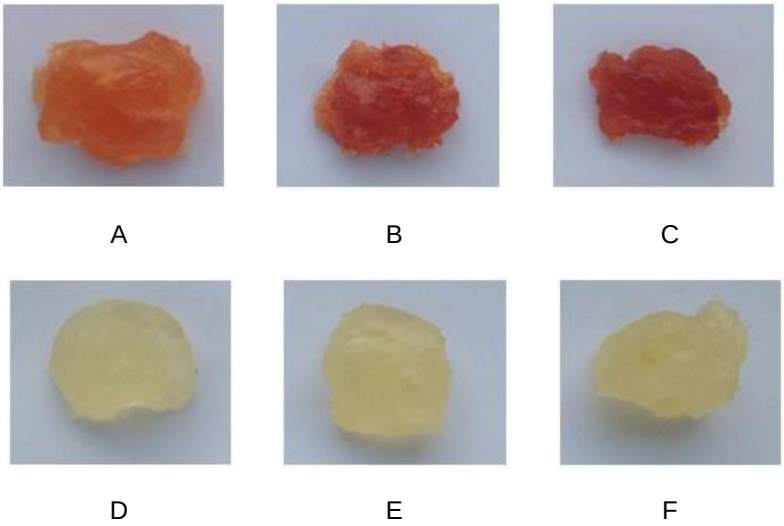

Figure 1. Turkish delight samples produced with capsicum pepper powder (A, 0.1%; B, 0.3% and C, 0.5%) and natural cheese aroma (D, 6.5%; E, 10.0% and F, 12.5%)

Table 1. Color properties of Turkish delights flavored with CPP and NCA

Flavor	Flavor concentration (%)	L*	a*	b*
CPP	0.1	32.84±1.43^{B}	2.99±0.72^{C}	0.78±0.49^{C}
	0.3	33.08±0.85^{B}	9.12±0.70^{A}	4.90±0.24^{A}
	0.5	33.66±0.57^{B}	8.21±0.33^{B}	2.53±0.30^{B}
NCA	6.5	40.41±0.44^{A}	0.54±0.04^{D}	-0.08±0.71^{D}
	10.0	38.18±2.37^{A}	0.57±0.12^{D}	-0.25±0.25^{D}
	12.5	31.02±1.83^{B}	-0.15±0.10^{D}	- 0.85±0.37^{D}

$^{A-D}$: Different letters in a column show statistical differences among means ($p<0.05$).

Dry Matter and Ash Contents

Results for the dry matter and ash contents of Turkish delights produced with CPP and NCA flavorings are given in Table 2. According to Table 2, the dry matter content of Turkish delights containing 10% NCA was 94.00% and the sample containing 0.5% of CPP had a dry matter content of 91.92%. Differences in dry matter contents among Turkish delights were found statistically insignificant ($p>0.05$).

In a study [22] on the properties of four unpackaged Turkish delight samples obtained from two different locations in Çanakkale (Turkey), the dry matter contents of samples were reported to vary between 78.4 and 93.0%.

Table 2. Dry matter and ash contents of Turkish delights with CPP and NCA flavorings

Flavor	Concentration (% w/w)	Dry matter content (%)
CPP	0.1	93.58±0.04^{A}
	0.3	92.31±0.08^{A}
	0.5	91.92±0.21^{A}
NCA	6.5	93.87±4.49^{A}
	10.0	94.00±0.03^{A}
	12.5	93.08±0.49^{A}

^{A}: Different letters in a column show statistical differences among means ($p<0.05$).

In another study [17], the dry matter and ash contents of Sultan-type Turkish delights with pomegranate arils were determined as 86.39% and 0.29%, respectively. Akpunar [18] added cornelian cherry as a natural coloring agent to Turkish delights, and reported that the dry matter of samples ranged from 90.33 to 98.8 and ash contents from 0.07 to 2.16 during storage. Kaya et al. [21] produced pomegranate juice added Turkish delights and reported dry matter values ranging from 80.55 to 84.82%.

TPC, TFC and Antioxidant Activity Values

The TPC, TFC and antioxidant activity values of Turkish delights produced with CPP and NCA flavorings are demonstrated in Table 3.

Table 3. Total phenolic (TPC) and flavonoid contents (TFC) and antioxidant activities of Turkish delights produced with CPP and NCA flavorings

Flavor	Concentration (% w/w)	TPC (mg GAE/100g dm)	TFC (mg CE/100g dm)	Antioxidant activity (µmol TE/100g dm)
CPP	0.1	15.23±1.32^{D}	6.03±3.99^{A}	3.18±0.05^{C}
	0.3	24.60±1.05^{B}	8.25±2.37^{A}	5.46±0.55^{B}
	0.5	27.59±1.23^{A}	10.18±2.15^{A}	6.11±0.18^{A}
NCA	6.5	14.83±2.76^{D}	15.31±4.78^{A}	2.19±0.20^{D}
	10.0	15.45±1.66^{D}	12.09±5.98^{A}	2.12±0.21^{D}
	12.5	18.05±1.19^{C}	13.84±5.60^{A}	2.36±0.11^{D}

$^{A-D}$: Different letters in a column show statistical differences among means ($p<0.05$).

According to Table 3, the highest TPC was found as 27.59 mg GAE/100 g dm for the Turkish delights containing 0.5% CPP ($p<0.05$). Among the CPP added samples, the difference was found statistically significant ($p<0.05$), and the lowest TPC value was found for 0.1% of CPP added Turkish delights as 15.23 mg GAE/100 g dm. The highest TPC among the NCA added Turkish delights was found for 12.5% of NCA added samples as 18.05 mg GAE/100g dm ($p<0.05$). TPC values were generally increased by an increase in the concentration of flavorings.

The TFC value of Turkish delights containing 0.5% CPP was 10.18 mg CE/100g dm, and it was 6.03 mg CE/100g dm for the samples containing 0.1% CPP ($p>0.05$). While the TFC value of 6.25% NCA flavored Turkish delights was determined as 15.31 mg CE/100g dm, it was found as 12.09 mg CE/100g dm for 10% NCA ($p>0.05$). Generally, the TFC values of samples increased with an increase in CPP concentration, and they decreased with an increase in the concentration of NCA. On the other hand, differences in TFC values among Turkish delights were found statistically insignificant ($p>0.05$).

The highest antioxidant activity was determined as 6.11 µmol TE/100g dm in Turkish delights containing 0.5% CPP ($p<0.05$). The lowest antioxidant activity among CPP added samples was found as 3.18 µmol TE/100g dm for Turkish delights with 0.1% CPP addition ($p<0.05$). The difference in the antioxidant activities among NCA added Turkish delights was found statistically insignificant ($p>0.05$).

Batu and Arslan [19] added black grape and sour cherry fruit syrups into Turkish delights and found that the TPC and antioxidant activity values of samples increased with an increase in flavoring concentration from 2.5 to 7.5%. Kaya et al. [21] reported the TPC values of Turkish delights with pomegranate juice between 201.33 and 760.33 mg GAE/kg. In the presents study, as the CPP concentration increased in Turkish delights, their TPC and antioxidant activity values also increased, which indicated that these results were in good agreement with the literature.

Sensory Analysis

Results of the sensory analysis for Turkish delights produced with CPP and NCA flavorings are given in Table 4.

Table 4. Sensory analysis results of Turkish delight samples with CPP and NCA flavorings

Flavor	Concentration (% w/w)	Ranking score
CPP	0.1	2.08±0.90^{BA}
	0.3	2.00±0.85^{BA}
	0.5	1.92±0.79^{BA}
NCA	6.5	1.92±0.79^{BA}
	10.0	1.58±0.67^{B}
	12.5	2.50±0.80^{A}

$^{A-B}$: Different letters in a column show statistical differences among means ($p<0.05$).

Ranking score for 0.1% CPP flavored Turkish delights was determined as 2.08, while it was 1.92 for the 0.5% CPP added Turkish delights ($p>0.05$). It was found that liking scores decreased with an increase in CPP concentration; however, the difference in ranking scores among CPP flavored Turkish delights was found statistically insignificant ($p>0.05$), which indicated that panelists liked samples equally.

While the ranking score for the 12.5% NCA flavored Turkish delights was 2.50, it was 1.58 for the samples containing 10% NCA. The difference between the ranking scores of these samples was found statistically significant ($p<0.05$). In a study on Turkish delights produced by the addition of cornelian cherry as a natural coloring agent, Akpunar [18] reported that the highest desirability in sensory analysis was found for the samples which contained 12.2% cornelian cherry pulp. Batu and Arslan [19] found that Turkish delights produced with 2.5% fruit juice concentrates had the highest acceptability score on appearance, color, aroma, and overall acceptability.

CONCLUSION

Although there are many types of Turkish delights, CPP and NCA flavored Turkish delights are neither produced nor consumed in Turkey. In this study, potential use of CPP and NCA in the production of Turkish delights as flavorings were determined. Dry matter and ash contents, color analyses, total phenolic and total flavonoid contents, antioxidant activity and sensory analyses were carried out to determine the characteristics of these potentially novel types of Turkish delights. When the lightness values were considered, the highest value was determined for the Turkish delights with 6.5 and 10.0% NCA addition, and it decreased with an increase in the concentration of NCA. The lightness values of the NCA added samples were generally higher than those of the CPP added samples. In terms of TPC values, as the ratio of CPP and NCA increased in formulation, TPC values increased, and the highest value was found as 27.59 mg GAE/100 g dm for Turkish delights containing 0.5% CPP. According to the results of TFC, it was 15.31 mg CE/100 g dm for Turkish delights containing 6.5% NCA flavoring. In terms of the total antioxidant activities of Turkish delights, the highest value was found as 6.11µmol TE/100g dm for Turkish delights containing 0.5% CPP. According to sensory analyses, Turkish delights containing 12.5% of cheese had a ranking score of 2.50. CPP flavored Turkish delights, which might have a different taste (hot and sweet) for general consumers, equally liked by panelists, and its ranking score decreased slightly as its concentration increased. In the current study, healthy, naturally colored and sweet Turkish delight samples were produced, and these novel products could be potentially produced by the lokum industry and attract consumers' appreciation. With high bioactive properties, Turkish delights with CPP flavorings may be more beneficial as a traditional food and providing added value to the food industry and economy.

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REFERENCES

[1] Minifie, B.W. (1989). Chocolate, Cocoa, and Confectionery: Science and Technology. AVI Book, New York, USA.

[2] Batu, A., Kırmacı, B. (2006) Lokum üretimi ve sorunları. *Gıda Teknolojileri Elektronik Dergisi*, 37-49.

[3] Akbulut, M., Özen, G. (2008). Kayısı lokumu üretimi ve beslenmedeki önemi. *Gıda Teknolojileri Elektronik Dergisi*, 1, 7-11.

[4] Şalk, A., Arın, L., Deveci, M., Polat, S. (2008). Özel Sebzecilik. Sevil Cilt Evi ve Matbaası, Tekirdağ.

[5] Yaşar, H., Melek, S. (2003). Besinler ve Beslenme. Nobel Yayınları, Ankara.

[6] Nadeem, M., Anjum, F.M., Khan, M.R., Saeed, M., Riaz, A. (2011). Antioxidant potential of bell pepper (*Capsicum annum* L.)-A review. *Pakistan Journal of Food Science*, 21(1-4), 45-51.

[7] Bilişli, A. (2013). Şeker ve Şekerli Ürünler, Özel Gıdalar, Sidas Medya, Çankaya, İzmir.

[8] Çiçek, H., Yılmaz, N., Çelik, A., Ceylan, N.Ö., Meram, İ. (2005). Kapsaisinin (kırmızı biber) insan sağlığı üzerine etkileri, *Anadolu Tıp Dergisi*, 31.

[9] Batu, A. (2006). Türk lokumu üretim tekniği ve kalitesi. *Gıda Teknolojileri Elektronik Dergisi*, 1, 35-46

[10] Gönül, M. (1985). Türk Lokumu Yapım Tekniği Üzerine Araştırmalar. Ege Mühendislik Fakültesi, Bornova, İzmir.

[11] Baysal, T., Ersus, S. (1999). Karotenoidler ve insan sağlığı. *Gıda*, 24(3), 177-185.

[12] Ağarcık, H. (1989). Cezerye Üretim Teknolojisi Üzerine Araştırmalar. Yüksek Lisans Tezi, Fen Bilimleri Enstitüsü, Ankara Üniversitesi, Ankara.

[13] Cemeroğlu, B. (2013). Gıda Analizlerinde Genel Yöntemler, Gıda Analizleri, Bizim Grup Basımevi, Ankara.

[14] Zhishen, J., Mengcheng, T., Jianming, W. (1999). The determination of flavonoid contents in mulberry and their scavenging effects on superoxide radicals. *Food Chemistry*, 64(4), 555-559.

[15] Miller, N.J., Rice-Evans, C., Davies, M.J., Gopinathan, V., Milner, A., (1993). A novel method for measuring antioxidant capacity and its application to monitoring the antioxidant status in premature neonates. *Clinical Science*, 84(4), 407-412.

[16] Altuğ Onoğur, T., Elmacı, Y. (2015). Gıdalarda Duyusal Değerlendirme. Sidas Medya, Çankaya, İzmir.

[17] Hayoğlu, İ., Başyiğit, B. Dirik, A. (2017). Tane nar ilaveli lokum üretimi ve vakum ambalajlamanın raf ömrü üzerine etkisi. *Gıda*, 42(5), 553-560.

[18] Akpunar, E. (2015). Türk lokumu üretiminde kızılcık (ergen) meyvesinin doğal renklendirici olarak kullanılması ve depolama stabilitesinin araştırılması. Yüksek Lisans Tezi, Fen Bilimleri Enstitüsü, Afyon Kocatepe Üniversitesi, Afyon.

[19] Batu, A., Arslan, A. (2014). Biochemical and sensory evaluations of Turkish delight (lokum) enriched with black grape and sour cherry syrups. *Turkish Journal of Agriculture and Forestry*, 38(4), 561-569.

[20] Ozen, G., Akbulut, M., Artik, N. (2011). Stability of black carrot anthocyanins in the Turkish delight (Lokum) during storage. *Journal of Food Process Engineering*, *34*(4), 1282-1297.

[21] Kaya, C., Güldane, M., Topuz, S., Bayram, M. (2018). Determination of some properties of Turkish delight produced by the addition of pomegranate juice. *Turkish Journal of Agriculture-Food Science and Technology*, 6(12), 1814-1819.

[22] Doyuran, S.D., Gültekin, M., Güven, S. (2004). Geleneksel gıdalardan lokumun üretimi ve özellikleri. Geleneksel Gıdalar Sempozyumu, Van, 334-342.