Avrupa Bilim ve Teknoloji Dergisi
Sayı 53, S. 64-70, Ocak 2024

Araştırma Makalesi

www.ejosat.com ISSN:2148-2683

European Journal of Science and Technology
No. 53, pp. 64-70, January 2024

Research Article

Stevia ile Tatlandırılmış Meyveli Dondurmanın Kalitesi*

Feray İnci Maden[1†], Salih Özdemir[1]

[1] Atatürk Üniversitesi, Ziraat Fakültesi, Gıda Mühendisliği Bölümü, Erzurum, Türkiye, (ORCID: 0009-0005-3949-9747), maden.feray@gmail.com
[1] Atatürk Üniversitesi, Ziraat Fakültesi, Gıda Mühendisliği Bölümü, Erzurum, Türkiye (ORCID: 0000-0002-9583-4379), ozdemirs@atauni.edu.tr

(İlk Geliş Tarihi 19 Ağustos 2023 ve Kabul Tarihi 23 Ekim 2023)

(**DOI:** 10.5281/zenodo.10623787)

ATIF/REFERENCE: Maden, F. İ. & Özdemir, S. (2024). Stevia ile Tatlandırılmış Meyveli Dondurmanın Kalitesi. *Avrupa Bilim ve Teknoloji Dergisi*, (53), 64-70.

Öz

Bu çalışmada dondurma örneklerine sükroz yerine stevia ilavesi yapılarak şeker hastalarının tüketebileceği ayrıca diğer tüketicilerinde damak zevklerine hitap edebilecek meyveli ve sade dondurma üretimi yapılarak stevianın sükroz yerine tatlandırıcı olarak kullanılıp kullanılamayacağının tespit edilmesi amaçlanmıştır. Dondurma örnekleri 3 farklı meyve (kivi, greyfurt ve portakal) ve 2 farklı tatlandırıcı kaynağı kullanılarak üretilmiş olup 1 ve 15. günlük muhafaza sürelerinde analizlere tabi tutularak elde edilen sonuçlar değerlendirilmiştir. Dondurma örneklerinin kuru madde oranı % 29,42 ile %34,32 arasında, kül oranı da %0,82 ile %1,55 arasında değişmiştir. Dondurma örneklerinin pH değeri 5,07 ile 6,45 arasında değişmiş ,meyve katılmış örneklerin pH değeri sade dondurma örneklerinden daha düşük bulunmuştur.15 günlük muhafaza periyodunda taze (1.gün) örneklere göre pH değeri azalırken % asitlik oranı artmıştır. Dondurma örneklerinin ilk damlama süresi 2,47 dakika ile 87,65 dakika arasında, tam erime süresi ise 34,18 dakika ile 75,20 dakika arasında değişiklik göstermiştir. En yüksek L renk değeri sükrozlu sade ,en düşük L değeri ise, stevialı kivili örneklerde saptanmıştır. Dondurma örneklerinde hacim artış oranı 14,82 ile%27,97 arasında değişmiştir. Stevia ile tatlandırılan dondurmalarda vizkozite değerleri sükroz katılmış örneklerden genellikle daha yüksek bulunmuş ve örneklerin muhafaza süresi arttıkça vizkozite değerleri de artmıştır. Panelistler genel kabul edilebilirlik ve lezzet açısından sükrozlu kivili dondurma örneklerini en yüksek düzeyde beğenmişlerdir.

Anahtar Kelimeler: Dondurma, Sükroz, Stevia, Kivi, Portakal, Greyfurt.

The Quality of Fruit Ice Cream Sweetened with Stevia

Abstract

In this study, it was aimed to determine whether stevia can be used as a sweetener instead of sucrose by producing fruit and plain ice cream that can be consumed by diabetics and appealing to the tastes of other consumers by adding stevia instead of sucrose to ice cream samples. Ice cream samples were produced using 3 different fruits (kiwi, grapefruit and orange) and 2 different sweetener sources(sucrose and stevia) and the results were evaluated by analyzing them at 1 and 15 days of storage. The dry matter ratio of ice cream samples varied between 29.42% and 34.32%, and the ash ratio varied between 0.82% and 1.55%. The pH value of the ice cream samples varied between 5.07 and 6.45, and the pH value of the samples was lower than the plain ice cream samples. During the 15-day storage period, the pH value decreased compared to the fresh (1st day) samples, while the acidity ratio increased. The first dripping time of ice cream samples varied between 2.47 minutes and 87.65 minutes, and the full melting time varied between 34.18 minutes and 75.20 minutes. The highest L* color value was found in plain sucrose samples and the lowest L* value in kiwi with stevia. The volume increase rate in ice cream samples varied between 14.82 and 27.97%. The viscosity values of the ice creams sweetened with stevia were generally higher than that of samples added sucrose, and the viscosity values of the samples increased as the storage time of the samples increased. As a result of sensory evaluation, plain sucrose ice cream samples were the most liked by the panelists in terms of color and appearance. The panelists liked the sucrose kiwi ice cream samples at the highest level in terms of overall acceptability and taste.

Keywords: Ice cream, Sucrose, Stevia, Kiwi, Orange, Grapefruit.

* Bu çalışma Feray İnci Maden'in Yüksek Lisans Tezinden alınmıştır.

† Sorumlu Yazar: maden.feray@gmail.com

1. Introduction

For the continuity of our health, we need to take adequate and regular nutrients. With the increasing importance given to human health, the interest of many people in functional foods is increasing (Turgut and Çakmakçı, 2009). Ice cream is a dairy product with a very complex structure, which is produced by freezing the mixture formed by adding milk, sugar, oil, salep, emulsifier and in some cases, color and flavoring substances (Karaman 2009). Ice cream is a food that appeals to the taste of consumers with its high nutritional value and variety of flavors. It is a dairy product that appeals to the senses of people with the color and aroma substances it contains and that people enjoy most when consuming . Ice cream containing ingredients is a food that human sense organs can enjoy at the highest level (Akın 2009). Since there is a very close relationship between human health and the foods consumed, research on these issues is increasing day by day.

Although there is no definite information about who and how ice cream was first produced, there is a lot of information about its making. It is said that the first production of ice cream was in Italy at the beginning of the 16th century, but according to some sources, ice cream began to be produced in England with the discovery of ice. In our country, ice cream was first produced in Istanbul and Kahramanmaraş in 1900. Today, the ice cream industry has become one of the areas in the food industry and dairy technology. The most important reason for the rapid development of ice cream production in our country is that the variety of raw materials is abundant and cheap (Dığrak et al., 2000).

The ice cream industry constitutes has a large part of dairy technology in the USA and European countries. Ice cream production occurs mostly in the USA, where the annual consumption per capita reaches almost 25 liters. Ice cream production and consumption are increasing in our country and it is generally consumed more in hot seasons. In developed countries, ice cream is seen as a dessert with milk, and because it is consumed in all seasons, the amount of consumption reaches the desired level (Milci and Common 2003). Ice cream production for the whole world is a new concept compared to other dairy products and has progressed rapidly in a short period (Şahan and Kaçar 2004). Today, to meet the increasing demand, ice cream production has been produced in larger facilities by going beyond the traditional production methods, and as a result, it has become consumed all the time, not only in the summer season (Bostan and Akın 2002).

Fruit ice creams produced using various fruit and fruit sauces attract the attention and appreciation of consumers. There is a wide variety of flavored ice creams on the market today. Fruit ice creams are also one of the prominent groups. In ice creams to which hard-shelled fruits are added, the fruit ratio should constitute at least 5% of the ice cream weight. In fruit ice cream, the fruit ratio should be 15% of the total weight of the ice cream (Anonymous 2016). According to the Ice Cream Communiqué, fruit ice cream; is called the type of ice cream produced by adding fruit, fruit juice, fruit concentrate, fruit puree and fruit paste to the ice cream mixture (Anonymous 2005). Fruits, fruit purees, fruit juices, nuts, etc. are added to the ice cream during the making of ice cream. increases the nutritional value of ice cream even more (Badem 2006).

Today, people are turning to sweeteners that are more natural for our health. Stevia is also an important sweetener, especially for diabetic patients, and studies on stevia are increasing day by day. Various studies conducted today have proven that stevia does not have any carcinogenic effect (Lemus-Mondaca et al. 2012). Özdemir et al. (2015) used stevia as a sweetener in making plain ice cream and found that the viscosity (7.25Pa.s) of the samples with stevia was lower than the samples with the addition of sucrose (13.95Pa.s). In addition, the researchers determined the initial melting time of the samples between 1400s and 3460s, the final melting time between 8700s and 9440s, the pH level between 6.50 and 6.62, the dry matter ratio between 30.77% and 35.39%, and the volume increase rate of 8%. They found it between 54 and 10.17%. The researchers found that the dry matter and volume increase rates of the plain samples added to stevia were lower than the samples added to the sucrose, but the initial dripping and final melting times were longer.

To worldwide interest in the stevia plant, which is in the group of plants with high economic value, the production of the plant in Turkey

2. Material and Method

2.1. Material

Full-fat cow's milk, salep, emulsifier, cream, granulated sugar, powdered stevia and powdered milk, and fruits (kiwi, grapefruit, orange) used in the production of ice cream samples, whose composition and sensory properties are suitable, were obtained from the Erzurum market. Ice cream production was carried out in the laboratory of Atatürk University, Faculty of Agriculture, Department of Food Engineering.

2.1.1. Methods

2.1.1.1.Production of Ice Cream Samples

Plain ice cream mixes were prepared by adding 100 g skimmed milk powder, 50 g cream (50% fat), 10 g salep, 5 g emulsifier and 200 g sucrose or 5 g stevia to 1 liter of full-fat cow's milk (3.1%). In addition, 8 plain and fruit ice cream mixes were prepared by adding 200g fruit pulp (kiwi, orange and grapefruit) to the mixes with the same composition at 30ºC after pasteurization. The mixes

were matured in the refrigerator for 12 hours. It was then converted into ice cream in an ice cream machine and stored in a deep freezer at -18 °C. This experiment was repeated 2 times.

2.1.1.2.Sampling and Preparation of Samples for Analysis

On the 1st and 15th days of the storage period, one glass jar was opened and samples were taken from each type of ice cream stored in glass jars in the deep freezer. One day after the production, 8 packages were opened for each parallel for the physical and chemical properties of the ice creams kept in the deep freezer. For sensory evaluations, 5 ice cream samples from each type of ice cream, which were kept in the deep freezer in plastic containers, were used separately.

2.1.1.3.Physical and Chemical Analysis

The pH values of the mixtures of ice cream samples were determined at 20±1°C with a pH meter (Thermo Scientific Orion 4-Star Benchtop pH/Conductivity Meters brand) adjusted with the help of buffer solutions (pH 4.0 or 7.0). (Öner and Aloğlu 2018). The titration acidity value was made according to the alkali titration method in milk and ice cream, and the data was written by converting it to SH (Soxhlet Henkel) (Anonymous 1983). In the dry matter analysis, approximately 10 grams of samples were weighed precisely into the previously cleaned, dried and tared dry matter containers and left to cool after drying in an oven at 100±5°C for 3 hours. When the samples reached a constant weight, the drying process was terminated (Kurt et al. 2012). Porcelain crucibles were placed in a muffle furnace at 550°C for the determination of ash content in ice cream samples. The crucibles were taken to the desiccator after 6 hours of burning, and after cooling, they were weighed and put back into the muffle furnace. The process was terminated as soon as the last weighing of the crucible and the previous weighing were equalized. (Kurt et al. 2012).

In the determination of volume increase, ice cream was filled up to a certain volume in a measured cylinder, the tare of which was determined, and weighed. The same ice cream sample was placed in a beaker and melted in a water bath. The melted mixture was transferred to the same volume in the cleaned measuring cylinder and weighed again (Jimenez-Florez et al. 1993). The volume increase rates were determined according to the formula below. Volume increase rate (%) = [(Volume of Ice Cream - Volume of Melted Ice Cream) / Volume of Melted Ice Cream] x 100. In determining the first dripping time, 10 g of ice cream sample was placed in a wire strainer on tared containers and left to melt at 24°C. The time during which the ice creams begin to melt and the first drops fall has been determined (Cotrell et al. 1979). In determining the full melting time, the hardened ice cream samples were left to melt on a 0.2 cm wire mesh screen on top of a beaker at 20°C and the time (min) after the ice creams were completely melted ratio was recorded (Guven and Karaca 2002). The viscosity of samples was determined using a digital Brookfield viscometer (Model DV-II) after keeping the ice cream mixture at 4˚C for 24 hours (Brookfield Engineering Laboratories, USA) (Soukoulis et al. 2014). Head no 6 was used for viscosity measurements and measurements were carried out at 20 and 50 rpm shear speeds. Hunter color values (L, a* and b*) were determined by measuring from the surface using a color measuring device. Before making color readings, it was calibrated with the standard calibration plate of the device (L*= 97.79, a*= -0.44 and b*= +2.04) (Mc Guire 1992**).**

2.1.1.4.Sensory Analysis

Ice cream samples were evaluated by 5 trained panelists. Ice cream samples were presented to the panelists at approximately -10 degrees. Sensory evaluations were made over 9 points (Bodyfelt et al. 1988).

2.1.1.5.Statistical Analysis

The research was established and carried out according to the Full Chance Experimental Plan in factorial arrangement (8×2) with 8 different fruit, sucrose and stevia ratios and 2 replications in 2 different storage periods. The obtained data were subjected to variance analysis using the SPSS 20 package program (SPSS 20 for Windows, SPSS Inc., USA) and the average values of the major sources of variation were analyzed with the Duncan multiple comparison test.

Table 1. Some analysis results of milk, cream, milk powder and fruits used in making ice cream samples

Analysis	Milk	Cream	Dry Milk	Kiwi	Orange	Grapefruit
pH	6.63	6.72	-	3.27	3.48	3.38
Acidity (SH)	6.73	20.93	-			
Dry Matter (%)	12.78	64.70	96.00	16.38	12.58	12.04
Fat (%)	3.1	62.36	1.34	-	-	-

Table 2. Physical and chemical analysis averages of ice cream samples and Duncan test results

Ice Cream Samples	DM(%)	Ash (%)	pH	Acidity(SH)	First Drip. Time (min.)	Full Melt Time(min.)	Owerrune (%)
Sucrose plain	33.30^{c}	0.95^{c}	6.24^{d}	10.38^{a}	16.33^{c}	36.12^{a}	27.97^{c}
Stevia Plain	30.82^{ab}	1.64^{g}	6.41^{e}	13.98^{b}	84.65^{e}	180.37^{d}	16.70^{ab}
Sucrose orange	31.80^{b}	1.04^{d}	5.43^{b}	21.97^{d}	6.40^{b}	34.18^{a}	19.72^{b}
Stevia orange	29.77^{a}	0.66^{a}	5.80^{d}	15.58^{b}	2.47^{a}	75.20^{c}	16.99^{ab}
Sucrose kiwi	30.20^{a}	0.84^{b}	5.63^{c}	20.97^{cd}	7.84^{b}	74.20^{c}	14.82^{a}
Stevia kiwi	34.12^{c}	1.55^{e}	5.54^{c}	25.66^{e}	6.03^{b}	73.76^{c}	16.47^{ab}
Sucrose Grapefruit	34.32^{c}	1.35^{f}	5.36^{b}	19.57^{cd}	15.32^{c}	74.32^{c}	17.99^{ab}
Stevia Grapefruit	29.42^{a}	0.82^{b}	5.07^{a}	15.58^{b}	21.01^{d}	43.62^{b}	15.35^{b}

Table 3. Viscosity and color measurement averages of ice cream samples and Duncan multiple comparison test results

Ice Cream Samples	Color (L*)	Color (a*)	Color (b*)	Viscosity 20 rpm	Viscosity 50 rpm
Sucrose Plain	91.90^{c}	-3.58^{a}	11.43^{a}	4873.75^{c}	5257.25^{d}
Stevia Plain	84.48^{bc}	-3.15^{a}	14.97^{ab}	9091.50^{d}	6494.00^{g}
Sucrose orange	85.61^{bc}	-3.47^{a}	20.61^{c}	3315.75^{a}	2210.75^{a}
Stevia orange	86.98^{bc}	-3.24^{a}	15.06^{ab}	3771.25^{b}	2940.00^{b}
Sucrose Kiwi	83.92^{bc}	-4.66^{a}	12.82^{a}	8970.25^{d}	4314.50^{c}
Stevia Kiwi	71.36^{a}	-2.69^{a}	18.26^{bc}	12211.50^{e}	5282.25^{d}
Sucrose Grapefruit	85.55^{bc}	-2.54^{b}	12.45^{a}	10543.50^{d}	5477.00^{e}
Stevia Grapefruit	82.79^{b}	-5.92^{c}	10.36^{a}	11961.25^{e}	5990.25^{f}

Table 4. Sensory Analysis Means of Ice Cream Samples and Duncan Multiple Comparison Test Results

Ice Cream Samples	Color and Appearance	Texture	Gummy	Flavor	Degree of Sweetness	General Admissibility
Sucrose Plain	8.10^{c}	6.80^{b}	6.30^{b}	6.60^{c}	5.90^{c}	6.70^{a}
Stevia Plain	6.70^{a}	7.20^{b}	6.60^{b}	6.60^{c}	8.20^{e}	6.80^{a}
Sucrose Orange	6.80^{a}	7.50^{cd}	6.50^{b}	7.40^{d}	7.70^{e}	7.60^{b}
Stevial Orange	6.60^{a}	6.70^{b}	5.20^{a}	5.40^{b}	6.30^{cd}	6.40^{a}
Sucrose Kiwi	7.60^{b}	7.60^{cd}	6.60^{b}	8.30^{e}	7.70^{e}	7.80^{b}
Stevia Kiwi	6.60^{a}	5.20^{a}	5.30^{a}	5.60^{b}	6.80^{d}	6.40^{a}
Sucrose Grapefruit	6.90^{a}	7.80^{e}	6.30^{b}	6.40^{c}	5.20b	6.80^{a}
Stevia Grapefruit	7.70^{bc}	6.70^{b}	6.20^{b}	4.30^{a}	4.40a	6.80^{a}

3. Conclusion and Discussion

As a result of the analysis of variance on the dry matter and ash ratios of the ice cream samples, the difference between the samples was found to be significant at the $p<0.01$ level. According to the Duncan multiple comparison test results, the ice cream sample with the lowest dry matter ratio was grapefruit with stevia, while the highest dry matter ratio was found in the ice cream sample with added stevia kiwi, and sucrose grapefruit. An example of ice cream is grapefruit with sucrose. Özcan and Kurdal (1997), in their study on cherry, strawberry and lemon ice cream in Bursa, concluded that fruit type and amount changed the dry matter ratio. These results show a parallel with our study. Ozdemir (2023) found the dry matter ratio between 29.82% and 33.13% and the ash ratio between 0.72% and 0.97% in their study by adding oleogel and different emulsifiers. According to the Duncan multiple

comparison test results, the ice cream sample with the lowest ash content was the orange sample with stevia, while the ice cream sample with the highest ash content was the plain ice cream sample with stevia. The reason why the ash ratio is high in sucrose ice cream samples can be thought of as the fact that the sucrose we use is refined and the stevia we use contains mineral substances. Açu (2014) determined that the ash ratios of ice cream samples with improved functional properties were between 1.13% and 1.26%. Yeşilsu (2010) reported that the amount of ash in the trial samples could be between 0.76% and 1.02%. Our findings are generally similar to the results determined in this study.

As a result of the variance analysis of the pH values of the ice cream samples, the difference between the samples was found to be significant at the $p<0.01$ level. The difference between storage times was found to be significant at the $p<0.01$ level. As a result of Duncan's multiple comparison test, the lowest pH value was determined in the grapefruit ice cream samples with stevia, and the highest pH value was determined in plain ice cream with stevia. As a result of the Duncan test regarding the storage times; It was determined that the pH values of the ice cream samples decreased with the increase of storage time. This is due to the high acidity value of the fruits we use. Turgut (2006), in his study on probiotic and cream-enriched ice creams at different rates, stated that the pH values of the mixes varied between 5.71 and 6.30. Küçükçetin et al. (2009) found pH values in the range of 5.51-7.16 in a study on probiotic ice cream. These results show parallelism with the findings obtained in this study. It has been reported that the pH change in fruit-added ice creams may be caused by processes such as the acidity of the fruit, the interactions between polyphenols and milk proteins, and pasteurization applied to milk (Sun-Waterhouse et al. 2013). It was found significant at the 01 level. While the titration acidity value of the grapefruit and orange ice cream samples with stevia added was lower than the samples with the addition of sucrose, the addition of stevia increased the acidity value in the other samples. As a result of Duncan's multiple comparison tests, the lowest titration acidity value was observed in sucrose plain ice cream samples, and the highest titration acidity value was determined in kiwi fruit ice cream samples with stevia. In fruit ice creams, acidity; varies according to the amount of acid contained in the fruit varieties used in the production of the mix. The main factors affecting this are the maturity of the fruit used and the amount of fruit added to the mix. In the study conducted by Erkaya et al. (2012), it was determined that the acidity values of ice creams with golden strawberries added were between 9.72 to 14.66 SH and that SH values increased with the addition of fruit. The findings of Erkaya et al. (2012) showed parallelism with the results of this study. Yeşilsu (2010) found the acidity values of ice creams between 0.22% and 0.43% lactic acid in his study named the effect of some molasses varieties on the physical, chemical and sensory properties of ice cream. It was determined that these results were generally similar to the findings of our study.

As a result of the analysis of variance on the first dripping times of the ice cream samples, the difference between the samples was found to be significant at the $p<0.01$ level. The difference between storage times is insignificant ($p>0.05$). According to Duncan's multiple comparison test results, it was determined that the earliest dripping ice cream sample was orange with stevia, and the latest dripping was seen in plain stevia ice cream. Aslaner and Salık (2017) found the average first dripping time of ice cream samples to be 344 s (5.7 minutes). Aliyev (2006), in his study on kefir and blueberry ice creams, determined that the first dripping time was between 12.54-53.26 minutes. The results of these studies generally show parallelism with the findings of our study. As a result of the analysis of variance regarding the melting times of the ice cream samples, it was found to be significant at the $p<0.01$ level. The difference between storage times is insignificant ($p>0.05$). As a result of Duncan's multiple comparison test; The earliest full melting time was determined in the sucrose plain ice cream samples and the latest full melting time was determined in the stevia plain ice cream samples. With the addition of fruit in the stevia ice cream samples, it was observed that the full melting time was shortened compared to the plain stevia ice cream samples. Akın et al (2006), in their study on ice cream containing probiotic bacteria in free and encapsulated form, determined the full melting times between 1464 and 7600 s, respectively. These findings were in parallel with the results of this study. As a result of the variance analysis of the volume increase rates of the ice cream samples, the difference between the samples was determined to be significant at the $p<0.01$ level. The difference between storage times is insignificant ($p>0.05$). As a result of the Duncan multiple comparison test, the highest volume increase rate was observed in sucrose plain ice cream samples, and the lowest volume increase rate was determined in sucrose kiwi ice cream samples. Generally, the addition of stevia to ice creams significantly decreased the volume increase rate of the samples compared to the samples with sucrose. Tekinşen and Tekinşen (2008) stated that the volume increase in high-quality ice creams should generally be between 15% and 50%. Ice cream samples obtained in this study can be classified as quality ice cream in terms of volume increase rates.

According to the variance analysis results, it was determined that all three color values of the ice cream samples were statistically significant at the $p<0.01$ level. The difference between the storage times is insignificant ($p>0.05$). As can be seen from the Duncan multiple comparison test result (Table 3), the highest L* value was determined in sucrose plain ice cream samples, and the lowest L* value was determined in kiwi ice cream samples with stevia. In ice creams, this value was found to be lower due to the different colors of the fruits. On the Hunter color scale, positive (+) values of a* color value indicate redness, and negative (-) values indicate green. The positive (+) values of the b* color value indicate yellowness and the negative (-) values indicate blue (Üren 1999). According to Duncan's multiple comparison test results, the highest a* value was determined in grapefruit ice cream samples with stevia, and the lowest a* value was determined in sucrose grapefruit ice cream samples. The highest b* value was determined in sucrose orange ice cream samples and the lowest b* value was determined in grapefruit ice cream samples with stevia. Since no blue fruit was used in our ice cream samples, b* values were positive (+). The a* value of ice cream samples with grapefruit is also positive (+), indicating that the ice cream is red due to the color of the grapefruit. In the kiwi ice cream samples, the negative (-) color value of a* shows the color of the ice cream as green due to the color of the kiwi fruit. Positive (+) values of b* indicate yellowness and b* (+) values were determined in orange ice cream samples due to the orange color of orange. As a result of the Duncan multiple comparison test, the lowest viscosity value was determined in sucrose orange ice cream samples at 20 and 50 rpm shear speed, and the highest viscosity value was determined in kiwi ice cream samples with stevia at 20 rpm. The highest viscosity value was determined in the sucrose plain ice cream mix samples at 50 rpm shear speed. More viscosity values were determined in the ice cream mix samples sweetened with stevia than in the samples with added sucrose. However, Ozdemir et al (2015) found that the addition of

stevia to ice cream samples decreased the viscosity compared to the addition of sucrose. Akın et al (2006), in their study on encapsulated ice cream, determined that the viscosity values of ice cream samples containing probiotic bacteria in free and encapsulated form varied in the range of 3960-42400 cP. These results generally show parallelism with the findings of our study.

As a result of Duncan's multiple comparison test, it was determined that the highest flavor score of ice cream samples was in sucrose kiwi ice cream samples and the lowest flavor score was found in grapefruit ice cream samples with stevia. In this study, it was determined that the flavor of ice creams sweetened with sucrose was generally more appreciated than ice creams sweetened with stevia. This situation was also detected in the study conducted by Özdemir et al. (2015). This is because stevia leaves a slightly bitter taste in the mouth (Alizadeh et al. 2014). As a result of Duncan's multiple comparison test, it was determined that the highest score in the general acceptability was obtained by the kiwi ice cream sample with sucrose, and the lowest score was obtained by the kiwi with stevia and orange ice cream with stevia. While it was seen that the general acceptability did not change in grapefruit ice creams, in other ice cream samples, the general acceptability of those with sucrose was higher than those with stevia (Table 3).

4. General Conclusion and Recommendations

This research, it was aimed to produce a healthy, delicious and functional product by using stevia instead of sucrose in ice cream production and to determine the sensory properties of the ice cream samples produced. A total of 8 ice cream samples were produced, including 1 plain with sucrose and 3 with sucrose (orange, kiwi, grapefruit), 1 plain with stevia and 3 with stevia (orange, kiwi, grapefruit) and stored for 15 days at -18˚C. has been done. During storage, samples were analyzed on the 1st and 15th days. In the evaluation of the analysis results, the data from the sucrose ice cream samples were taken as a reference. In this study, it was observed that there was no ice cream sample rejected in general acceptability according to the sensory test result. It will be beneficial to carry out new studies and to produce functional ice creams by using stevia as a sweetener in ice creams produced using plain and various fruits.

References

Açu M., 2014. Fonksiyonel Özellikleri Geliştirilmiş Dondurma Üretimi. Ege Üniversitesi Fen Bilimleri Enstitüsü. Süt Teknolojisi Anabilim Dalı, Yüksek Lisans Tezi, İzmir.

Akın N., 2009. Dondurma Bilimi ve Teknolojisi. Damla Ofset,437,Konya.

Akın, M.B., Akın, M.S.,Özer, H.B., Kırmacı, H.A., 2006. Kapsüllenmiş ve serbest Lactobacillus acidophilus, Lactobacillusrhamnosus'un dondurmada canlı kalma sürelerinin dondurmanın duyusal özelliklerine etkisinin belirlenmesi. Tübitak Projesi Sonuç Raporu. Proje No: 105O033, Şanlıurfa, 61s.

Aliyev, C., 2006. Kefir ve yaban mersininin dondurmanın fiziko kimyasal,duyusal ve mikrobiyolojik özelliklerine etkisi.Yüksek Lisans Tezi,19 Mayıs Üniversitesi Fen Bilimleri Enstitüsü,Gıda Mühendisliği Anabilim Dalı,Samsun.69s

Alizadeh M., Lalabadi MA, Kheirouvris S., 2014b. Şekerin yerine Stevia'nın meyve bazlı süt sallanmasının fizikokimyasal ve duyusal özellikleri üzerine etkisi. J Sci Res Rep 3 (11): 1421-1429.

Anonim, 1983. Gıda Maddeleri ve Analiz Metotları. T.C. Tarım Orman ve Köy İşleri Bakanlığı Gıda İşleri Genel Müdürlüğü. Genel Yayın, No: 65, 796s. Ankara.

Anonim, 2016e. TGK Dondurma Tebliği (Tebliğ No: 2004/45) http://www.resmigazete.gov.tr/ eskiler /2005/01/20050113-13.htm (02.01.2016). Anonim, 2005. Dondurma Tebliği (Tebliğ No: 2004/45).Türk Gıda Kodeksi Yönetmeliği. 13 Ocak 2005 tarih ve 25699 sayılı Resmi Gazete, Ankara.

Anonim, 2005. Dondurma Tebliği (Tebliğ No: 2004/45).Türk Gıda Kodeksi Yönetmeliği. 13 Ocak 2005 tarih ve 25699 sayılı Resmi Gazete, Ankara.

Aslaner, A., Salık, M.A., 2017. Ceviz ezmesi ve dut kurusu tozu ilavesiyle üretilen düşük kalorili dondurmanın bazı kalite niteliklerinin belirlenmesi. Atatürk Üniv. Ziraat Fak. Derg., 48 (1):57-64.

Badem, A., 2006. Dondurma üretiminde kullanılan karragenan, ksantan ve keçiboynuzlu zamkların dondurmaların kalite üzerine etkisi. Akdeniz Üniversitesi Fen Bilimleri Enstitüsü Gıda Mühendisliği Anabilim Dalı Yüksek Lisans Tezi, Antalya,Türkiye, 73s.

Bodyfelt, F.W., Tobias, J. and Trout, G.M., 1988. The Sensory Evaluation of Dairy Products. Van Nostrand Reinhold, 598 s., New York

Bostan K., Akın B., 2002. Endüstriyel Dondurmaların Mikrobiyolojik Kalitesi Üzerine Bir Araştırma, Türk J. Vet. Anim. Sciences., (26), 623-629.

Cotrell, J.I.L., Pass, G. and Philips, G.O., 1979. Assesment of polysaccharides as ice cream cream stabilizers.J.Sci.Food Agric.30:1085-1088.

Dığrak M., Tanış H., Bağcı E., Kırbağ S. Kahramanmaraş'ta Tüketime Sunulan Dondurmalarda Listeria, Salmonella, E. Colive K. Pneumoniae' nin Araştırılması. Gıda, 2000, 25 (5), 349-353.

Erkaya, T., Dağdemir, E., Şengül, M., 2012. Influence of cape gooseberry (*Physalis peruviana* L.) addition on the chemical and sensory characteristics and mineral concentrations of ice cream. Food Research International, 45, 331-335.

Güven, M. ve Karaca, OB., 2002. Değişen Şeker İçeriği ve Meyve Konsantrasyonunun Vanilya ve Meyveli Dondurma Tipi Dondurulmuş Yoğurtların Fiziksel Özellikleri Üzerine Etkileri. Uluslararası Süt Teknolojisi Dergisi, 55, 27-31.

Jimenez-Florez R, Klipfel NJ, Tobias J., 1993. Dondurma ve dondurulmuş tatlılar. In: Hui YH (ed) Süt bilimi ve teknolojisi el kitabı. 2. Ürün imalatı. VCH Yayıncıları, New York, s 57.

Karaman S., 2009. Çay veya bazı bitki çayları İle aromatize edilmiş dondurma üretim olanaklarının araştırılması, Yüksek Lisans Tezi, Erciyes Üniversitesi, Fen Bilimleri Enstitüsü, Kayseri.

Kurt A., Çakmakçı S., Çağlar A., 2012. Süt ve Mamülleri Muayene ve Analiz Metotları Rehberi , 10, Atatürk Üniversitesi Yayınları, Erzurum.

Küçükçetin, A., Milci, S., Demir, M., 2009. Farklı Yöntemler Kullanılarak Üretilen Probiyotik Dondurmaların Bazı Probiyotik Özellikleri ve Kalite Karakteristiklerinin Belirlenmesi, TÜBİTAK Proje No:107 O 438, 148 s.

Lemus-Mondaca, R., Vega-Gálvez, A., Zura-Bravo, L., Ah-Hen, K., 2012. Stevia rebaudiana Bertoni, source of a high-potency natural sweetener: a comprehensive review on the biochemical, nutritional and functional aspects. Food Chem., 132: 1121–1132.

Mc Guire, R.G., 1992. Reporting of objective color measurements. Hortscience, 27 (12), 1254-1255

Milci, S. ve Yaygın, H., 2003. Üretimden tüketime dondurmada kritik kontrol noktalarında tehlike analizi uygulamaları. Süt Endüstrisinde Yeni Eğilimler Sempozyumu. 22-23 Mayıs 2003, İzmir, 239-24.

Öner, Z., and H. Şanlıdere-Aloğlu. "Süt ve Süt Ürünleri Analiz Yöntemleri. Sidas Medya Ltd. Şti., Çankaya, İzmir." (2018).

Ozdemir ,C.2023 An Investigation of Several Physicochemical Characteristics, as well as the Cholesterol and Fatty Acid Profile of Ice Cream Samples Containing Oleogel, Various Stabilizers, and Emulsifiers.Gels 9 (7), 543; https://doi.org/10.3390/gels9070543.

Özcan, T., Kurdal, E., 1997. Bursa il merkezinde satılan meyveli dondurmaların kimyasal ve mikrobiyolojik nitelikleri üzerine araştırma.Gıda, 22 (3), 217-225.

Özdemir, C., Arslaner, A., Özdemir, S., Allahyari, M., 2015. The production of ice cream using stevia as a sweetener. Journal of Food Sci Technol, 52 (11):7545- 7548.

Sun-Waterhouse, D. Edmonds, L. Wadhwa, S.S. Wibisono, R., 2013. Producing ice cream using a substantial amount of juice from kiwifruit with green, gold or red flesh. Food Res. Int., 50:647–656.

Şahan, N., ve Kaçar, A., 2004. Farklı Yağ Oranları ve Tatlandırıcı Kombinasyonlarının Enerjisi Azaltılmış Dondurmaların Fiziksel ve Duyusal Özelliklerine Etkileri. Harran Üniversitesi Ziraat Fakültesi Dergisi, 2004, 8 (1):1-6.

Tekinşen , C., Tekinşen, K.K., 2008. Dondurma. 1. Baskı.Selçuk Üniversitesi Basımevi, Konya.

Turgut, T., 2006. Bazı Probiyotik Bakterilerin Dondurma Üretiminde Kullanım İmkanları, Doktora Tezi, Atatürk Üniversitesi Fen Bilimleri Ensttitüsü Gıda Mühendisliği Anabilim Dalı, 168s.

Turgut, T., Çakmakçı, S., 2009. Investigation of the possible use of probiotics in ice cream manufacture. Internatıonal Journal of Dairy Technology, 62 (3), 444-451.

Üren, A., 1999. Üç boyutlu renk ölçme yöntemleri. Gıda, 24 (3): 193-200.

Yeşilsu, A.F., Temiz, H. Effect of Pekmez. 2010. Addition on the Physical, Chemical and Sensory Properties of Ice Cream.Department of Food Engineering, Ondokuz Mayis University, Samsun.