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Effects of Black Grape Syrup on Texture, Colour and Sensory Qualies of Value Added Turkish Delight (Lokum)

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Abstract

In this study, the changes in the color, texture profile and sensory values of lokum were investigated simply by adding black grape concentrate into lokum during cooking. The amounts of fruit concentrate added to simple lokum depend on its physical, chemical and sensory quality parameters. In order to examine the effect of the concentration of black grape syrups (2.5%, 5.0%, 7.5%; w/w) were added to simple lokum during cooking. In this fruit-concentrated lokum, the texture profile analysis (TPA), color analysis and sensory quality were determined. As a result of the research phase of examining the effect of the concentration of fruit syrup, it was shown that the firmness, gumminess and chewability of fruit concentrated lokum decreased with increasing amounts of black grape concentrate. At the end of the sensory evaluations, while there was no significant difference between 7.5% and 5.0%, the most acceptable lokum was the sample which had 2.5% black grape concentrate. The hardness, adhesiveness, cohesiveness and elasticity values of concentrated black grape lokum decreased. However in contrast, the chewability and gumminess values of lokum produced with black grape concentrate increased significantly. It was observed that while the Minolta L* values decreased with the increase of black grape concentrate, the a* and b* values decreased with the increase of black grape juice concentrate.

Keywords: Black grapes; Starch, Turkish delight; Lokum; Sensory evaluation; Texture profile analysis

Introduction

Turkish delight (lokum), a food consisting essentially of sugar and starch raw material, has been known in the Ottoman territories in Anatolia for the soothing of the throat since the 15th century [1]. When a British tourist brought "Turkish delight" to Europe it the 18th century, it began to be known there [2]. In later years it was recognized in the Balkans and it has taken a place in the international confectionery literature. During the first period honey or molasses were used as a sweetener and flour was used to bind the water for consistency in the production of lokum [3]. After the development of refined sugar, it began to be used for the production of lokum in the second half of the 18th century. Starch was discovered by a German scientist in 1811 and then it started to be used in lokum production. Today appropriate sugar and starch instead of flour is used for the production of lokum. After starch replaced flour in the production of lokum, "Turkish delight" emerging value became a very well-known food all over the world [2,4].

There has not been enough scientific research regarding the production of Turkish delight. The first study on lokum was done in 1967 by Babev and Vakrilov in Bulgaria [5]. The researchers conducted a technical study to enable the cooking of lokum in a shorter time. In one of the studies by Vakrilov in 1969 [6], cooked lokum mass was cooled from 95°C to 25°C and the viscosity measurements were made at intervals of 5°C during the cooling period. Changes in the viscosity properties of the mass of the lokum were observed, especially under 45°C, and it was seen that tension and shear viscosity rapidly dropped below 45°C [6]. Vakrilov made some serial studies on the thermal processes and the structural and mechanical properties of lokum [6]. In this study, data were obtained from the mass of lokum during cooking or cooling. As a result of this study, the optimal condition of cooling time was determined to be 30 minutes at 0°C [5].

The most comprehensive study on Turkish delight was carried out in our country at Aegean University in the 1980s. The work titled "Research on the Construction Technique of Turkish Delight" was very extensive. In this study, the general nature of technical problems in Turkey and the experimental nature of the industry in terms of lokum production and its raw materials, formulation, cooking temperature and time, candy molding, as well as quality criteria such as surface cracking, and scaling were investigated [4]. Another study provided information about the definition of delight, its historical development, the first period during which the components were produced and its current state. In addition, another paper was given on the main raw materials used in the production of lokum, the lokum production stages andthe quality criteria of lokum [2]. Another study focused on the problems of lokum in terms of production and raw material problems, and the marketing of lokum [7]. Another study gives information about the production of Afyon cream lokum, and the packaging of creamy lokum in MAP to extend its shelf life [8].

Akbulut and Özen [9] indicated the importance of the production of apricot delight, its nutritional values and its vitamin and mineral content. In recent years dried apricots and figs have been used to develop new flavors and to create a new different product. In addition, the study gives detailed information about the raw materials used in the production of apricot and fig delights. However, there has not

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been a study on the production of black grapes delight. Black grapes are very important in terms of health. Grape antioxidant compounds are anthocyanins, flavonols, phenolic substances, malvidin and procyanidin. Total phenolic concentration varies in direct proportion with the antioxidative activity. In many countries, excessive intake of saturated fats is associated with high mortality due to coronary heart disease. However, it is not the case in some parts of France, and this paradox is linked to the consumption of red wine [10]. Red grape juice and wine contains flavonoids in amounts higher than 500 mg/L. Black grape concentrate includes high amounts of trace elements (iron, potassium, magnesium), organic acids, a high proportion of B-group vitamins, resveratrol, quercetin, catechins, anthocyanidins and proanthocyanidins [11,12]. In recent years, patients being treated for cancer (chemotherapy) have shown increased blood values with the use of black grape concentrate [13].

Lokum that has higher energy is produced by adding black grape concentrate with higher contents of phenolic compounds, nutrients and energy. Lokum with the addition of grape concentrate is produced with a high energy value, which will be beneficial in terms of nutritional and health care. Today Turkish delight is not produced with fruit or fruit concentrate, particularly with black grapes. It is made by adding only fruit aroma. However, this lokum contains artificial flavors and coloring agents which are seen as a disadvantage in terms of health. For this reason, the consumption of black grapes as a fruit was liked everywhere by everyone. Therefore, due to the support for the production of functional food in the food industry, especially as healthy food, new food products can be produced. In this context, black grapes can be used as raw material as an enhancer of the healthy values of products. Thus, the functional aspect of the enriched polyphenolic content of black grape is high and it is possible to produce foods that support health care benefits. Considering all these benefits, the aim of this study was to produce a Turkish delight as nutrient-rich, consumer taste and health in terms of high-producing literature aimed to gain a useful kind of delight.

Texture evaluation is an important factor in developing a new food product. Both sensory evaluation techniques and instrumental measurements are used in food texture research to assess texture parameters. Correlations are generally used to assess the relationship between the instrumental measurement and sensory perception in order to predict consumer responses or to evaluate quality control tools or parameters [14]. The heterogeneity of the test samples may also influence the nature and degree of correlation between sensory and instrumental measurements of food texture. Therefore, if the relationship between sensory and instrumental data is nonlinear, the calculation of a linear correlation coefficient between the two untransformed sets of data may not be appropriate [15]. A multitude of instrumental tests, both imitative and empirical, have been designed for the evaluation of the texture characteristics of foods. The most popular instrumental imitative test, Texture Profile Analysis (TPA), was first developed for the General Foods Texturometer. Our objectives were to assess the relationships between the primary textural characteristics of hardness, cohesiveness, springiness, and chewiness when evaluated simultaneously in foods representing the food texture spectrum.

Materials and Methods

Materials

The lokum used in the research was produced on-site at a pilot plant in Tunceli University. In lokum production a boiler is used that has a double walled oil heater and which is 110x110x50 cm in size. The boiler is electrically driven and the stirrer speed can be adjusted. The granulated sugar (from a sugar factory in Erzincan, Turkey), corn starch and citric acid (Baghdad Spices, Kahramanmaraş) used in lokum production were obtained from a supermarket in Tunceli. The water used in the lokum was obtained from Tunceli city tap water. The black grape and sour cherry fruit concentrate (65% dry matter) used in the lokum production was obtained from the Dimes Food processing factory (Tokat).

Production of black grape concentrated lokum

In this study, black grape concentrates with 65% dry matter were used. For the production of the fruit lokum, ratios of 2.5%, 5.0% and 7.5% by mass of black grape concentrate were used (Table 1). The amounts of water in these concentrates were calculated and the water was reduced during lokum production. Before adding raw materials into the boiler, the 3.5 kg corn starch that would be used in lokum production was dissolved in approximately 7-8 liters of water (25 L, the amount of water that comes from fruit concentrate). Thus, the starch milk was prepared. Then the rest of the water and 20 kg of granulated sugar was poured into the boiler then the mixer of the boiler was operated.

After dissolving the sugar in water and then adding the starch milk, a temperature of about 40°C was set, then 30 g citric acid was added and finally the cooking time started. After the mixture started to boil (about 20 minutes), the steam fan of the boiler was operated. The black grape concentrates were added on 55 minutes of production. Then cooking was completed by 5 minutes more cooking. To make a homogeneous mixture, 4-5 kg of lokum mass was taken out of the drain valve of the boiler, and it was poured back into the boiler. All of the lokum was poured from the bottom drain valve into wooden framed trays. The lokum was left to ripen for 24 hours at room temperature. After about 24 hours, samples were manually cut by hand and then the necessary analysis was carried out.

Colour measurement

The methods described by Anonymous [16] and Batu et al. [17] were used to determine the color values of the lokum. CIE L*a*b* color parameters were recorded as L* (lightness), a* (redness), and b* (yellowness) with a color difference meter (CRN300 model, Konica Minolta Sensing Inc., Osaka, Japan) using the transmission mode. Samples were filled in a 5 cm^3 glass cell and color measurement was made. The color results were expressed as follows: L*, a* and b*, indicating lightness, redness and yellowness, respectively.

Black Grape Concentration in Lokum (%)	Added Sucrose Amount in Lokum Mass (g)	Added Fruit Concentrate Amount in Lokum (g) (100% SÇKM)	Added Fruit Concentrate Amount in Lokum (g) (65% SÇKM)	The Water Amount in Fruit Concentrate (L)	The Water Amount Should be Added in Lokum (L)
% 2,5	18756	1244	1914	670	24330
% 5,0	17446	2554	3929	1375	23625
% 7,5	16066	3934	6053	2119	22881

Table 1: Lokum containing black grape concentrate sugar, water and the amount of black grape concentrate.

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Instrumental texture analysis

Texture values were evaluated instrumentally at room temperature (20-25ºC) applying the InstrumentalTexture Profile Analysis (TPA) instrument (TA-XT Plus, Stable Microsystems, Godalming, Surrey, UK) by slightly modifying the methods of Uslu et al. [18]. TPA was carried out using a flat ended pressure plate and then three-time compressions of the consecutive samples of Turkish delight were made (Figure 1).

Samples of Turkish delight (20x20x20 mm) were compressed with a compression device under a pressure plate with a 35 mm diameter. The amount of force applied was based on the hardness of the product itself. There were 10 seconds between two compressions and then the second compression was set to be 50% of what was expected of the first one. With regards to the printing plate, the pre-test speed was 1 mm/sec, the test speed was 5 mm/s and the post test speed was 5 mm/s. Parameters corresponding to sensory attributes were obtained from the curves. The test was configured so that the four TPA parameters; hardness, cohesiveness, springiness, chewiness, gumminess and resilience were calculated at the time of the test by determining the load and displacement at predetermined points on the TPA curve with the use of the TPA device-specific software (Texture Exponent 32, Stable Microsystems, Godalming, Surrey, UK) [18].

Sensory descriptive analysis

Eleven panelists were screened and recruited from a pool of panelists trained for the descriptive analysis of hardness, gumminess, chewiness, resilience, appearance, color, aroma and overall acceptability. Training procedures followed the guidelines defined by Meilgaard et al. [19]. The panelists had received prior extensive training on the term definitions as well as exposure to suggested reference lokums. The samples of lokum produced with 2.5%, 5.0% and 7.5% concentrations of black grapes were offered to the panelists to evaluate in terms of their sensory scores. Earlier studies utilizing a sensory evaluation form were prepared and used by Kurtcan and Gonül [20] and in order to prevent the prejudice of the panelists, each sample was given a product code and the presentation was randomized. Samples were presented for the panelists on white plates. The panelists were informed about the products before beginning the assessment. The panelists were given a test and were asked to rate the properties of the samples according to the sensory criteria of appearance, color, aroma and overall acceptability scores of 0-5. The evaluation scale ranged from 0: very poor, 1: bad, 2: moderate, 3: good, 4: very good, 5: excellent. The average asset value of six replications in the statistical analysis was conducted based on the average value of 11.

Statistical analysis

Physical, chemical and sensory analysis of both plain (control) samples and fruit concentrated Turkish delight was carried out to determine the differences between the groups in order to interpret the results of the analysis of variance (one-way MANOVA). The differences between the two groups were observed in order to determine which Duncan Multiple Comparison Test would be used. Means and standard deviations were calculated for both sensory (n=11) and instrumental (n=7) data using the SPSS (18.0) computer program. The transformations evaluated were selected based on the principles of psychophysics described by Meullenet et al. [15]. Pearson's correlation coefficients were calculated between all transformed and non transformed response variables using. Correspondence analysis was also conducted on the data to observe the consensus space of sample relationships [21].

Results and Discussions

Instrumental Texture Profile Analysis (TPA) values

The hardness, gumminess and chewiness values of lokum with black grape syrup (BGS) which were measured instrumentally are given in Table 2 and Figure 2. There was a significant difference ($p<0.05$) between the hardness, chewiness and gumminess values of lokum produced with BGS. The hardness value of lokum produced with 7.5% BGS concentration was the softest one (1941.61) and the control sample was found to be the most rigid (3201.95) one. The lowest chewiness and gumminess values, found to be 1483.55 and 1468.12 respectively, were obtained with the use of 7.5% BGS. The highest chewiness and gumminess values were found to be 2616.37 and 2521.55, respectively from control samples which contained no BGS.

When the research results are analyzed, the cohesiveness of black grape lokum decreased in relation to the concentration. Similarly, the addition of water as well as the fruit concentrate in the plain (control) lokum is thought to have caused a decrease in the degree of viscosity stiffness which led to a decrease in cohesion between the molecules. However, the research results showed the assumption that the flexibility properties of lokum can not change in according to the concentration of black grape in lokum mass.

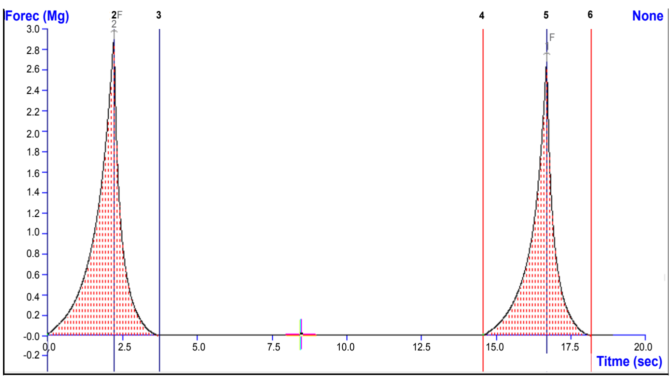

Figure 1: Aspects of a Texture Profile Analysis Curve.

Parameter	Sensorial and Instrumental Definition
Hardness	Force required to compress a food between the molars
Cohesiveness	The strength of the internal bonds making up the food
Chewiness	The energy required to chew a solid food until it is ready for swallowing, Chewiness = Hardness x Cohesiveness x Elasticity
Gumminess	The energy required to disintegrate a semisolid food so that it is ready for swallowing, Gumminess = Hardness x Cohesiveness
Springiness	The spring back is measured at the down stroke of the second compression, so the wait time between two strokes can be relatively important. Expressing springiness as a ratio of its original height, comparisons can be made between a broader set of samples and products.
Resilience	Resilience is measured on the withdrawal of the first penetration, before the waiting period is started. Resilience can be measured with a single compression, however, the withdrawal speed must be the same as the compression speed.

Table 2: Parameters Measured by Texture Profile Analysis.

According to the research results of elasticity values, grape juice was not shown to produce significant changes in the cohesiveness, springiness and resilience values of lokum produced by increasing the concentration of BGS (Table 3, Figure 2). A significant difference (p<0.05) was found on the cohesiveness, but not on the springiness and resilience values of the products depending on the concentration levels. While the samples had the lowest score (0.743) of cohesiveness with the 5% concentration of BGS, the control group had the highest score (0.817). While it was 0.817, it significantly (P<0.05) decreased to 0.764 when 7.5% BGS was used (Table 3). That is why a significant change was observed with the increase of the BGS concentration of (Figure 2).

According to the research survey results, the hardness values of lokum decreased proportionally with increases of the concentration of black grapes (Figure 2). The stabilization of hardness, gumminess and chewiness values of lokum produced with BGS were ranked as control>2.5%>5.0%>7.5% (Table 3). It means that adding the BGS in lokum mass made the texture juicy. Water added into lokum mass must be fully dissolved in the presence of starch in the media. By adding 65% BGS into the plain lokum, 35% water also entered the media at the same time. It was thought that the hardness might be lost because of adding fruit concentration which has invert sugar. In addition, the amount of invert sugar is effective on the structure of the texture. Increasing the amount of invert sugar in the textural structure of the material makes it so soft. The amount of glucose and fructose increased with the increases of grape juice concentration. Therefore, the softening of the structure may be caused by excessive use of glucose and fructose [22]. Since the molecular weight of sucrose is 342, in comparison with 180 for glucose or fructose, the concentration of either monosaccharide required to give a solution with the same molar concentration of individual sugar rings. The viscosity of sucrose, fructose and glucose solutions, and mixes of them, are all Newtonian, meaning that the viscosity is independent of the shear rate. However, highly concentrated glucose syrups can be slightly pseudoplastic, i.e. the viscosity decreases when the shear rate increases [23]. The more viscose the more harder food. In addition, the decrease in hardness may have been effective because of the amount of water used in the concentration of grape syrup. This theory confirms that the softening in texture increases with an increase in the amount of invert sugar in the lokum mass. The gummy and chewable values of lokum vary depending on the concentration of black grape fruit. These values decreased when the concentration of fruit decreased. Chewable showed resistance to shear and compression strength refers to the product [24]. Therefore, the chewability feature changes in direct proportion to viscosity. Thus, adding black grapes into plain lokum (control) reduced viscosity, depending on the concentration, but this may alsohave caused a decrease in chewiness and gumminess properties. There was an obvious decrease in the chewable features of lokum that had between 2.5% and 5.0% fruit concentrate, and there was less of a decrease in lokum that had between 5.0% and 7.5% fruit concentrate. According to these results the hardness, gumminess and chewiness values of lokum decreased due to the increased concentration of black grapes.

Changes in CIELAB color values

Color is one of the most important quality attributes of foods. The color values of the lokum produced with BGS are given in Table 4. The research results show that the differences between the L* values of the treatments were significant (p<0.05). The L* values of the control group (40.07) reached the highest value. The L* values decreased in parallel with the increases in added fruit concentrate in lokum mass. Thus, while the L* values of the lokum samples produced with 2.5% BGS reached the highest value of 29.16,decreasescontinued to the lowest value of 26.09 with the increasing of the amount of BGS to 7.5%.

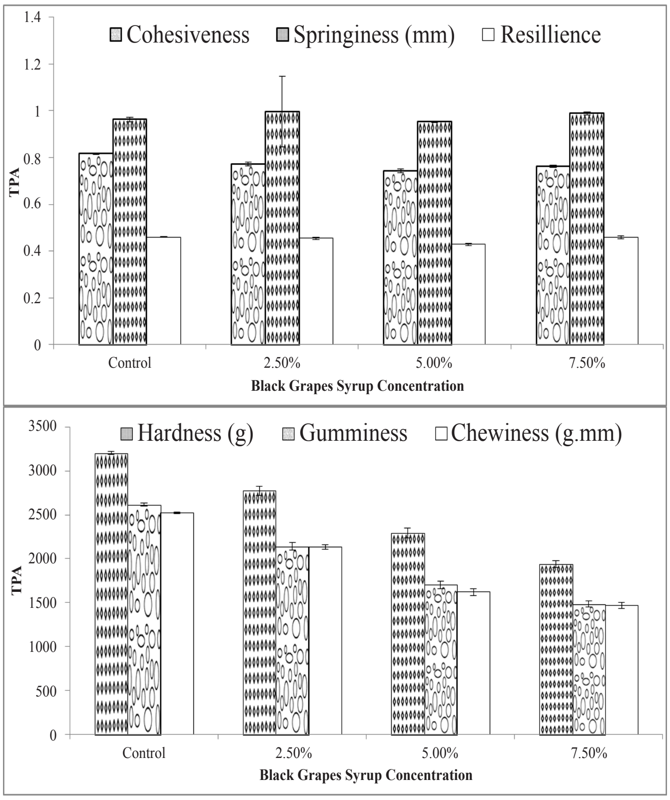

Figure 2: The changes in hardness, chewiness, gumminess, cohesiveness, resilience and resilience values of Turkish delight produced with black grape concentrate (syrup).

Black Grapes Concentrate (Syrup)	Hardness (g)	Gumminess	Chewiness (g.mm)
Control	3201,95 ± 16,08a	2616,37 ± 14,12a	2521,55 ± 11,47a
%2,5	2772,70 ± 50,07b	2139,75 ± 43,23b	2131,67 ± 27,34b
%5,0	2291,87 ± 58,67c	1701,51 ± 38,94c	1622,52 ± 37,96c
%7,5	1941,61 ± 38,45d	1483,55 ± 34,04d	1468,12 ± 36,54d
Black Grapes Concentrate (Syrup)	**Cohesiveness**	**Springiness (mm)**	**Resillience**
Control	0,817 ± 0,003a	0,963 ± 0,009a	0,460 ± 0,002a
%2,5	0,772 ± 0,008b	0,997 ± 0,277a	0,455 ± 0,005a
%5,0	0,743 ± 0,008c	0,953 ± 0,003a	0,429 ± 0,005b
%7,5	0,764 ± 0,005b	0,989 ± 0,007a	0,458 ± 0,006a

a-d Means within a column with different letters are significantly different (p<0.05)

Table 3: The Hardness, Gumminess and Chewiness values of Turkish Delight produced with BGS with 65% soluble solids (n = 7).

Red Grapes Juice Concenration	L*	a*/b*
Control	40,070 ± 0,262a	1,624±0,064a
%2,5	29,158 ± 0,254b	2,376±0,304b
%5,0	27,151 ± 0,296c	1,943±0,101c
%7,5	26,096 ± 0,325d	1,526±0,142a

In the same column with different letters are statistically significant differences between means (p <0.05)

Table 4: The Minolta L* and a*/b* values of Turkish Delight produced with BGS with 65% soluble solids (n = 7).

There were differences in the L* values of treatments produced with an addition of 5.0% and 7.5% BGS was found to be significant. The L* values of lokum produced with 7.5% were darker than those samples produced with 2.5% and 5.0%. This shows that the color of lokum produced with high BGS was darker, this could be due to the higher BGS lokum having more anthocyanins than lower level of it [25,26]. All samples indicated that the grape concentration had a significant effect on L* values. A significant decrease in L* asset value was observed as the fruit juice concentration increased. Therefore, the effect of this darkness increases in accordance with increasing the amounts of BGS involved in lokum.

Table 4 shows the Minolta L* and a*/b* values of Turkish delight produced with BGS with content and the color of grape products. Thus, it was worth investigating whether or not black grape concentration would have an effect on lokum color. Adding BGS in lokum resulted in a darkening in color by decreasing the L* values. The higher the added fruit concentration resulted in the greater the darkness of the product color (Figure 3). The L* value changed inversely proportionally to the concentration of black grape fruit concentrate. In other words, the brightness of lokum produced with BGS decreased with increases in the concentration of black grapes, and therefore, the product became darker in color (Table 4).

The color of grape juice is mainly influenced by the presence of various anthocyanins. Cyanidins are primarily responsible for magenta and crimson colors, while purple, mauve and blue colors are due to the presence of delphinidins. The degradation of anthocyanins present in grape juice may undergo oxidative cleavage either as a direct reaction to ozone or as an indirect reaction because of secondary oxidators or intermediate radicals [27]. Dirik [28] reported that the average L* value of pomegranate lokum was 79.55. It was reported that the L* value of lokum produced with black carrot juice concentrate at 20°C was determined to be 26.02. Thermal degradation of anthocyanins in lokum mass during cooking allows increased browning and makes the color of lokum mass darker.

Yildiz [29] reported that there were significant linear correlations between all CIELAB parameters of L*, a* and b* values. All the CIELAB parameters were correlated with the total anthocyanin content. It was also reported that L* values were high in the cultivars with low total anthocyanins but the values fell rapidly as total anthocyanins increased. Therefore, there was a negative correlation with anthocyanins, meaning that if the L* value is higher, the anthocyanin content is lower. There was a significant inverse correlation between a* values and the anthocyanin content of grapes; the a* value was high when total anthocyanins were low. Regarding b* values, they changed in the same pattern as L* values. During the juice processing stages and particularly during their storage, the anthocyanin content decreased progressively and irreversibly forming more stable polymeric pigments. These pigments are responsible for changing the grape juice aroma, color, and flavor. The initial increase in the lightness (L*) value is attributed to the partial precipitation of unstable suspended particles followed by a decrease due to oxidative darkening [30].

Most of the color of anthocyanins changes as an indicator depending on the degree of the pH. Anthocyanins are purple-red at low pH, whereas they are green-blue in color at high pH. The pH values of these lokum samples are around 3.5; which is why it is in the low pH group. Thus, the color of the lokum samples appeared as purple-red tones. As much as the acidity decreases, the color makes it weaker and changeable. When the acidity is higher, the color is stabilized.

As the BGS increased in the production of lokum, the brightness decreased. Because of this, in the presence of blue media the perception of the red color becomes difficult. As the brightness decreases, the blue color is perceived instead of the red one. Thus, while the opposite position was expected, the red color in the lokum declined and the blue one increased. Dirik [28] carried out a study on the production of a type of Turkish delight with pomegranate juice and found the a* and b* values to be 0.11 and 7.61, respectively. The mean of the a*/b* values (refering to redness) of the control lokum samples was the lowest one with a value of 1.54. In addition, while there was a significant difference between 2.5% and 7.5%, it was significantly lower when produced with 7.5% BGS.

Sensory panel and texture profile analysis

The sensory evaluation results of lokum produced with BGS are given in Table 5. In addition, all sensory values had good scores for all fruit concentrations. The research results showed that the lokum produced with 2.5% BGS gave the best and highest score in terms of appearance, flavor and overall acceptability, whereas the lokum produced with 7.5% BGS had the worst and lowest score in terms of appearance, aroma and overall acceptability. However, the samples produced with 5.0% and 7.5% BGS gave the best scores in terms of color. As a result of the sensory evaluation, the scores showed a general decrease due to the increased fruit juice concentration (Figure 4). In parallel with an increase in the BGS concentration added to plain lokum, the amount of water added in the lokum mass also increased. This might have caused a decrease in viscosity.

Therefore, the hardness, chewiness and consumer acceptability values of the products decreased. This could be due to the increased fruit concentration which negatively related with the sensory qualities of the lokum. The means of the sensory and instrument scores showed that the 18 lokum samples used in this study spanned almost the entire range of values for texture scales based on standard reference foods. Because the standard deviations for the instrument scores were small, it was concluded that the instrumental test offered good reproducibility.

Standard deviations for the sensory scores were, in some cases, greater than expected, especially when evaluating cohesiveness. In light of these values, it is possible to say that adding black grape concentrate to plain lokum gives positive and acceptable results for producing high quality and value-added lokum. In general, lokum containing 2.5% BGS gave acceptable results in terms of taste and overall acceptability. The overall acceptability scores of the products produced with 2.5% and 5.0% BGS were approximately the same. However, the 7.5% one was the product that had lowest overall acceptability score.

Correlations between TPA and sensory evaluation

Pearson's correlation coefficients between sensory and

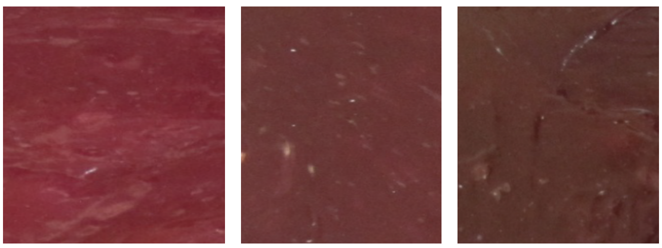

Figure 3: Lokum colours that were produced in different concentrations of black grape concentrate.

instrumental attributes are given in Table 6. The TPA hardness was strongly and positively correlated with gumminess (r=0.983, p<0.01) and chewiness (r=0.539, p<0.05). The TPA resilience (springiness) was not significantly correlated (r=0.111-0.329) with hardness, gumminess or chewiness. TPA gumminess was also the most highly (r=0.638, P<0.01) correlated with TPA chewiness. Sensory hardness was found to be highly (P<0.01) correlated with instrumental hardness (r=0.719), gumminess (r=0.733) and chewiness (r=0.578). Sensory gumminess also highly (P<0.01) correlated with instrumental hardness (r=o.639), TPA gumminess (r=0.637), additionally sensory chewiness also highly (P<0.01) correlated with TPA hardness (r=0.647) and gumminess (r=0.632). These correlation coefficients were comparable to values reported in previous studies. Montejano et al. [31] reported a significant correlation between instrumental hardness and sensory firmness. Munoz et al. [32] reported a higher correlation between sensory firmness and the yield force of gelatin and sodium alginate. Lyon et al. [33] also reported very poor correlations between TPA cohesiveness and sensory notes for patties made with mechanically deboned poultry meat. Sensory resilience was not highly correlated with instrumental resilience (r=0.181).Statistically insignificant correlations between sensory chewiness and its instrumental corollary seem to be the norm rather than the exception. Two explanations are offered. The first is because instrumental chewiness was calculated as the product of hardness, cohesiveness and resilience. The inadequacy of some of the measurements for instrumental cohesiveness may have influenced the calculated instrumental values of chewiness. A second explanation may be that the instrumental definition of chewiness does not correspond to the sensory perception of chewiness. Defining instrumental chewiness as the arithmetic result of multiplying the values of hardness, cohesiveness and resilience may be an over simplification. It would be expected for hardness, cohesiveness and springiness to have contributed equally to the overall sensory perception of chewiness.

Highly positive correlations were found between sensory evaluation and instrumental measurement. Of the TPA and sensory scoores analyzed, a significant and positive correlation was observed between the TPA values. Sensory evaluation seems to correlate significantly with instrumental hardness and gumminess with the TPA instrument or measuring the hardness and gumminess values of lokum with the TPA instrument seems to correlate significantly with the evaluation of them by panelists. Correlations of chewiness and resilience values between scores measured by the TPA instrument and those obtained from panelists are lower and not significant because all correlation coefficients show weak correlation. The analysis of the statistical correlation of measurement by the TPA instrument affects chewiness and resilience. We suggest that the result of this study will be helpful for future investigations on the determination of the measurement of TPA values or sensory evaluation. No correlation was found between sensory-color and Minota-L* values, whereas there was a significant (P<0.01) correlation with Minolta L*and a*/b* values. Several works on rabbit meat have shown poor relationships between WB measurements and tenderness. Sensory appearance (SA) was highly (P<0.01) correlated with the Minolta-L* and a*/b* values obtained from a Minolta color instrument. SA had a significant (P<0.01) correlation with the L* (r=0.617) and a*/b* (r=0.799) values of a Minolta color instrument and with the color sensory scores (r=0.770) given by panelists. However, the L* value did not show a significant correlation (r=0.287) with the color sensory scores given by panelists, whereas Minolta a*/b* values significantly correlated (p<0.05) with color sensory color evaluation (Table 7). A discussion was not made here because of any research did not find related with this topic.

Conclusion

High linear correlations were noted between corresponding objective parameters and sensory scores for hardness and springiness, but not for cohesiveness and chewiness. This was illustrated by problems encountered with the instrumental measurement of cohesiveness when dealing with foods that exerted little or no springiness. An instrumental measurement of cohesiveness producing reliable results independently

Black Grapes Syrup	**Hardness**	**Gumminess**	**Chewiness**	**Springiness**
%2,5	3.63 ± 0.152a	3.36 ± 0.226a	3.63 ± 0.314a	3.36 ± 0.278a
%5.0	3.09 ± 0.284a	3.09 ± 0.122a	3.27 ± 0.226a	3.09 ± 0.315a
%7,5	2.90 ± 0.295a	2.63 ± 0.245a	2.81 ± 0.314a	2.81 ± 0.345a
Black Grapes Syrup	**Appearance**	**Colour**	**Aroma**	**Overall Acceptability**
%2,5	3.91 ± 0.247a	3.63 ± 0.195a	4.00 ± 0.312a	3.63 ± 0.340a
%5.0	3.72 ± 0.345a	3.91 ± 0.278a	3.72 ± 0.237a	3.54 ± 0.263a
%7,5	3.54 ± 0.226a	3.91 ± 0.205a	3.36 ± 0.263a	3.18 ± 0.195a

In the same column with different letters are statistically significant differences between means (p<0.05)

Table 5: The sensory hardness, gumminess, chewiness, resilience, appearance, color, aroma and overall acceptability values of Turkish delight produced with BGS (n =11).

	H-TPA	**G-TPA**	**C-TPA**	**R-TPA**	**SH**	**SG**	**SC**	**SR**
H-TPA	1							
G-TPA	0,983**	1						
C-TPA	0,539*	0,638**	1					
R-TPA	0,111	0,231	0,329	1				
S-Hardness (SH)	0,719**	0,733**	0,578**	0,225	1			
S-Gumminess (SG)	0,639**	0,637**	0,392	0,188	0,706**	1		
S-Chewiness (SC)	0,647**	0,632**	0,330	0,071	0,654**	0,636**	1	
S-Resilience (SR)	0,427	0,425	0,125	0,181	0,551**	0,615**	0,638**	1

*Correlation is significant at the 0.05 level (2-tailed).
**Correlation is significant at the 0.01 level
TPA: Textural Profile Analyses, H: hardness, G: gumminess, C: chewiness, R: resilience, S: sensory

Table 6: Pearson Correlation coefficients (PCC) between Textural Profile Analyses (TPA) and sensory scores.

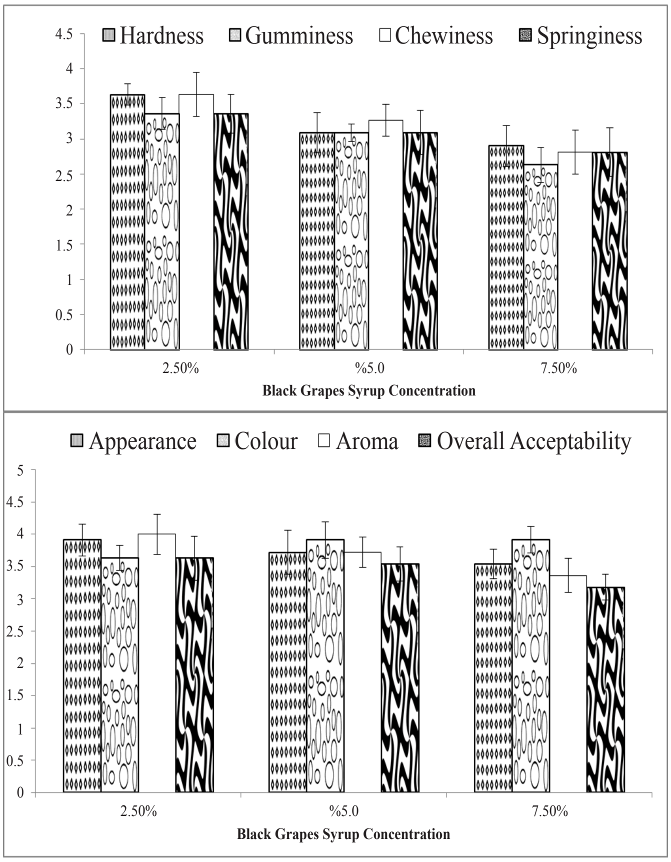

Figure 4: The hardness, chewiness, gumminess, springiness, appearance, color, flavor and overall acceptability values analyzed in terms of sensory evaluation, obtained from lokum produced with BGS.

	Minolta L*	Minolta a*/b*	SA	SC
Minolta L*	1			
Minolta a*/b*	0,673**	1		
Sensory Appearance (SA)	0,617**	0,799**	1	
Sensory Colour (SC)	0,287	0,507*	0,770**	1

*Correlation is significant at the 0.05 level (2-tailed), **Correlation is significant at the 0.01 level

Table 7: Pearson Correlation coefficients between Minolta L*,a*/b* and Sensory (Appearance+Colour).

of a product's springiness needs to be developed. The results also suggested that correlations between instrumental parameters and sensory attributes should be reported based on adequately chosen data transformations.

It was seen that the hardness, chavability, chewiness, appearance, color and aroma of lokum produced with BGS won the appreciation of the panelists. When there is a wish to produce a different, attractive and an alternative to plain lokum, the production of a fruit concentrated lokum takes very important place among the options. In recent years, the various side effects of drugs produced and used in modern medicine have been identified, and the demand for alternative medicine or support food for health care has increased. With the growing demand for and interest in support food crops, consumers have begun to question the benefits and losses and the contents of industrially produced food which are in food for various purposes such as artificial sweeteners, colorants and so on.

It is also known that the Turkish delight called fruit lokum is not a real fruit lokum, it is fruit-flavored Turkish delight. Lokum for this study, the total phenolic content and antioxidant activity of the lokum produced with fruit concentrates to increase the participation lokum is the fact. It is also a fact that phenolic substances and anthocyanins are important components in terms of health. Considering lokum liked to have consumed a traditional confectionary delight of concentrated fruit delight will be able to meet the needs of social production. In addition, similar studies to be made in the future will benefit from this work.

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References

1. Anonymous (2004) Gıdaların üretimi, tüketimi ve denetlenmesine dair kanun hükmünde kararnamenin değiştirerek kabulü hakkında kanun, Kanun No:5179 ve kabul tarihi: 27.5.2004.
2. Batu A (2006) Türk lokumu üretim tekniği ve kalitesi (Production technique of Turkish delight and its quality). Gıda Teknolojileri Elektronik Dergisi 35-46.
3. Doyuran SD, Gültekin M, Güven S (2004) Geleneksel gıdalardan lokum üretimi ve özellikleri, Geleneksel Gıdalar Sempozyumu 334-342.
4. Gönül M (1985) Türk Lokumu Yapım Tekniği Üzerine Araştırmalar. Baskı, Ege Mühendislik Fakültesi, Ders Kitapları Yayın No: 8, Bornova, İzmir.
5. Babev D, Vakrilov V (1967) Nova Technology; Aparature Zasvarevanena Lokum. Nauchni Trudove. Vissh Institut PO Khranitelna; Wkusova promyshlennost tom 15.
6. Vakrilov V (1969b) Study of structural and mechanical properties of lukum mass during cooling, Vkusova Promyschlennost 16: 197-202.
7. Doğan İS (2008) Hammadde ve sorunlarıyla Türk lokumu üretimi. Gıda Teknolojileri Elektronik Dergisi 13-17.
8. Dereli Z, Şevik R (2011) Modifiye Atmosferde Paketlenerek Depolanan Afyon Kaymağında Oluşan Kimyasal Değişimler. Teknolojik Araştırmalar GTED 1-8.
9. Akbulut M, Özen G (2008) Kayısı lokumu üretimi ve beslenmedeki önemi. Gıda Teknolojileri Elektronik Dergisi 1: 7-11.
10. Gülcü M, Demirci A, Güner K (2008) Siyah Üzüm; Zengin Besin İçeriği ve Sağlık Açısından Önemi. Türkiye 10. Gıda Kongresi, Erzurum.
11. Anastasiadi M, Pratsinis H, Kletsas D, Skaltsounis AL, Haroutounian SA (2010) Bioactive non coloured polyphenols content of grapes, wines and vinification by-products: Evaluation of the antioxidant activities of their extracts. Food Research International 43: 805-813.
12. Stavikova L, Polovka M, Hohnova B, Karasek P, Roth M (2011) Antioxidant activity of grape skin aqueous extracts from pressurized hot water extraction combined with electron paramagnetic resonance spectroscopy. Talanta 85: 2233–2240.
13. Aziz MH, Kumar R, Ahmad N (2003) Cancer chemoprevention by resveratrol: in vitro and in vivo studies and the underlying mechanisms (review). Int J Oncol 23: 17-28.
14. Szczesniak A (1987) Correlating sensory with instrumental texture measurements: An overview of recent developments. Journal of Texture Studies 18: 1-15
15. Meullenet JF, Lyon BG, Carpenter JA, Lyon CE (1998) Relation Between Sensory and Instrumental Texture Profile Attributes. Journal of Sensory Studies 13: 77-93.
16. Anonymous (1992) Minolta, Precise Colour Communication, Colour Control From perception To İnstrumentation. Handbook, Printed by Minolta Camera Co.
17. Batu A, Thompson AK, Ghafir SAM, Abdel-Rahman NA (1997) Minolta Hunter renk ölçüm aletleri ile domates, elma ve muzun renk değerlerinin karşılaştırılması. Gıda 22: 301-307.
18. Uslu MK, Erbaş M, Turhan İ, Tetik N (2010) Nişasta miktarının ve çöven suyu ilavesinin lokumların bazı özellikleri üzerine etkileri. Gıda 35: 331-337.

19. Meilgaard M, Civille GV, Carr BT (1992) Sensory Evafuation Techniques. CRC Press, Boca Raton, Florida. Bicyclical instrument for assessing texture profile parameters and its relationship to sensory evaluation of texture. J Texture Studies 28: 101-118.

20. Kurtcan Ü,Gönül M (1987) Method of scoring for the sensory evaluation of food. Üniviversite of the Aegean. Journal of Faculty of Engineering, Series B, Food Engineering 51: 137-146.

21. Norusis MJ (1993) SPSS For Windows, Base System User's Guide, SPSS, Chicago.

22. Nikam PS, Ensari HR, Mehdi H (2000) Density and viscosity studies of glucose and frutose solutions in aqueaus and in 0.5 mol dm3 aqueaus NH4CI. J Mol Liq 87: 97-105.

23. Evageliou V, Richardson RK, Morris ER (2000) Effect of sucrose, glucose and fructose on gelation of oxidised starch. Carbohydrate Polymers 42: 261-272.

24. Karagözlü C (2010) Yüksek lisans Reoloji Ders Notları, Ege Üniversitesi Fen Bilimleri Enstitüsü, İzmir.

25. Watada AE, Abbott JA (1975) Objective method of estimating anthocyanin content for determining color grade of grapes. Journal of Food Science, 40: 1278-1279.

26. Tiwari BK, O'Donnell CP, Muthukumarappan K, Cullen PJ (2009b) Anthocyanin and colour degradation in ozone treated blackberry juice. Innovative Food Science and Emerging Technologies 10: 70-75.

27. Tiwari BK, O'Donnell CP, Patras A, Brunton NP, Cullen PJ (2009a) Effect of ozone processing on anthocyanins and ascorbic acid degradation of strawberry juice. Food Chem 113: 1119-1126.

28. Dirik A (2009)Nar ve nar suyunun lokum üretiminde kullanım olanakları, Yüksek Lisans Tezi, Harran Üniversitesi Fen Bilimleri Enstitüsü, Şanlıurfa.

29. Yıldız SD (2007) Enoant ve sağlık üzerine etkileri. Gıda Teknolojileri Elektronik Dergisi 1: 65-70.

30. Carrilho MC, Campo MM, Olleta JL, Beltrán JA, López M (2009) Effect of diet, slaughter weight and sex on instrumental and sensory meat characteristics in rabbits. Meat Sci 82: 37-43.

31. Montejano JG, Hamnn DD, Lanier TC (1985) Comparison of two instrumental methods with sensory texture of protein gels. J Texture Studies 16: 403-424.

32. Munoz AM, Pangborn RM, Noble AC (1986) Sensory and mechanical attributes of gel texture. II. Gelatin, sodium alginate and kappacarrageenan gels. J Texture Studies 17: 17-36.

33. Lyon CE, Lyon BG, Davis CE,Townsend WE (1980) Texture profile analysis of patties made from mixed and flake-cut mechanical deboned poultry meat. Poultry Sci 59: 69-76.

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