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The quality of ice cream samples made from buffalo milk

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ABSTRACT

The aim of this study was to evaluate physical, chemical and organoleptic properties the ice creams made from buffalo milk, cow milk, and their mix during storage for 21 days. Before the cow milk ice-cream samples were made, cow milk was standardized to fat ratio of 7.10 % with fresh cow milk cream. The highest acidity values were determined in ice cream samples made from buffalo milk using the alkali titration method. The pH of ice cream samples was found at between 6.44 and 6.60. The average pH of ice cream samples was found as 6.53. The overrun values of ice cream samples ranged from 34.10 % to 43.23 % and the highest overrun values were determined in samples made with buffalo and cow milk mix. The first melting time of ice cream samples was between 1109s and 1510s. Generally, the first melting time of ice cream samples made from buffalo milk was longer than that of only cow milk ice cream samples. The highest L color value was determined at ice cream samples made from only buffalo milk. Generally, buffalo milk ice cream samples were preferred by the panelist with the highest scores when compared with ice cream samples made from cow and mix of cow and buffalo milk. As a result, it can be surely said that the use of buffalo milk in dairy products such as ice cream enriches the sensory, chemical and physical properties of the product.

Keywords: Ice cream, Buffalo milk, Melting time, Overrun, Acidity, L color value

Introduction

Ice cream is a very desirable dairy product that has been consumed by everyone from seven to seventy in worldwide. Ice cream is a dessert making from milk, sugar, additives including stabilizer, may also contain other food products such as fruits, which enhances its nutritive value same as sales. Recent studies show that ice cream plays a fundamental role in our diets, which consume great amounts of it. Generally, cow milk is used to ice cream production in many countries of the world. Buffalo milk contains butter fat at a high level. For this reason, generally, buffalo milk is used at dry cream making. However, buffalo milk contains higher calcium and protein. But, the cholesterol level of buffalo milk is lower than that of cow milk (Zicarelli 2004). Although buffalo milk contains more lactose than the cow milk, lactose intolerance problem sourcing from buffalo milk is less (Ahmad et al., 2013).

Buffalo milk has a higher value than the other milk types in terms of the amount of mineral matter as well as the fat content (Cashman 2002a, b). In particular, the amount of B12, riboflavin and folic acid is higher than other milk kinds whereas folate binding capacity is lowest of buffalo milk (Sharma et al., 2007). Oligosaccharides, which form a large part of lactose in the milk and contribute to the realization of many vital and biological functions, are found in high quantities in buffalo milk compared to other milk varieties (Martinez-Ferezet al., 2006). Since the buffalo milk has a high dry matter content, it can be used in many milk products, but also contributes to energy saving in production poses (Ahmad, et al., 2013).

When cow milk was used at ice cream making, milk must be fortified with fresh cream. Because buffalo milk contains fat at high level, the ice-cream can be produced from buffalo milk unless fat adding. Milk fat increases the body, texture, homogeneity and organoleptic properties of ice cream samples. The fat ratio must be minimum of 8% for hard ice cream and for 7% for soft ice cream (Hamilton 1990). However, the color of buffalo milk is whiter than that of cow milk. This state will be effected as positive to color of ice cream. There is paper at limiting number according to the buffalo milk ice cream. Minhas et al. (2002) made ice cream from buffalo milk with different stabilizators and found that when the viscosity of ice cream increased, the organoleptic properties increased too. Guven et al. (2002) made Turkish Maras ice cream from goat milk and found that the average overrun ratio and pH degree of samples were 21.74% and 6.58 respectively. Akalın and Gonc (1995) made the cow milk ice cream and found that viscosity and overrun ratio of samples were between 5622 mPa.s-7324 mPa.s and 28.02%-40.10%, respectively. Simsek et al. (2006) made ice cream from cow milk with different stabilizers and found that pH and first melting time were between 6.31-6.39 and 36.63- 75.63 min, respectively. Ozdemir et al. (2003) made ice cream for diabetic patients and found that the pH, viscosity and overrun were among 6.50- 6.77, 2350 mPa.s- 6020 mPa.s and 26.30%- 37.52%, respectively. Konar and Akın (1992) made ice cream samples from cow, sheep and goat milk and found that sheep milk ice cream had the highest viscosity than that of other samples. The objective of this study was to compare the buffalo milk ice cream quality and cow milk ice cream quality.

Materials and Methods

Materials

Buffalo milk samples used in ice cream making were taken from milk producers in Erzurum. Cow milk samples and raw cream were taken from Ataturk University Pilot Milk Plant. Sugar, salep, emulgator and plastic containers and glass were purchased in Erzurum.

Methods

The preparation of ice cream samples

In this research, buffalo milk, cow milk standardized with fresh cream and buffalo and cow milk mix (1:1) were used for ice cream making. Because the fat ratio of the buffalo milk was 7.1%, the fat ratio of cow milk was standardized to 7.1% too. Milk samples of 3 kg (buffalo, cow and buffalo and cow mix) were heated to 40℃ and added to milk the 550 g sugar, 30 g stabilizer (salep) and 10 g emulgator. Mix was pasteurized at 78℃ for 10 minutes. Then, the mix was cooled to 5℃ and ripened at same temperature for 24 hours. The ice cream samples were prepared in ice cream machinery and hardened in deep freezer (-18℃). Samples were taken at 1,7,15 and 21 days of storage periods and analyzed. Ice cream samples were produced in triplicate.

The analysis of milk, cream and mix samples

The dry matter, fat, acidity and pH analysis of milk, cream and mix samples was made as Kurt et al. (2007). The dry matter was performed using an air circulation oven (Memmert UF110, Germany). The fat content of samples was measured by Gerber Method using Gerber centrifuge machine (Funke Gerber 12105, Germany). The pH value was measured using a digital pH meter (model WTW pH-340-A, Weilheim, Germany). The acidity was determined by the alkali titration method using sodium hydroxide (0.1 N) and the results were expressed in °SH (Soxhlet Henkel).

The analysis of ice cream samples

The viscosity of ice cream mix samples was calculated by

Viscositmetry (Polten RY-8). The calculation of viscosity was made at 20 rpm using 0,5 no spindle (Abrahamsen and Holman, 1980). The pH value was measured using a digital pH meter. Before analysis, pH meter was standardized (Kurt et al., 2007). Overrun was calculated according to the equation [(volume of ice cream) − (volume of mix)/volume of mix × 100] given by Jimenez et al., (1993). First melting time that expressing the strength and structural properties of ice cream was determined according to the method UM 0801 described by Anonymous (1997). Color analysis of samples was made with Minolta Data Processor DP- 300 series. Results were given as L, a, b degrees (Chroma Meter, CR-200, Osaka, Japan; Anonymous, 1979). The sensory evaluation of the ice cream samples was performed by 7 panelists selected from the academic staff of food engineering department via the use of a score test for flavor, body and texture, color and appearance, resistance to melting, creamy taste, unacceptable taste and general acceptability. Hardened ice cream samples were tested at a serving temperature of -10°C. The sensory characteristics were assessed on a scale from 1, for very poor, to 9, for excellent (Roland et al., 1999). Ice cream samples were served to participants selected from nonsmokers who had previous sensory analysis experience at serving temperature (-10°C). Warm water and bread were provided to the panelists among two samples in order to find out the differences between the samples easier to perceive.

The data were analyzed using of variance (SPSS 13.0 for Windows) and Duncan's new multiple range tests were done using the SAS program (Yıldız and Bircan, 1991).

Results and Discussion

The total solid, fat and pH results of buffalo milk, cow milk and fresh cream were given Table 1.

The physical and chemical analysis results of ice cream samples were given in Table 2.

Table 1. The some physical and chemical properties buffalo milk, cow milk, raw cream and mixes used at making of ice cream samples

Analyses	Buffalo Milk	Cow Milk	Raw Cream	Buffalo Ice Cream Mix	Cow Ice Cream Mix	Buffalo and Cow Mix
Drymatter (%)	17.25	12.73	54.50	33.12	31.96	32.32
Fat (%)	7.10	3.4	51.00	7.10	7.20	7.15
pH	6.68	6.43	6.55	6.59	6.43	6.40

Values represent means of triplicates

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

Ice Cream Samples	Storage Time (Days)	Acidity (SH)	pH	First Dripping Time (Second)	Overrun (%)	Viscosity (cP)	Color L	Color a	Color b
(A) Buffalo Milk Ice Cream	1	10.67	6.55	1510	41.0	4420	108.5	-1.15	3.54
	7	9.03	6.54	1386	43.2	4550	105.6	-1.17	3.44
	14	8.88	6.55	1455	42.0	3955	102.3	-1.18	3.21
	21	8.43	6.64	1465	42.0	3975	106.5	-1.15	3.36
(B) Cow Milk Ice Cream	1	7.90	6.52	1109	42.3	1440	81.4	-3.35	8.29
	7	6.51	6.47	1165	42.0	1685	79.6	-3.83	7.73
	14	6.71	6.53	1183	42.0	2805	80.0	-3.16	7.49
	21	7.21	6.59	1124	41.0	2010	81.5	-3.38	8.07
(C) Buffalo and Cow Milk Ice Cream	1	8.90	6.44	1202	34.1	5735	102.4	-1.92	6.43
	7	8.92	6.57	1276	37.0	4350	100.2	-1.78	6.67
	14	8.96	6.60	1215	35.2	6150	101.6	-2.10	5.89
	21	8.45	6.49	1275	36.0	4650	101.5	-1.83	6.32

Values represent means of triplicates

From the analyses results of ice cream samples, the average pH value of buffalo ice cream samples was found as 6.53. The results were paralleled with results of Ozdemir et al. (2003). But, the pH degrees (6.31- 6.39) found by Simsek et al. (2006) were lower than that of our results. It was observed that there were no significant changes when the pH and acidity (SH) values of the ice cream samples are examined during storage. The differences in the first dripping times and color values of the ice cream samples were determined to be insignificant. The first dripping times of ice creams made from buffalo milk were prolonged compared to cow milk ice cream. We want that the ice cream can be stay in mouth longer time. The buffalo milk ice cream can be maintained structure for a longer time that is a feature requested in the ice cream industry.

It is well known that the overrun of ice cream is related to its structure and general quality. Overrun is related to not only effect consistency of ice cream but also effect nutritive value, firmness, to be eat status and productive of ice cream (Arbuckle 1986). According to results (Table 2), overrun values ranged from 34.10% to 43.23% and highest overrun values were determined in samples made from only buffalo milk or cow milk. When buffalo and cow milk mixed, the overrun ratio decreased. This state can be sourced different protein structures of cow and buffalo milk. The overrun ratios found at ice creams added stevia by Ozdemir et al. (2015) were lower that of the research founds. Flores and Goff (1999) found that a slight decrease in mean ice crystal size caused increase of overrun. These effects may be related to the change in heat transfer rates from the ice cream upon increased aeration. Wilbey et al. (1997) found a decrease in hardness of ice cream caused to increased overrun. However, Prindiville et al. (1999) and Abd El-Rahman et al. (1997) found the opposite effect other factors (air cell and ice crystal size distributions) had more effect on hardness than total overrun. This finding was likely as the overrun value of recent research.

The viscosity of ice cream that has a major influence on sensory and texture quality is determined in particular. The viscosity of ice cream is one of the most important parameter to be shown that ice cream structure. The viscosity values in samples were varied from 1440 mPa.s to 6150 mPa.s and it's the highest values were detected in ice cream of mix buffalo and cow milk mix when compared each to other. Using milk that has high dry matter or mix of sort of milk could be of particular importance in the case of developing new products. Except for the ice cream samples made from cow milk, the viscosity values decreased during storage times.

The color parameters (*L, a, b*) of varieties of ice creams were given in Table 2. The L values indicate whiteness of the ice cream samples and its values ranged from 79.06 to 108.5. The highest L values determined in ice cream samples made from buffalo milk depending on nature of buffalo milk. Consumers generally prefer whiter ice cream.

The differences of color values of the ice cream samples were determined to be insignificant.

Organoleptic attributes such as color, body and texture, melting resistance of ice creams is showed in this sensory analysis that was made by the panelist (Table 3). When the results of sensory analysis were examined, it was seen that the highest color scores belong to buffalo milk ice cream. In a similar study carried out by Guimarães and Silva (2014), buffalo milk ice cream was found more preferable than cow milk ice cream and cow- buffalo mix ice cream in terms of sensory properties such as color and flavor, although not statistically different.

Use of buffalo milk helped in enhancing the color, body and texture and flavor quality. Especially sensory characteristics are the most important parameter that can be caused increase consumer acceptability. Generally, buffalo ice cream samples were preferred by the panelist with highest scores for total evaluation in most of sensory characteristics when compared with ice cream made from cow and mix of cow-buffalo milk.

Conclusion

In this study, we determined that based on physical, chemical properties of ice cream with made from buffalo, cow and mix of this milk and compared theirs as the total quality. At results of the research we found that quality of buffalo milk ice cream was remarkable higher than that of ice cream of cow milk. Based on results, adequate evidence has been provided to support the lots of benefits to structure and texture of using milk has high dry matter as buffalo milk.

Table 3. Sensory analysis results of ice cream samples

Ice cream samples	Storage Time (Days)	Color	Body and Teksture	Melting Resistance	Flavour and Taste	Creamy Taste	Mouth Coating	Gummy Body	Icy Body	Unaccaptable Taste	Generall Accep.
(A) Buffalo Milk Ice Cream	**1**	9.00	8.50	9.00	9.00	9.00	9.00	9.00	8.25	**9.00**	**9.00**
	7	8.00	8.75	8.50	8.25	8.75	8.50	8.50	8.00	**8.75**	**9.00**
	14	8.75	9.00	8.50	8.00	9.00	8.50	8.50	9.00	**8.50**	**8.50**
	21	8.75	8.75	9.00	8.00	8.75	8.00	8.75	8.75	**8.25**	**8.50**
(B) Cow Milk Ice Cream	**1**	7.57	7.00	7.00	7.25	7.00	7.25	6.25	5.25	**7.00**	**7.00**
	7	7.25	6.25	6.00	6.25	5.25	5.25	5.00	5.00	**8.00**	**6.25**
	14	6.25	6.25	6.00	6.25	5.25	5.00	4.00	5.00	**7.50**	**6.50**
	21	6.00	6.25	6.00	6.00	5.00	4.50	4.25	5.25	**7.50**	**5.25**
(C) Buffalo and Cow Milk Ice Cream	**1**	9.00	8.25	8.25	8.25	8.50	8.00	8.75	8.25	**8.00**	**8.50**
	7	8.00	8.00	8.00	8.50	8.75	8.00	9.00	8.00	**7.75**	**9.00**
	14	8.75	8.00	8.50	8.50	8.50	8.50	9.00	7.75	**7.75**	**8.50**
	21	8.00	8.00	8.50	8.50	8.50	8.50	8.50	8.00	**8.00**	**8.00**

Values represent means of triplicates

Compliance with Ethical Standard

Conflict of interests: The authors declare that for this article they have no actual, potential or perceived the conflict of interests.

Ethics committee approval: No ethics committee approval is needed.

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