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Determination of the production process and some quality properties of Biga cheese dessert

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Abstract

Biga cheese dessert, a traditional dessert in Biga county of Çanakkale province in Turkey, is a semi-finished product prepared by kneading daily fresh salt-free cheese produced using the milk obtained from Biga, eggs, flour, a small amount of high-quality semolina (optional), baking powder and water properly and shaping the dough and baking it in the oven until its top surface turns to golden brown. Sugar syrup is added to the dessert before serving for consumption. Up until today, there has been no study conducted on Biga cheese dessert. Accordingly, this study aimed to determine the dessert's production process and its quality properties. In this study, non-syruped Biga cheese dessert dough formulation and production flow chart were revealed via personal communications and on-site examination of the commercial processes. Various physico-chemical analyses (color, dimensions, weight, moisture, ash, protein, total fat, acidity in extracted fat, peroxide number, water activity, pH) and sensory evaluation were also performed in 27 packages produced in different months by three different manufacturers of double-baked Biga cheese dessert. Based on the results, statistically significant differences were observed among the productions of different manufacturers for all parameters examined except for acidity (%), water activity, and sensory evaluation. Scores received in consumer testing with untrained panelists indicate that Biga cheese dessert has the potential to be consumed by a wider population, particularly in Turkey. This study may also contribute to receiving a geographical indication certificate for this dessert.

Key words: Biga cheese dessert, cheese-based traditional Turkish dessert, geographical origin, physico-chemical analysis, sensory evaluation

Introduction

Traditional food products are usually known by the name of the region they originate and gain their properties from the knowledge, skills, methods, and techniques developed from that specific region (Çandır, 2010). Since traditional products are usually produced in small quantities, they are typically marketed only within those regions. Traditional food products have the potential to create regional employment, increase the income of the local people, and support the development of the region. Traditional products in a region can also contribute to the economic development of the entire country. However, this may require updating traditional production techniques and improving quality standards (Kuşat, 2012). Biga cheese dessert has been produced in Biga county of Çanakkale province, Turkey, since the 1950s. Back in history, the dough of the dessert was made using daily fresh salt-free cheese, flour, eggs, baking powder, water, and a small amount of high-quality semolina. Then, the dessert was cut and shaped by hand and baked in a wood fire in bread ovens and was sold in a wheelbarrow only in Biga. Two different companies producing Biga cheese dessert in the region have pioneered the dessert until today.

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Currently, three local manufacturers are producing the dessert commercially, all of which are located in Biga. The dessert is currently sold in packages as cooked and ready to be syruped, and therefore it can be defined as a semi-finished product. Biga cheese dessert has similarities with some other Turkish traditional desserts such as Kemalpaşa and Hayrabolu desserts. However, they vary in the raw materials used, process flow, and the final shape of the dessert. Biga cheese dessert is round in shape, similar to Kemalpaşa dessert, but it is larger than Kemalpaşa and smaller than Hayrabolu dessert. The cheese dessert is unique to Biga and is made from fresh cheese produced daily from the milk collected from the Biga. No preservatives are used in its production. While a great amount of semolina is used in the production of Kemalpaşa and Hayrabolu dessert, very little or no semolina is included in Biga cheese dessert formulation.

As the importance of traditional products in local development increases day by day, it is known that there are insufficient numbers of field studies on the protection of traditional products and the construction of the traditional product legislation in Turkey. Additionally, the geographical indications are not utilized effectively, and the provisions regarding the foods specific to Turkey remain inadequate (Altuntaş & Gülçubuk, 2014). Similarly, there has been no study on Biga cheese dessert in the literature yet. However, a small number of studies related to similar desserts such as Kemalpaşa and Hayrabolu desserts, höşmerim and künefe are available in the literature (Akpınar et al., 2009; Akpınar et al., 2010; Cengiz, 2006; Çakır et al., 2017; Çakır & Çakır, 2010; Seçim &and Uçar, 2017; Seçim & Uçar, 2018; Uçurum et al., 2016).

Overall, Biga cheese dessert is different from other syruped desserts produced in Turkey. Therefore, it is necessary to determine the quality criteria and to ensure standard production. In order to obtain a standard quality product, the specific quality characteristics of the dessert should be determined, and the raw materials used in the traditional production of Biga cheese dessert should be clearly stated. Changes in quality are manifested by negative changes in flavor, color, texture, and nutritional value. The color and aroma of baked products also depend on the type of flour included in the dough formula (Göncü, 2011), with Maillard reaction having a great impact on the baked products' color and flavor. This product has the potential to obtain geographical indication and, if accomplished, it will have a positive impact on the economic activities of the Biga. By determining the quality criteria of Biga cheese dessert, the situations that may cause unfair competition are expected to be minimized, and it will also contribute to the increase of trust between producers and consumers. The overall aim of this study was to contribute to the promotion of Biga cheese dessert and to encourage its transition to industrial-scale production. Determination of the production stages and the desserts' specific properties through some physicochemical analyses and sensory evaluation were also aimed.

Materials and Methods

Samples

The dessert samples produced by three different manufacturers in Biga were the material of the research (Figure 1). Double-baked Biga cheese desserts without syrup produced in three different times (August, October & December 2017) were purchased from three different manufacturers sold in Biga. The desserts were coded as X, Y, and Z for color, dimension, weight, and sensory analyses, and the samples were used as pieces. For the other physico-chemical parameters, the samples were ground, homogenized, and then utilized in further analyses. Packages, taken from the same company in different months, were evaluated as the replications. To elucidate the production process and the raw materials used, the manufacturers currently producing this dessert and the people who have been involved in the production of the dessert since the 1950s were contacted. Accordingly, the raw materials and process flow were established.

Figure 1. A picture of double-baked unsyruped Biga cheese dessert

Determination of Traditional Production Process of Biga Cheese Dessert

In the first stage of this study, it was aimed to determine the production style of non-syruped Biga cheese dessert. For this purpose, the pioneering people in the region and their families involved in the production of the dessert were contacted, and the manufacturers producing commercial Biga cheese desserts were examined on-site. It was learned that one of the manufacturers producing Biga cheese dessert did not use semolina in the early days, and they started to use a limited amount of semolina in the dough composition afterward. Overall, approximate ratios of the five ingredients used in the production of Biga cheese dessert are shown in Table 1. The cheese used by all three manufacturers for Biga cheese dessert production was produced daily by manufacturers and used without salt addition. At least 3% fat containing raw milk obtained specifically from the Biga region was used in cheese production after pasteurization. High-quality pastry flour was also used in the formulation. Water in the dough composition was the city water of the Biga. Besides, sodium bicarbonate and large size eggs obtained from Biga were utilized in production.

Table 1. Mixing ratios of raw materials used in Biga cheese dessert formulation

Ingredient	Ratio (%, m/m)
Unsalted Biga cheese	42
Flour and/or semolina	31
Water	18
Egg	8
Sodium Bicarbonate	1

This study also determined that Biga cheese dessert production consisted of 11 steps in total, as illustrated in Figure 2. Raw milk containing a minimum of 3% milkfat is obtained from the

Biga and then pasteurized at below 100 °C. When the hot milk cools down to the temperature around 35°C, it is coagulated by rennet and left for 90 minutes. Then, the curd is obtained by breaking and pressing. Incoming milk is usually turned into curd in about 4-5 hours. The unsalted curd obtained on the same day is filtered, then the cheese is ground in the grinding machine and mixed with all the other ingredients in the dough kneading kettle. Kneaded dough is taken into oven trays after giving their shapes by automatic machines. It is then cooked in a steam oven at 280°C for 20 minutes and in a conventional oven at 180°C for 45 minutes, cooled, packaged in polyethylene packages, and becomes ready to be sold as non-syruped Biga cheese dessert on the local markets. Baking in the steam oven only or subsequent conventional oven as well depends on the desired shelf-life of the desserts. If the desserts are sold in the nearby region and consumed rapidly, it is usually produced by cooking in the steam oven only. In contrast, it is cooked in steam and conventional oven if the desserts are expected to be shipped to far provinces and sit on the market shelf for longer periods. The restaurants in Biga are known to prefer single-cooked desserts due to their superior quality.

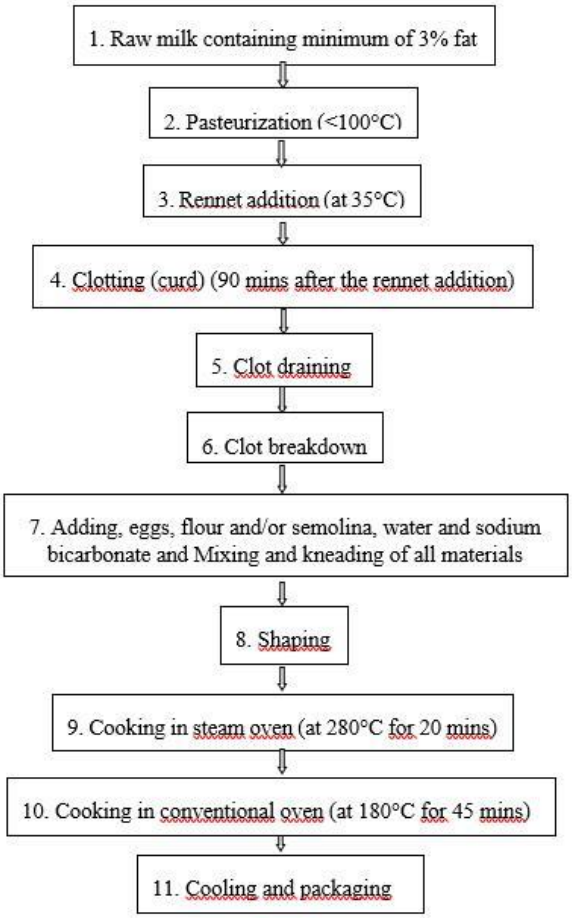

Figure 2. Production flow chart of Biga cheese dessert

Methods

Physico-chemical Analyses

Apart from the sensory evaluation, all other analyses were performed on the unsyruped Biga dessert samples. On the other hand, a sensory evaluation was carried out in the desserts after syrup addition.

Color Determination

A colorimeter (Minolta Chroma Meter, Model CR-400, Minolta Company, Osaka, Japan) was used to measure the desserts' color parameters. According to the CIE universe, L* (whiteness-blackness), a* (redness-greenness), and b* (yellowness-blueness) values of the products were determined. For each month, measurements were taken from different sides (top, side, bottom) of 10 unsyruped dessert samples, and the averages of the measurements were given separately.

Dimension and Weight Determination

Electronic digital caliper (Mitutoya 500 - 181U CE, CD-15 CP, England) was used to measure the samples' diameter and thickness, and the results were given in "mm". The samples were weighed using an analytical balance (RADWAG - Model AS 220.R2, Poland), and the results are given in "g". Diameter, thickness, and weight measurements were taken for each month of 10 samples from each manufacturer, and the averages of the measurements were given separately.

Moisture Content

The gravimetric method was used for moisture content analysis (ISO, 2008) using an oven (Electro-mag M420 P, Turkey). Drying vessels, washed with distilled water, were dried at 105±5°C in the oven. The dried containers were cooled in a desiccator, weighed, about 5 g of homogeneous dessert sample was added to the containers and placed again in the oven at 105±5°C. After about 4 hours, the samples were taken in the desiccator, cooled, and weighed. The process was continued to ensure that the difference in weighing results reached a maximum of 0.5 mg. Moisture content (%) was calculated using the associated formula given in the method.

Ash Content

Ash analysis was performed according to AOAC (2000). Clean glass crucibles were kept in the furnace at 550±10ºC (Nüve MF120, Turkey) for 30 minutes, cooled in a desiccator, and weighed. Approximately 3 grams of the ground sample was put into the crucible. The samples were soaked with pure ethanol and burnt on the front cover of the oven. Then, the oven temperature was gradually increased, and the samples were burnt at 550±10°C until they turned to white in color. Completely burnt samples were cooled to room temperature in a desiccator and weighed. Ash content (%) was calculated using the associated formula given in the method.

Protein Content

The samples' protein content was determined using the automatic protein analyzer (Thermo Scientific -Flash 4000, Germany) based on the combustion principle (AOAC (2006)). The sample was burned with the application of pure oxygen (99.9%) at elevated temperatures (850-950±10°C), the nitrogen was measured by thermal conductivity, and finally the nitrogen content was converted to protein content with the conversion factor of 6.25. In the analysis, EDTA (Ethylene diamine tetra acetic acid) was used as a standard substance.

Total Fat Content and Acidity in Extracted Fat

The samples' fat analysis was carried out according to oil seeds and oil content determination standard of TS EN ISO 659 (TS, 2010a). The Soxhlet apparatus (IKA-HB10, Turkey) and a water bath (IKA-RV8, Turkey) were used in the analysis.

Three grams of the sample was weighed into a cartridge, and the cartridge was sealed with oil-free cotton. The samples with the cartridge were dried in the oven for 15-30 minutes at 100±5°C. 150 mL petroleum ether (40-65°C) was added to the cartridge with dried samples, and the oil was extracted for 3-4 hours. At the end of this period, the round bottom flask was removed, and the petroleum ether (boiling point 40-80°C) was evaporated in the water bath. The flask was left in the hot, ventilated oven for about half an hour to remove all the petroleum ether. Finally, the flask was cooled, weighed, and the total fat content was calculated according to the associated formula given in the method.

According to biscuit standard TS 2383 (TS, 2017a), acidity in extracted fat was performed using the fat extracted as described above. Fifty mL of a benzene-alcohol-phenolphthalein (BAP) mixture (1 L of distilled benzene, 1 L of 95% ethyl alcohol, and 0.4 g of phenolphthalein) was added to the flask and titrated with 0.05 M potassium hydroxide solution with a micro burette until pink color appeared. If turbidity was observed during the titration step, titration was continued by adding another 50 mL of the BAP mixture. A further experiment was carried out with 50 mL of the BAP mixture without the sample as blank. The value obtained from the blank test was subtracted from the values calculated for the samples. The calculations of acidity in extracted fat content were done according to the associated formula given in the method.

Peroxide Value Determination

This analysis was performed according to TS EN ISO 3960 (TS, 2010b) determination of peroxide number in animal-vegetable fats and oils. The Soxhlet apparatus (IKA-HB10, Turkey) and a water bath (IKA-RV8, Turkey) were used in the analysis. Two hundred mL of solvent n-hexane was added onto approximately 100 g of the ground sample and stirred for one hour on a magnetic stirrer. At the end of this period, the solvent was filtered with filter paper. The oil-solvent mixture was boiled for 10 minutes at the Soxhlet device. Thus, the solvent was collected in the Soxhlet flask. It was then left again in the water bath at 80±5 °C for 30 minutes to remove any remaining solvent. Five g of the obtained oil was weighed into an Erlenmeyer. As soon as 10 mL of chloroform was added, the Erlenmeyer was shaken rapidly, and the oil dissolved. Then, 15 mL of acetic acid (with ice) and 1 mL of saturated potassium iodine solution were added. The mouth of the Erlenmeyer was closed and shaken for 1 minute. After standing for 5-10 minutes in the dark at room temperature, 75 mL of pure water, and 1 mL of 1% solution of the gelatinized starch were added. When the color change occurred (greyed out), it was titrated with sodium thiosulfate ($Na_2S_2O_3$; 0.01 N) solution. Calculations were made according to the associated formula given in the method.

Water Activity and pH Determination

The desserts' water activity was measured using a water activity meter (Novasina Lab Master, Novasina AG, Lanchen, Switzerland). The pH meter (Mettler Toledo Seven Compact pH / Ion S220, Mettler-Toledo, Switzerland) was used to measure pH. One hundred ml distilled water was mixed with 5 g ground Biga cheese dessert, and pH was measured at room temperature (AOAC, 1990).

Sensory Evaluation

A consumer test was performed for sensory evaluation of the Biga cheese dessert. For this purpose, the same sugar-water mixture ratio was added to the desserts, prepared in the same environment, and presented to consumers within the same day. Hedonic scales between 1 and 9 (1 the least, 9 the most liked) were used to determine the flavor, acceptability, and quality parameters (Romero-Lopez et al., 2011). The male-female distribution of the participants was 50-50%. Scores were received in consumer testing with untrained panelists. The samples were randomly numbered with 3-digit numbers and presented to consumers in each session. The samples were evaluated by 66 consumers regarding the appearance/color, taste/smell, and texture. Also, the type of female/male likings was obtained. The untrained panelists were offered one of the desserts from each company on the same plate, and water was used to neutralize the panelists' mouths.

Statistical Analysis

Statistical analyses were performed using the SPSS program (Version 23, IBM Ltd., IL, USA). The samples of Biga cheese desserts were tested for normality. The groups' difference was analyzed by one-way analysis of variance (ANOVA), and the specific differences among the groups were analyzed using Tukey's post-hoc test at a 95% confidence interval. The effect of gender and age parameters of the sensory evaluation was determined by Chi-Square analysis. Alpha was calculated according to the 95% error margin.

Results and Discussion

Physico-chemical Analysis Results

Color Determination

The color characteristics of food is an important sensory parameter in consumer preference. Average L*, a*, and b* values of the manufacturers are summarized in Table 2. In this study, it was found that L*, a*, and b* values of the samples taken from three manufacturers were statistically different from each other ($p < 0.05$). L*, a*, and b* values of the samples were found to be in the range of 57.00-69.06, 8.69-13.64, and 34.61-39.23, respectively. When all the manufacturers (X, Y, and Z) included, the average L*, a*, and b* values of the dessert were 62.81±7.85, 11.02±2.82, and 37.01±2.84, respectively. The highest lightness and yellowness values were observed in manufacturer Y's desserts, while the desserts of manufacturer X contained the highest redness. The factors that cause color differences among the products could be the type of oven, cooking style, and raw materials (cheese, eggs, flour, raising agents, and such). Changes in the food's physical and chemical structure during cooking lead to changes in the final color of the product. During the product's cooking, color, structural properties, taste, smell, optical properties, moisture content, dimensions, and nutritional value changes. In this study, it was found that products belonging to the company X were both the darkest and the highest in protein content, indicating the effect of Maillard reaction on color. This was in agreement with the study by Meral & Doğan (2006), who associated the dark crust color of their soy bread with high protein content and, therefore, the Maillard reaction. In this study, it is thought that the amount of curd is another factor contributing to the color change. Similarly, Uçurum et al. (2016) stated that the cheese used as a raw material in another traditional Turkish dessert, Kemalpaşa dessert, had a significant effect on quality contributing to the weight and

color changes of the product. Additionally, factors affecting the color of cheese used, such as milk type, composition, production method, proteolysis level, ripening level, salt distribution, microbial flora-related changes, and seasonal effects on milk components, can be considered (Doğan, 2018). The eggs in Biga cheese dessert are used in a considerable amount. Eggs are used to improve color in bakery products, and color changes may occur due to carotenoids in the eggs. Eggs give a golden-brown color to the crust in bakery products (Akpınar et al., 2010). Besides enhancing the nutritional value of the final product, egg yolk in dough products, especially in the products in which yellow color is preferred, such as pasta and noodles, give color to the final product. In contrast, egg white provides texture to the product. In addition, it changes the physical and sensory properties of the product (Özen, 2006).

Sodium bicarbonates are salts of fully ionizing carbonic acid (HCO_3) and one of the most used food additives in both industrial and homemade food for many years. Sodium bicarbonate used in the Biga cheese dessert may affect the color of the product based on the findings of Taş et al. (2016). They reported that they produce darker color biscuits as they added more raising agents.

Table 2. Average and standard deviation values of L*, a*, and b*

Parameter	Manufacturer	Average ± Standard Deviation[1]
L*	X	57.00±6.31[a]
	Y	69.06±7.02[b]
	Z	62.37±4.82[c]
	Average L*	**62.81±7.85**
a*	X	13.64±1.04[a]
	Y	8.69±2.56[b]
	Z	10.74±1.96[c]
	Average a*	**11.02±2.82**
b*	X	34.61±3.16[a]
	Y	39.23±2.62[b]
	Z	37.18±2.72[c]
	Average b*	**37.01±2.84**

[1] Different lower-case letters indicate the statistical difference among the manufacturers ($p<0.05$)

Dimension and Weight Determination

The average diameter, thickness, and weight of one Biga cheese dessert produced by the different manufacturers are given in Table 3. The average diameter, thickness, and average weight of one Biga cheese dessert were 36.08 ± 2.56 mm, 22.43 ± 2.48 mm, and 6.03 ± 0.15 g, respectively. There was a statistical difference in the diameter of the desserts produced by different manufacturers ($p<0.05$). This variation in the dimension could be attributed to raising agents used in the formulation. Taş (2016) reported that the raising agents used in the formulation affected the diameters of the biscuit samples, and there was a positive relationship between the proportion of the raising agents and the diameter of the product. According to the comparison of thickness measurements, it was found that there was a statistically significant difference between X and the other two manufacturers (Y and Z) ($p <0.05$), but there was no difference between Y and Z themselves ($p> 0.05$). When the weight of an average one Biga cheese dessert was examined, it was found that the manufacturers Z's desserts were statistically heavier than the desserts of the company X and Y, with the average weight of the desserts ranging from 5.86 g to 6.36 g. Cronin & Preis (2000) reported in their study that the process of converting viscoelastic dough into a solid baked product during cooking and the ingredients in the formulation affected their biscuits' dimensions (diameter and thickness) and weight. Biga cheese dessert and two other Turkish traditional desserts, namely Kemalpaşa and Hayrabolu dessert, show similarities in appearance. However, the raw material, shape, and production stages among the desserts vary. Biga cheese dessert is round in shape, similar to Kemalpaşa dessert, but it is larger than Kemalpaşa dessert and smaller than Hayrabolu dessert. In a study measuring Kemalpaşa dessert's diameter in the literature, it was reported that the diameters of Kemalpaşa desserts ranging from 14.98 to 24.89 mm (Akpınar et al., 2010). These values of Kemalpaşa dessert were found to be smaller than Biga cheese desserts, which were determined to have diameters between 33.62 and 38.13 mm in this study.

Table 3. Average and standard deviation values of dimension (diameter, thickness) and weight

Parameter	Manufacturer	Average ± Standard Deviation[1]
Diameter (mm)	X	36.48 ± 1.43^{a}
	Y	33.62 ± 1.10^{b}
	Z	38.13 ± 2.47^{c}
	Average	**36.08±2.56**
Thickness (mm)	X	23.93 ± 1.82^{a}
	Y	21.74 ± 3.06^{b}
	Z	21.62 ± 2.57^{b}
	Average	**22.43±2.48**
Weight per Piece (gr)	X	5.88 ± 0.05^{a}
	Y	5.86 ± 0.19^{a}
	Z	6.34 ± 0.22^{b}
	Average	**6.03±0.15**

[1] Different lower-case letters indicate the statistical difference among the manufacturers ($p<0.05$)

Chemical Analyses

Results of chemical analyses for Biga cheese dessert are summarized in Table 4. Accordingly, the average moisture content of Biga cheese dessert was between 7.05-8.48%. When the samples' moisture contents taken from different manufacturers were compared, it was found that there was a statistically significant difference between the moisture contents of the X and Y ($p <0.05$). However, Z's statistical difference with the other two groups was not significant ($p> 0.05$). According to TS 13470 (non-syruped dough desserts standards), the moisture content of the various desserts should be at least 12% (m/m) (Biga cheese dessert is not included in the standard yet). Biga cheese dessert had moisture levels lower than the 12% specified in the standard. In a similar study on Kemalpaşa dessert, which has similar characteristics to Biga cheese dessert, desserts' moisture content was determined as 10% (Akpınar et al., 2010). Cronin & Preis (2000) stated that the process of converting viscoelastic dough into a solid baked product and temperature fluctuations in the oven affected the moisture content of the biscuit.

The ash content of the desserts varied between 2.40 and 2.86% (Table 4). While there was no statistically significant difference between the ash amounts of X and Z ($p> 0.05$), it was found that the ash contents of Y were significantly lower than the other two groups ($p <0.05$). Our results on ash content were similar to Akpınar et al. (2010), who reported similar ash levels (3%) on the Kemalpaşa dessert but higher than those of Höşmerim desserts (1.10% by Seçim & Uçar, 2018 and 1.09-1.75% by Cengiz, 2006).

The desserts' protein content was found to be between 19.46 and 22.36% (Table 4). There was no statistically significant difference between Y and Z ($p> 0.05$). However, X's products contained a significantly higher protein content than those of the Y and Z samples. These results were in agreement with Uçurum et al. (2016). They reported the protein content of 15.21-28.8% in Kemalpaşa dessert, while higher than 9.40% protein in Kemalpaşa dessert by Akpınar et al. (2009) and 7.21-9.09% protein level in Höşmerim by Cengiz (2006). The quantity and quality of eggs, cheese, and flour (and/or semolina) used in the production of Biga cheese dessert could be effective in the protein content of the Biga cheese dessert. Brennan & Samyue (2004) mentioned that the flour, oil, water levels, and cooking parameters affect the protein and biochemical and physicochemical reactions that occur during cooking (water evaporation, protein denaturation, and Maillard reaction) and alters the product quality.

Fat is an important component in terms of the physical functions of the product, affecting the flavor and nutritional value of foods. When the fat contents of the samples were examined, they varied between 11.01 and 16.76%, and the difference among the total fat contents of X, Y, and Z was found to be statistically significant ($p <0.05$). Similarly, Uçurum et al. (2016) determined the total fat content of Kemalpaşa dessert as between 6.96-24.08%, and Akpınar et al. (2009) reported the fat content of Kemalpaşa cheese desserts as 15.7%. Although it is not currently included in this standard TS 13470 (TS, 2017b), Biga cheese dessert samples were found to be generally in accordance with this standard in terms of oil content. Çağlar & Çağlar (2013) stated that the fat content of cheese varies depending on the fat content of the milk to be processed. This may cause the fat ratio of Biga cheese dessert to fluctuate in some seasons, depending on the change in the cheese's fat ratios.

There was no statistically significant difference between the samples' total acidity taken from the manufacturers ($p> 0.05$). The Biga cheese dessert samples' total acidity levels were found in the range of 0.39 - 0.52% (%, as oleic acid). Uçurum et al. (2016) found the total acidity of Kemalpaşa desserts in the range of 0.83- 1.21%, and Seçim and Uçar (2018) reported 0.79% in Höşmerim desserts made by cheese from cow's milk. According to the results of the pH analysis of the samples, company X produced desserts with a statistically low pH value compared to the products of the company Y and Z. In the pH determination, the lowest value was determined as pH 7.54 (company X), and the highest value was determined as pH 7.65 (company Y). These results were found to be higher than the literature reporting pH values of 4,97 (Seçim &Uçar, 2018) and 5,60-5,86 of Höşmerim (Cengiz, 2006).

Foods are divided into three groups based on their water activity levels as high (a_w 0.90-1.00), medium (a_w 0.60-0.90), and low (a_w<0.60), and microbiological activities are minimized in foods below 0.60. In this study, it was observed that the a_w values of the desserts analyzed were between 0.46 and 0.51, and there was no statistically significant difference between the Y and Z companies in terms of a_w ($p > 0.05$). The low a_w values of the Biga cheese dessert samples also indicate that they can withstand a long period under suitable storage conditions without preservatives.

The number of peroxides in fats is measured by the amount of active oxygen, which is milliequivalent grams of active oxygen in 1 kg of fat. It gives an idea about the number of peroxides in the oil, the degree of oil degradation, and the product's shelf life. Peroxide values of Biga cheese dessert samples were less than 1 meq active oxygen/kg fat for all the products. Uçurum et al. (2016) reported a remarkably higher peroxide number in their study (4.97-6.57 meq active oxygen/kg fat). This could be attributed to the fact that Biga cheese dessert samples were collected directly from the manufacturers on the manufacturing day while Kemalpaşa desserts were offered for sale in the market and sampled a while later.

Table 4. Results of chemical analyses of Biga cheese desserts

Parameter	Manufacturer	Average ± Standard Deviation[1]
Moisture (%)	X	7.05 ± 0.58^{a}
	Y	8.48 ± 0.69^{b}
	Z	7.67 ± 1.36^{ab}
	Average	**7.73±1.08**
Ash (%)	X	2.86 ± 0.06^{a}
	Y	2.40 ± 0.02^{b}
	Z	2.86 ± 0.06^{a}
	Average	**2.70±0.22**
Protein (%)	X	22.36 ± 0.72^{a}
	Y	20.13 ± 1.05^{b}
	Z	19.46 ± 0.66^{b}
	Average	**20.65±1.49**
Total Fat (%)	X	14.75 ± 2.09^{a}
	Y	11.01 ± 1.08^{b}
	Z	16.76 ± 0.48^{c}
	Average	**14.17±2.76**
Total Acidity (%, as oleic acid)	X	0.39 ± 0.02^{a}
	Y	0.52 ± 0.18^{a}
	Z	0.40 ± 0.06^{a}
	Average	**0.44±0.12**
pH	X	7.54 ± 0.02^{a}
	Y	7.65 ± 0.03^{b}
	Z	7.62 ± 0.02^{b}
	Average	**7.60±0.05**
Water Activity	X	0.46 ± 0.01^{a}
	Y	0.51 ± 0.03^{b}
	Z	0.50 ± 0.00^{b}
	Average	**0.49±0.02**

[1] Different lower-case letters indicate the statistical difference among the manufacturers ($p<0.05$)

Sensory Evaluation

The untrained panelists who participated in the sensory evaluation were asked to evaluate the sample groups' appearance/color, texture, and taste/odor characteristics. Consumer test results obtained from 66 consumers consisting of 33 females and 33 males in the 24-50 age range are shown in Table 5. In terms of appearance/color, texture/texture, and taste/smell, the panelists did not observe a statistically significant difference between the Biga cheese desserts of the manufacturers X, Y, and Z ($p > 0.05$). Although a statistically significant difference among X, Y, and Z was not detected for appearance/color, texture/texture, and taste/odor

characteristics, Biga cheese dessert produced by X company always received higher average scores of sensory evaluations. The panelists stated that they felt intense milk or cheese flavor in the desserts.

The effect of gender on sensory analysis results was also investigated. No correlation was found between gender and appearance, texture, and taste parameters for any desserts ($p>0.05$). In this study, the relationship between consumers' age and the sensory evaluation of the products was examined, and no correlation was found ($p>0.05$).

The cheese used in Biga cheese dessert is obtained from the milk of the animals grown in the rich geographical climate of Biga. The high level of cheese in the dessert has a positive effect on the dessert's unique flavor, similar to Ezine cheese, where the geographical environment provided by Mount Ida has a significant effect on its properties. Kemalpaşa cheese dessert showing similar characteristics to Biga cheese dessert has a distinguishing feature of using cow's milk collected from Mustafa Kemalpaşa county borders in making unsalted cheese according to its geographical registration certificate.

As a result of the consumer test, most panelists stated that the desserts' physical properties were important because of their visual impact. These semi-finished products are bright-amber brown, round-convex with fresh, intense cheese taste and not pale. Some of the panelists stated that this dessert could be an export product. The high scores given by the panelists indicate that Biga cheese dessert is compatible with Turkish taste. The dessert was found to be similar to Kemalpaşa dessert by the panelists. However, dimension, flavor, color, and the content are different from Kemalpasa dessert, and Biga cheese dessert can be served by adding tahini or cream during the service for consumption.

Table 5. The scores of sensory evaluations (n=66)

Parameter	Manufacturer	Average ± Standard Deviation[1]
Appearance/Color	X	6.35±2.15[a]
	Y	5.95±1.96[a]
	Z	5.86±1.96[a]
	Average	**6.06±2.03**
Texture	X	6.65±1.99[a]
	Y	5.86±2.10[a]
	Z	5.95±2.00[a]
	Average	**6.16±2.05**
Taste/Odor	X	6.42±2.17[a]
	Y	6.00±2.24[a]
	Z	5,89±2.22[a]
	Average	**6.10±2.21**

[1] Different lower-case letters indicate the statistical difference among the manufacturers ($p<0.05$)

Conclusion

In this study, the ingredients used and process flow followed in commercial Biga cheese dessert production were introduced. Some physico-chemical analyses and sensory evaluation of commercial desserts sold on Biga's local market were also performed. Various physico-chemical parameters (color, dimension, weight, moisture, ash, protein, total fat, the acidity of extracted oil, peroxide number, water activity, and pH) of non-syruped Biga cheese dessert and sensory evaluation upon syrup addition for the desserts obtained from 3 different manufacturers in Biga were conducted. According to the analysis results, statistically significant differences were observed among manufacturers' production for all parameters examined except acidity (%), water activity, and sensory evaluation. The panelists' high scores in sensory evaluation indicate that Biga cheese dessert can be consumed by a wider consumer, especially in Turkey. Biga cheese dessert, a traditional local dessert that is loved and consumed in the Çanakkale province and offered in almost all restaurants, is a nutritious product, especially in terms of protein and mineral content. The dessert has the potential to have geographic sign registration and to be an export product for Turkey.

Author Contributions

Aynur Aslan: Validation, Resources, Writing - Original Draft
Gülgün Yıldız Tiryaki: Conceptualization, Supervision
Zayde Ayvaz: Formal analysis, Writing - Review & Editing
Hüseyin Ayvaz: Validation, Supervision, Visualization, Project administration, Writing - Original Draft

Conflict of Interest

The authors declare that there is no conflict of interest.

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