



Effect of Cherry Laurel (*Laurocerasus officinalis* Roem.) Incorporation on Physical, Textural and Functional Properties of Cakes and Cookies

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Abstract: Cherry laurel (*Laurocerasus officinalis* Roem.) is a highly nutritious fruit and can be consumed in both fresh and processed form. Due to its phenolic compounds, cherry laurel demonstrates antioxidant activity and may therefore be evaluated as an ingredient to obtain a functional food. This study was performed to investigate the possible usage of dried cherry laurel fruit in the production of cakes and cookies, and to develop a novel formulation of these products. Cakes (0, 10, 20, 40%) and cookies (0, 5, 10, 20%) were incorporated with a coarse milled form of dried cherry laurel, and the quality of the baked products was evaluated by determining the color, texture, sensory properties, total phenolic content and antioxidant capacity. All of the color values (L^* , a^* , b^*) were significantly ($p<0.05$) affected by the level of fruit. Fruit level also had a significant ($p<0.05$) effect on the total phenolic content and antioxidant capacity, and these values were found to be increased with increasing fruit levels. It was observed that the increase in cherry laurel addition resulted in firmer cakes, but softer cookies. In addition, a decrease was observed in the springiness values of 40% fruit-containing cakes as compared to the control sample. Sensory evaluation of the products showed satisfactory results. Products containing higher levels of fruit were generally the most preferred by the panelists.

Key Words: Cherry laurel, cake, cookie, phenolic, antioxidant, texture.

Karayemiş (*Laurocerasus officinalis* Roem.) İlavesinin Kek ve Kurabiyelerin Fiziksel, Tekstürel ve Fonksiyonel Özellikleri Üzerine Etkisi

Özet: Karayemiş (*Laurocerasus officinalis* Roem.) oldukça besleyici bir meyve olup hem taze hem de işlenmiş olarak tüketilebilmektedir. Bu meyve, fenolik bileşikleri sayesinde antioksidan aktivite gösterdiğinden dolayı fonksiyonel gıda üretiminde bileşen olarak kullanılabilir. Bu çalışma,

kurutulmuş karayemişin kek ve kurabiye üretiminde kullanım olanaklarının araştırılması ve bu ürünler için yeni bir formülasyon geliştirilmesi için yapılmıştır. Kurutulmuş karayemiş kabaca öğütüldükten sonra kek (% 0, 10, 20, 40) ve kurabiyelere (% 0, 5, 10, 20) ilave edilmiş ve elde edilen ürünlerin kalitesi renk, tekstür, duyuşal özellikler, toplam fenolik içerięi ve antioksidan kapasitesi aısından deęerlendirilmiştir. İlave edilen meyve miktarının, tüm renk deęerlerini (L^* , a^* , b^*) önemli seviyede ($p < 0.05$) etkiledięi tespit edilmiştir. Meyve miktarının ürünün toplam fenolik içerięi ve antioksidan kapasitesi üzerinde de önemli düzeyde ($p < 0.05$) etkisi olduęu ve bu deęerlerin artan meyve oranı ile birlikte arttıęı belirlenmiştir. Karayemiş ilavesindeki artışıñ kekleri sertleřtirdięi, kurabiyeleri ise yumuřattıęı gözlenmiştir. Ayrıca kontrol örneęi ile karřılařtırıldıęında %40 meyve ieren keklerin elastikiyetinin azaldıęı saptanmıřtır. Duyusal deęerlendirmede tatmin edici sonuçlar elde edilmiştir. Yüksek oranda meyve ieren ürünler genel olarak panelistler tarafından daha fazla beęenilmiştir.

Anahtar Kelimeler: Karayemiş, kek, kurabiye, fenolik, antioksidan, tekstür.

Introduction

Cherry laurel (*Laurocerasus officinalis* Roem.), locally called Taflan or Karayemiş, is a summer fruit (dark purple or black when mature) that is mainly distributed along the coasts of the Black Sea region of Turkey (Alasalvar et al. 2005; Halilova and Ercisli, 2010). Cherry laurel fruits provide a rich source of nutrients with high mineral content and are good natural sources of phenolic and antioxidant compounds (Kolaylı et al. 2003; Halilova and Ercisli, 2010). The annual production of cherry laurel in Turkey is not known because of its consumption as a fresh fruit in local markets. The fruit is consumed as fresh or dried, pickled, and processed into pekmez, jam, marmalade and fruit juice (Kolaylı et al. 2003; Alasalvar et al. 2005; Halilova and Ercisli, 2010). Besides its use in foods, both the fruit and seeds of cherry laurel have been used for the treatment of stomach ulcers, digestive system complaints, bronchitis, eczema, and hemorrhoids, and also as a diuretic agent (Alasalvar et al. 2005; Halilova and Ercisli, 2010; Karahalil and řahin, 2011).

Food and the manufacturing processes are attracting significant scientific and public interest due to their influence on human health. This has led to an increased consumer demand for healthy nutritious foods, i.e. functional foods (Day et al. 2009). Functional foods are defined as foods that may provide health benefits beyond basic nutrition. These foods can arise from a desire to provide additional benefits to consumers in the form of enhanced nutrition (Spence, 2006) and can increase the physical and mental well-being of consumers (Menrad, 2003). In addition to their nutritional function, product properties such as color, texture, taste and mouthfeel should be taken into account in order to design and develop functional foods, as the appearance and sensory properties of foods are the most important attributes to the consumer, ahead of their nutritional values (Day et al. 2009). Functional foods have been developed in almost all food markets; however, they have been mainly launched in the dairy, confectionery, soft-drinks, baby-food and bakery markets (Bigliardi and Galati, 2013). Ranging from bread through to biscuits, cakes and pastries, bakery products are consumed all over the world and provide an ideal matrix by which functionality can be delivered to the consumer in an acceptable food (Alldrick, 2007).

Phenolic compounds are important secondary plant metabolites and contribute to any health promoting effects of fruits and vegetables. Additionally, antioxidant activity is a result of several phytochemicals present in the fruit and their synergistic effects. A direct

relationship has been found between the phenolic content and antioxidant capacity of many fruits and vegetables (Jacobo-Velázquez and Cisneros-Zevallos, 2009; Matthes and Schmitz-Eiberger, 2009). Phenolic compounds that possess antioxidant activities may play a major role in the prevention of diseases such as cardiovascular diseases, cancer, diabetes, Alzheimer's disease and some immune disorders (Wilcox et al. 2004; Sun et al. 2011). Therefore, consuming an antioxidant-rich diet could play an essential role in the prevention of the diseases mentioned above. Several reports on the chemical composition, phenolic content and antioxidant capacity of cherry laurel fruits have been published (Ayaz et al. 1997a; Ayaz et al. 1997b; Kolaylı et al. 2003; Alasalvar et al. 2005; Halilova and Ercisli, 2010; Karahalil and Şahin, 2011); however, there is no available literature regarding its utilization in bakery products. Therefore, the present study investigates the usage of cherry laurel in cake and cookie production. In addition, it would be beneficial to develop a novel formulation of cake and cookie production with cherry laurel in order to obtain functional bakery products.

Materials and Methods

Materials

Dried fruits of *L. officinalis* Roem. were obtained from Trabzon, Turkey. All ingredients used for cake and cookie baking were purchased from a local commercial market (Antalya, Turkey) and all chemicals used in the analyses were purchased from Merck (Darmstadt, Germany) and Sigma-Aldrich (St. Louis, MO, USA).

Methods

Preparation of Cherry Laurel Fruits

The seeds were removed by cutting the fleshy parts of the fruit with the aid of a knife. Then, the fruits were milled in a coffee grinder (Bosch MKM6000, Türkiye) into coarse particles and the particles obtained were used for the production of cakes and cookies.

Production of Cake and Cookie

Preparation of the cake mix was performed according to Gomez et al. (2007) with some modifications. Milled fruits of cherry laurel were incorporated into the cakes at different levels (0, 10, 20, 40%) based on the flour weight. Composition of the cake mix was 320 g of flour, 220 g of sugar, 160 g of oil, 180 g of milk, 100 g of whole egg and 10 g of baking powder. In order to prepare the cake batter, sugar and whole eggs were mixed with a mixer (Philips HR1492, Holland) at a medium speed for 2 minutes; then, oil and milk were added and mixed at the same speed for 1 minute, before milled fruits, flour and baking powder were finally added and mixed at the same speed for 2 minutes. Aluminum baking pans (8 cm in diameter) were lined with wax paper and 70 g of cake batter was weighed into each pan.

Cookie dough was prepared according to the AACC (1999) recipe with some modifications. Milled fruits of cherry laurel were incorporated into the cookies at different levels (0, 5, 10, 20%) based on the flour weight. Composition of the cookie dough was 250

g of flour, 105 g of sugar, 100 g of vegetable margarine, 2.5 g of skimmed milk powder, 3 g of salt, 2.5 g of baking powder, and 35 g of distilled water. In order to prepare the cookie dough, vegetable margarine, sugar, salt, and powdered milk were mixed with a mixer (Bosch TurboFixx 350 W, Germany) at a medium speed for 3 minutes. Then, milled fruits, flour, baking powder and distilled water were also added and the mix was kneaded by hand for 5 minutes. The cookie dough was shaped with a circular die with a diameter of 7 cm and a height of 0.7 cm.

Cakes and cookies were baked in a preheated conventional oven (Kumtel KF-4125, Turkey) at 175°C for 20 min and 150°C for 30 min, respectively.

Cake and Cookie Analyses

Analyses were performed on cake and cookie samples after they had cooled to room temperature. In order to determine the total phenolic content and antioxidant capacity, the samples were milled in a coffee grinder (Bosch MKM6000, Turkey) and the powder obtained was used in the analysis.

Preparation of Extracts For Phenolic and Antioxidant Assays

Extraction was performed by modifying the method of Rupasinghe et al. (2008). For this purpose, 1 g of powdered sample was accurately weighed into 28 mL capacity centrifuge tubes and mixed with 10 ml of distilled water. The mixture was then subjected to sonication for 15 min x 3 times, with 10 min intervals in between sonication cycles to allow the mixture to cool. First, the aqueous extract was separated from solid matter by filtering through Whatman No. 40 filter paper and then the crude extract was centrifuged at 3000g for 15 min. Total phenolic compounds and the antioxidant capacity of water-soluble extracts were determined immediately after the extraction procedure.

Determination of Total Phenolic Compounds

Total phenolic content was determined by the Folin-Ciocalteu assay as described by Medina (2011) using gallic acid as a standard. This method was evaluated with gallic acid at 0, 10, 25, 50, 100, 200 and 250 µg/mL. In this procedure, 900 µL of distilled water was transferred to 3 ml tubes, followed by 100 µL of gallic acid standard, samples, and distilled water for the blank, and mixed. The Folin-Ciocalteu reagent (100 µL) was added, mixed, and allowed to react for 5 min before adding 1 mL of 7% Na₂CO₃, followed by the addition of 400 µL of distilled water. The mixture was allowed to react for 90 min at room temperature. Then, the absorbance was determined at 725 nm. The concentration of total phenolic compounds was determined by the standard calibration curve and expressed as mg of gallic acid equivalent per 100 g sample.

Determination of Total Antioxidant Capacity

Total antioxidant capacity was performed using the ABTS method according to Ozgen et al. (2006) with some modifications. For the method, a Trolox aliquot was used to develop a 2.5, 5.0, 7.5, and 10 mM standard curve. The ABTS^{•+} radical solution (7mM)

was prepared by mixing 2 ml of 12.25 mM potassium persulfate with 0.0384 g of ABTS (2,2'-azinobis-(3-ethyl-benzothiazoline-6-sulfonic acid)) which was previously dissolved in a small amount of distilled water, and the total volume was brought to 10 ml with distilled water. This mixture was allowed to stand for 12-16 h at room temperature in the dark. On the day of analysis, the ABTS^{•+} radical solution was diluted with phosphate buffer saline (PBS, pH 7.4) to an absorbance of 0.70±0.01 at 734 nm. To determine the inhibition ratio of extracts and standards, 10, 20, 30 and 40 µL aliquots of extracts or 10 µl of Trolox standards were added to 1 mL of the ABTS^{•+} radical solution and mixed immediately. Then, the absorbance was determined at 734 nm for 6 min with 1 min intervals. The percentage inhibition of absorbance at 734 nm was calculated and plotted as a function of concentration of antioxidants and of Trolox for the standard reference data. Total antioxidant capacity was expressed as µM of Trolox equivalent per g sample.

Color

The color (L^* , a^* , b^* values) of cakes and cookies was measured according to the CIE-Lab system with a Minolta colorimeter (CR-400, Japan), which was standardized with a white color tile ($Y=88.06$, $x=0.3176$ and $y=0.3349$). Cakes were cut into two halves and the crumb color of cakes was measured at five different positions on the surface of each half. The crust color of cookies was measured at five different positions on the cookie surface.

Texture

The instrument used for texture analyses was a TA-XT Plus Texture Analyzer (Stable Microsystems, Godalming, Surrey, UK) with a 5 kg load cell.

Cake compression tests were performed on cakes using a cylindrical probe (20 mm diameter) using the following test conditions: pre-test speed 1.0 mm·s⁻¹; test speed 1.0 mm·s⁻¹; post-test speed 10.0 mm·s⁻¹; strain 25%; hold time 60 s; trigger force 5 g. The following parameters were obtained with cake slices of 2 cm thickness; firmness (the force required to compress the product by a preset distance) and springiness (calculated by dividing the force recorded after 60 seconds by the maximum force, then multiplying by 100%).

A 3-Point Bending Rig (HDP/3PB) probe was used for the cookie analysis using the following test conditions: pre-test speed 2.5 mm·s⁻¹; test speed 2.0 mm·s⁻¹; post-test speed 10.0 mm·s⁻¹; distance 15 mm; trigger force 20 g. The following parameters were obtained with whole cookie; hardness (the peak force) and flexibility (the distance at the point of break).

Sensory Evaluation

Sensory evaluation was carried out on the representative samples of cakes and cookies by seven untrained panelists selected from graduate students in the Department of Food Engineering at Akdeniz University, aged 25-35. Cakes and cookies were coded by three-digit random numbers. Each parameter was graded with points ranging from 1 to 5 for appearance, texture, taste, overall appreciation for both cake and cookie, and cross sectional area for only cake (1 reflected a very low and 5 a very high score).

Statistical Analysis

Analysis of variance (ANOVA) was performed on data using SAS System Software (SAS Institute Inc., Cary, NC, USA) to determine the statistical significance between the cake/cookie samples containing different levels of dried cherry laurel fruit. Statistical evaluation of cake and cookie samples was made separately. Duncan's multiple range test was used for those effects determined as significant at the 95% confidence level. Duplicate samples were used in each experiment and the experiments were replicated twice.

Results and Discussion

Phenolic compounds are a major class of bioactive components and are becoming increasingly popular in the food industry because they improve the quality of food material (Celep et al. 2012). Phenolics are very unstable, reactive compounds and it has been previously reported that some degradation of phenolics will occur due to heat and oxidation during the baking process (Gupta et al. 2011). Additionally, it has been reported that naturally occurring bioactive compounds could behave differently during baking or thermal processing. The effects of thermal processing vary among bioactive compounds (Abdel-Aal and Rabalski, 2013). However, the primary objective of the present research was to observe an increase in phenolic content and antioxidant capacity in products with increased fruit concentration after baking. The total phenolic content and antioxidant capacity of cakes and cookies are presented in Figure 1. It was observed that these values were significantly ($p < 0.05$) affected by fruit concentration. Both phenolic content and antioxidant capacity increased with increasing fruit concentration. When the concentration of fruit was increased from 0% to 40% in cakes and to 20% in cookies, the phenolic content of cakes and cookies increased 279% and 116%, respectively. Moreover, the antioxidant capacity increased as well by 53% in cakes and 95% in cookies.

Color values of cakes and cookies are given in Table 1. As expected, brightness (L^* values) of both cakes and cookies were decreased with the increasing level of cherry laurel addition due to the dark color of the fruit. The decrease is statistically significant ($p < 0.05$) for all of the cakes. On the other hand, only the 20% fruit addition had a significant effect ($p < 0.05$) on the L^* values of cookies. A significant increase ($p < 0.05$) was noted in the a^* values of cakes with the increasing levels of cherry laurel. In contrast, there was a decrease in the a^* values of fruit-containing cookies when compared to that of the control cookies. The effect of the cherry laurel level on the b^* values of both cakes and cookies was statistically significant ($p < 0.05$). Higher levels of fruit caused a greater decrease in b^* values.

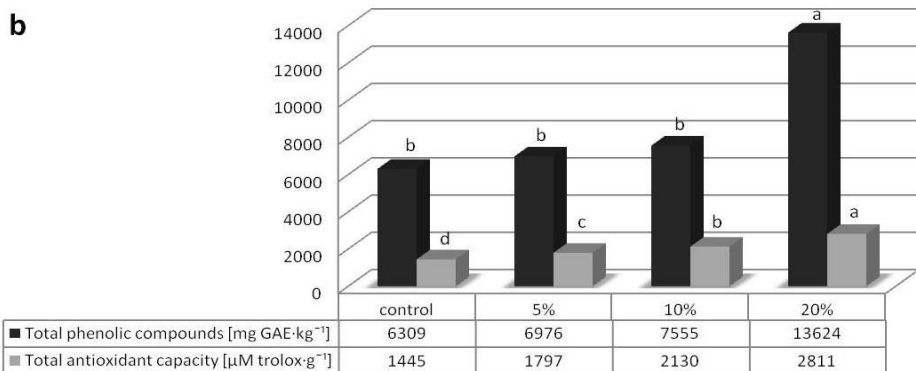
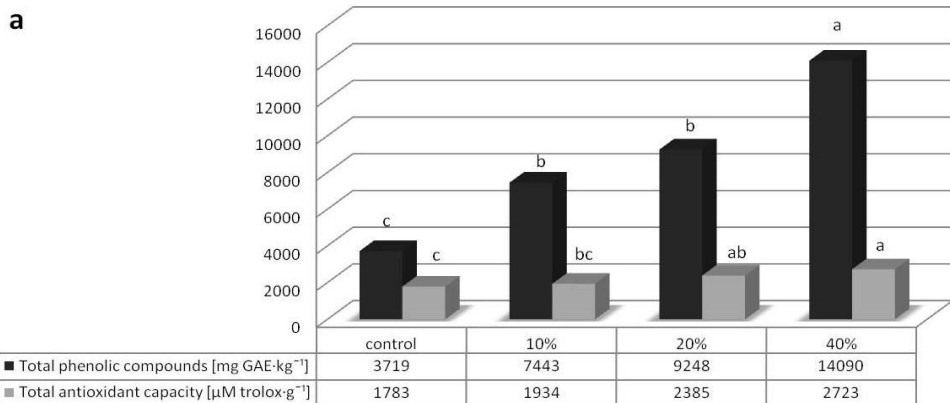


Fig. 1. Total phenolic compounds and antioxidant capacity of cakes (a) and cookies (b) containing different levels of cherry laurel fruit

Table 1. Color values of cakes and cookies

Cake (crumb color)	Control	10%	20%	40%
<i>L</i> [*]	71.08 ^a ± 0.70	66.54 ^{ab} ± 0.85	62.92 ^b ± 0.14	55.80 ^c ± 2.90
<i>a</i> [*]	-1.99 ^d ± 0.01	-0.34 ^c ± 0.22	0.43 ^b ± 0.09	1.55 ^a ± 0.24
<i>b</i> [*]	23.53 ^a ± 0.24	21.26 ^b ± 0.14	17.63 ^c ± 0.16	16.07 ^c ± 0.95
Cookie (surface color)	Control	5%	10%	20%
<i>L</i> [*]	54.20 ^a ± 0.91	52.86 ^a ± 0.59	50.92 ^a ± 0.95	42.98 ^b ± 0.87
<i>a</i> [*]	14.20 ^a ± 0.31	13.74 ^{ab} ± 0.12	12.93 ^b ± 0.33	12.80 ^b ± 0.37
<i>b</i> [*]	32.77 ^a ± 0.06	31.86 ^a ± 0.05	29.67 ^b ± 0.43	25.50 ^c ± 0.47

* Each value is expressed as mean ± standard error (n=5). Means with different superscript letter within a row were significantly different (p<0.05). Cakes and cookies were evaluated separately.

The resistance of cakes and cookies to an applied force was defined with different terms due to the small difference between the meanings of the two terms. Firmness represents the moderate resistance of a product to breaking. Hardness, on the other hand, is the substantial resistance of a product to deformation or breaking (Bourne, 2002). When the structure of a product is taken into consideration, it is logical to use firmness and hardness terms for cakes and cookies, respectively. Textural properties of baked products are shown in Figure 2. It was determined that the increase in cherry laurel fruit level in the formulation led to a significant ($p<0.05$) increase in the firmness of the cakes, probably due to the harder structure of the fruit when compared to the baked cake. Springiness is the ability of a product to return to its initial shape after the application of a force (Szczesniak, 1998). Cherry laurel fruit incorporation caused a substantial ($p<0.05$) decrease in the springiness of the cakes, especially at higher levels.

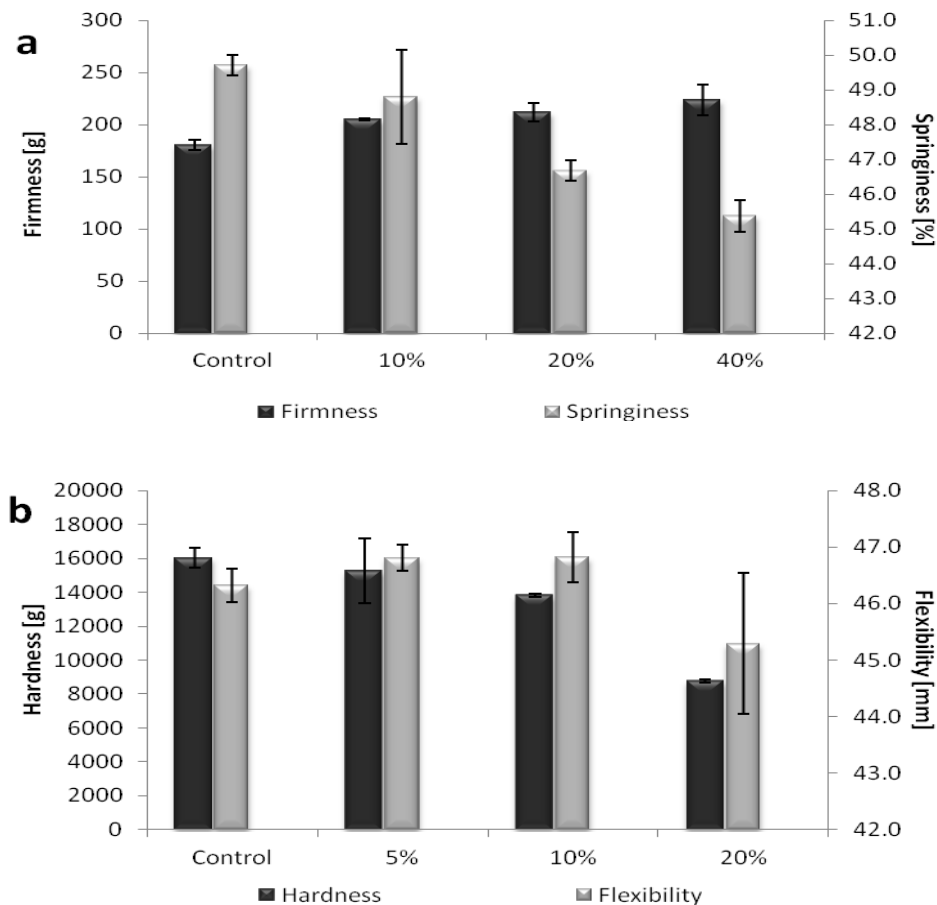


Fig. 2. Textural properties of cakes (a) and cookies (b) containing different levels of cherry laurel fruit (The bars represent the mean value of data, the error bars represent the standard error of the mean).

It was observed that the addition of cherry laurel fruit to the cookies resulted in decreased hardness values. However, it was not a significant decrease up to the 20% fruit level. The reason for the decrease is probably the moisture migration from fruits to cookies. Furthermore, it was determined that fruit addition had no significant ($p<0.05$) effect on the flexibility values of cookies.

The mean scores of a five-point scale sensory evaluation of cakes and cookies are shown in Table 2. According to the crude scores, cakes containing 40% cherry laurel were superior in terms of individual sensory properties, except for texture. However, statistical analysis showed that fruit addition did not affect the texture or cross-sectional area significantly ($p<0.05$). In addition, there were no significant differences between the appearance scores of cakes up to 40% cherry laurel level. It was observed that fruit level (10, 20, and 40%) did not have a significant effect on taste. The taste of the control cake, on the other hand, was significantly ($p<0.05$) different from the fruit-containing cakes, with a lower score. Overall, the sensory appreciation scores of cakes made with 20% and 40% cherry laurel were significantly ($p<0.05$) higher than the other formulations. Although there were no significant differences between the cookie samples, the sensory scores of fruit-added cookies were higher when the fruit level increased. The sensory evaluation results pointed out that there were no negative effects of cherry laurel on the sensory properties of both cakes and cookies. Owing to the fact that consumer acceptance/liking is the most important factor for developing a novel formulation, it could be said that the use of dried cherry laurel fruit in the production of cakes and cookies was satisfactory. Pictures of the products are shown in Figure 3.

Table 2. Sensory scores of cakes and cookies

Cake	Control	10%	20%	40%
Appearance	4.00 ^b ± 0.00	3.50 ^b ± 0.25	4.00 ^b ± 0.25	4.75 ^a ± 0.00
Texture	4.38 ^a ± 0.13	4.38 ^a ± 0.13	4.38 ^a ± 0.13	3.88 ^a ± 0.13
Taste	3.75 ^b ± 0.00	4.25 ^a ± 0.00	4.38 ^a ± 0.13	4.50 ^a ± 0.00
Cross sectional area	3.85 ^a ± 0.16	4.03 ^a ± 0.03	4.19 ^a ± 0.19	4.63 ^a ± 0.32
Overall appreciation	3.75 ^b ± 0.00	3.88 ^b ± 0.13	4.33 ^a ± 0.08	4.63 ^a ± 0.13
Cookie	Control	5%	10%	20%
Appearance	3.00 ^a ± 0.22	4.00 ^a ± 0.31	3.86 ^a ± 0.14	3.71 ^a ± 0.52
Texture	3.14 ^a ± 0.60	3.86 ^a ± 0.34	3.71 ^a ± 0.18	4.29 ^a ± 0.286
Taste	3.71 ^a ± 0.29	3.71 ^a ± 0.29	3.71 ^a ± 0.18	4.14 ^a ± 0.34
Overall appreciation	3.43 ^a ± 0.37	3.71 ^a ± 0.36	3.71 ^a ± 0.18	4.00 ^a ± 0.31

* Each value is expressed as mean ± standard error (n=7). Means within a row with different superscript letter were significantly different ($p<0.05$). Cakes and cookies were evaluated separately.

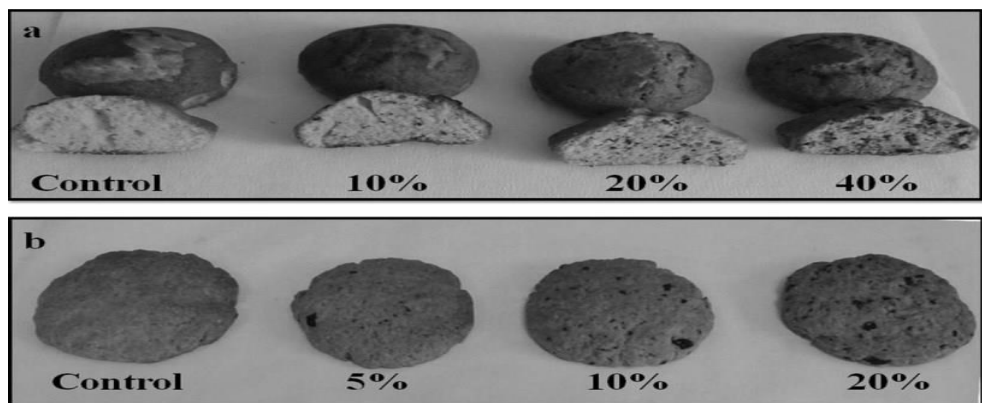


Fig. 3. Appearance of cakes (a) and cookies (b) made of cherry laurel fruit incorporation (Percentages below the pictures represent the level of cherry laurel)

Conclusions

Consequently, consumer awareness of the functional characteristics of the food products is increasing. Therefore, the functional food market is growing worldwide. The main aim of this study was to utilize cherry laurel fruit in bakery products due to its nutritional characteristics and to develop a novel functional food product. For this purpose, coarse milled fruits of cherry laurel were incorporated into cakes and cookies at different levels and some quality characteristics (total phenolic content, antioxidant capacity, color, texture and sensory properties) of these products were investigated. This study showed that all of the quality characteristics were significantly ($p < 0.05$) affected by the incorporation of fruit at different levels. The total phenolic content and antioxidant capacity of cakes and cookies were increased with increasing fruit levels. According to the color values, it was observed that increasing the level of cherry laurel resulted in a darker, redder, and less yellow cake crumb. Unlike the cakes, cookies with added cherry laurel became less red, and while the firmness of the cakes increased, the hardness of cookies decreased with increasing fruit levels. Cakes and cookies with higher fruit concentrations had higher preference levels for sensorial attributes.

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