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INVESTIGATION OF UTILIZING WHEY IN DAIRY-BASED DESSERT FORMULATIONS WITH CAROB POWDER

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ABSTRACT
The objective of this study is to develop a dairy dessert produced with whey at different ratios and carob powder (5%). Five dessert samples prepared by different milk: whey (v/v) ratios were as follows: 100:0, 75:25, 50:50, 25:75 and 0:100. Dessert samples were analyzed in terms of some physiochemical, color, textural and sensory properties on the 1st, 7th and 14th days of storage. It was determined that the use of whey significantly affected the titratable acidity, water holding capacity, color parameters (L^*, b^* and ΔE values) and textural qualities of the milk dessert samples produced by adding carob powder. Significant differences were also observed in terms of sensory characteristics. As a result of the evaluations, the C sample, which was produced at 50% milk and 50% whey ratios, received the highest scores by the panelists compared to the other samples and became the most liked sample. According to the results obtained, it was determined that the use of whey in milk-based dessert formulations produced with the addition of carob powder contributed positively to the product in terms of sensory and physical properties.
Keywords: Dairy dessert, whey, carob powder, functional food

KEÇİ BOYNUZU TOZU İÇEREN SÜT ESASLI TATLI FORMÜLASYONLARINDA PEYNİRALTI SUYU KULLANIMININ ARAŞTIRILMASI

ÖZ
Bu çalışmanın amacı, farklı oranlarda peynir altı suyu ve keçiboynuzu tozu (%5) ilavesi ile üretilen bir sütlü tatlı geliştirmektir. Süt:peynir altı suyu (v/v) oranları 100:0, 75:25, 50:50, 25:75 ve 0:100 olacak şekilde beş tatlı örneği üretilmiştir. Tatlı örnekleri fizikokimyasal, renk, tekstür ve duyusal özellikler açısından depolamanın 1., 7. ve 14. günlerinde analiz edilmiştir. Peynir altı suyu kullanımının keçi boynuzu tozu ilave edilerek üretilen sütlü tatlı örneklerinin titre edilebilir asitlik, su tutma kapasitesi, renk parametreleri (L^*, b^* ve ΔE değerleri) ve tekstürel niteliklerini önemli ölçüde etkilediği belirlenmiştir. Duyusal özellikler açısından da önemli farklılıklar gözlenmiştir. Yapılan değerlendirmeler sonucunda, %50 süt ve %50 peynir altı suyu oranlarında üretilen C örneği, diğer örneklere kıyasla panelistler tarafından en yüksek puanları alarak en beğenilen örnek olmuştur. Elde edilen sonuçlara göre, keçi boynuzu tozu ilavesi ile üretilen süt esaslı tatlı formülasyonlarında peynir altı suyunun kullanımının ürüne duyusal ve fiziksel özellikler açısından olumlu katkı sağladığı belirlenmiştir.
Anahtar kelimeler: Sütlü tatlı, peyniraltı suyu, keçi boynuzu tozu, fonksiyonel gıda

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INTRODUCTION

Nowadays, an increasing interest exists for food enrichment in ways that providing health benefits to the consumers (Zarzycki et al., 2019). These products are known as functional foods promising improvement in consumers' targeted physiological functions (Sun et al., 2007; Almeida Neta et al., 2018). In this regard, dairy-based desserts, with worldwide consumption capacity, can be a good option for consumers interested in functional foods (Damian, 2012; Zarzycki et al., 2019) in day by day growing dessert market with new products (Granato et al., 2012; Barros et al., 2017).

Dairy desserts are usually formulated with milk, sugar, starch, hydrocolloids, aroma and coloring agents. They are semisolid foods and the texture of them mainly results from between interaction of proteins and other ingredients such as starch and/or several hydrocolloids. These interactions contribute to their physical stability and sensory properties. Therefore, it is necessary to obtain a balance between ingredients in these formulated products to improve textural properties and to ensure consumer acceptability (Tárrega and Costell, 2007; Damian, 2012; Staffolo et al., 2017; Zarzycki et al., 2019). However, adding different ingredients to the basic formulation of dairy desserts could also lead to positive changes in the rheological and textural properties of the products (Zarzycki et al., 2019). The effects of the different ingredients used in dairy dessert has been the subject of several studies (Granato et al., 2012; Staffolo et al., 2017; Almeida Neta et al., 2018; Innova et al., 2018).

Whey, a by-product from cheese manufacture is considered as functional ingredient for food industry because of its valuable composition. Two main whey varieties produced are sweet and acid whey according to the procedure used for casein precipitation. Sweet whey (pH 5.8–6.6) is a by-product of rennet-induced coagulation of casein, whereas acid whey (pH 3.6–5.1) is obtained from acid coagulation of casein (Królczyk et al., 2016). Further to their nutritional contribution, it can improve the quality properties of whey-based products (Evdokimov et al., 2015). Whey components, particularly the proteins and peptides, will increasingly be preferred as ingredients for functional foods. In recent years, studies on the use of whey in food system have attracted attention (Sabokbar and Khodaiyan, 2015; Evdokimov et al., 2015).

Carob is the fruit of long-lived evergreen tree (*Cretonia siliqua* L.), which is cultivated in Mediterranean regions (Srour et al., 2016; Moreira et al., 2017). It is composed of two major part, pulp (90%) and seed (20%). The seeds are used to produce the carob bean gum which is widely used as stabilizer in food industry. Carob can be processed into powder and syrup for food applications. After the removal of seeds carob pulp is processed to obtain carob powder (Srour et al., 2016; Yatmaz and Turhan, 2018). The pulp contains high amounts of protein (3-4%) and low levels of fat (0.2-0.6%) (Şahin et al., 2009; Ibrahim et al., 2015). Due to its high sugar content (40-55%), limited amount of sugar is required in products where carob pulp is used (Loullis and Pinakoulaki, 2018). In addition, it contains considerable amount of dietetic fibers (Srour et al., 2016; Moreira et al., 2017). Carob has several beneficial effects on health, such as cholesterol-lowering, antibacterial and antioxidant properties. Recently, researchers are focused on its utilization as a valuable ingredient in production of different foods (Ibrahim et al., 2015; Rosa et al., 2015; Srour et al., 2016; Aydın and Ozdemir, 2017; Moreira et al., 2017; Villarreal 2017; Červenka, et al., 2019). However, there is limited literature concerning the formulating dairy dessert containing carob.

The aim of this study was to investigate the combined effects of whey utilization and carob powder use in dairy dessert formulation, besides that to observe the physicochemical, textural and sensorial effects of using these nutritious compounds in dairy-based dessert formulation.

MATERIALS AND METHODS

Ingredients and whey-based dairy dessert preparation

Sugar, tapioca starch, vanillin and carob fruit were obtained from local market. Carrageenan was supplied by CoPkelco (A Huber Company, Denmark). Raw milk (total solid 8%, fat 0.5%, protein 3.5%, ash 0.6% and 6.8 pH) and rennet-whey (total solid 6%, fat 0.1%, protein 0.8%, ash 0.7% and 5.7 pH) was used for the production of whey-based dairy dessert. Carob powder was obtained from the dry fruit pod after the removal of the seeds (Figure 1). Pods were milled using laboratory type mill (Mateka, Mutbex.com, Turkey) and stored at room temperature until use. Dessert samples formulated by mixing different ratios of milk and whey (v/v) were given in Table 1. The amounts of compounds exist in dessert formulations were determined by preliminary studies that got acceptable sensory scores were given as follows: sugar (3%, w/v), starch (4%, w/v), carrageenan (0.2%, w/v), vanillin (%0.03, w/v) and carob powder (5%, w/v). First, all ingredients were weighed, according to formulation and were mixed thoroughly with the required milk and whey ratio by using blender. Subsequently, the mixture was heated up to 85 °C, kept for 15 min by stirring on a laboratory water bath and all samples (A, B, C, D, and E) were allowed to cool until reaching room temperature. After that, 100 g desserts were put into individual plastic cups, closed with cap to prevent drying and were stored at refrigerated conditions (4 ± 1°C) for 14 days. Appearance of the samples were given in Figure 2.

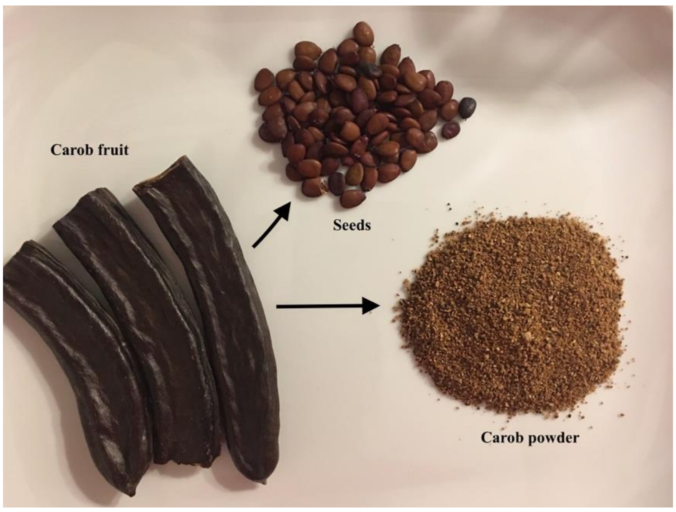


Figure 1. Carob fruit, seeds and carob powder

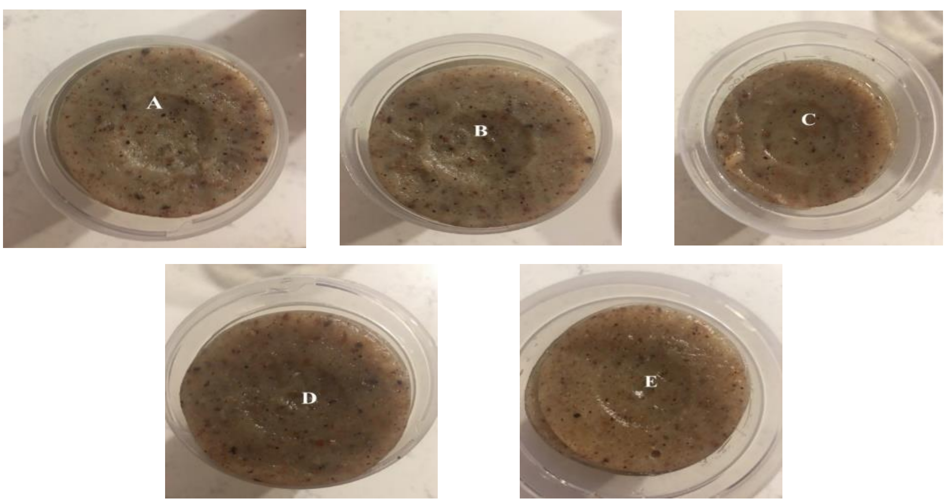


Figure 2. Appearance of carob powder added dairy-based dessert samples with different milk:whey ratios

Table 1 Dessert samples with different milk and whey ratios

Sample code	Milk (%,v/v)	Whey (%,v/v)
A (control)	100	-
B	75	25
C	50	50
D	25	75
E	-	100

Physiochemical analyses

The fat, titratable acidity, total solids and ash contents of the whey-based dairy desserts were determined according to the methods reported by Hooi et al., (2004). pH values were measured by digital pH meter (Ohaus, ST 300, USA). The protein content was calculated using the conversion factor 6.38, from the analysis of total nitrogen contents by the Kjeldahl method as described in the IDF Standard 20B (IDF, 1993). The water holding capacity (WHC) of the samples was measured by weighing about 20 g of dessert (DE) into cylindrical plastic tube and centrifugation (SIGMA Model 3-18K, Osterode am Harz, Germany) at 4°C for 40 min at 5000 rpm. After centrifuged the whey expelled (WE) was carefully removed and weighed. The WHC, % was calculated according to fallowing Equation (1). The WHC was determined in duplicate from independent samples (Granto et al., 2012).

$$\mathrm{WHC}\ (\%) = 100\ [(\mathrm{DE} - \mathrm{WE})/\mathrm{DE}] \qquad (1)$$

Texture analysis

Textural properties of samples were determined by using back extrusion test by Texture Analyzer TA-XT Plus (Stable Micro Systems, UK) with 5 kg load cell (Almedia Neta et al., 2018). Compression test was applied by using 35 mm disc (A/BE-d35, Stable Micro Systems, UK) on approximately 100 g samples in plastic cups. The parameters firmness, consistency, cohesiveness and viscosity index were recorded using Exponent software (Version 6.1.16.0, Stable Micro Systems). During the analysis, penetration distance, penetration speed and return speed were applied 30 mm, 1 mm/s and 10 mm/s, respectively. All determinations were carried out in triplicate.

Sensory evaluation

Sensory evaluation was performed by hedonic 5-point scale changing in "I dislike extremely" to "I like extremely and centered "neither like nor dislike" scale with a trained group of 10 panelists (Altug-Onogur and Elmacı, 2015). The panelists were selected from staff members and graduate students of Dairy Technological Department (Ankara University). The sensory attributes taken into consideration were color-appearance, flavor, textural, and overall acceptability. Approximately 20 g of each sample was presented to the panelists at refrigeration temperature in odorless plastic cups with three-digit random numbers coded. Water and cracker were provided to each panelists for palate cleansing between samples.

Color evaluation

Color measurement was performed in the samples by using a colorimeter Konica Minolta (CR 410, Sensing Inc., Osaka, Japan) and was reported as L^* (lightness), a^* (intensity of red to greenness) and b^* (intensity of yellow to blue) values. In addition, total color differences (ΔE) were calculated using the equation below, where L_0, a_0, and b_0 are the values measured for control (sample A) and used in Equation 2 (Chudy et al., 2020).

$$\Delta E = \sqrt{(\Delta L*)2 + (\Delta a*)2 + (\Delta b*)2} \qquad (2)$$

Statistical analysis

Statistical analysis of the data was performed using Statistical Package for the Social Science (SPSS) software program (SPSS Version 20.0, IBM Corp. Armonk, NY, USA, 2011). All whey-based dairy desserts were manufactured twice. Thus, results are mean ± standards deviation (SD) of n = 4. The two-way analysis of variance (ANOVA) was used to determine the effects of factors (sample type and storage time) on the measured parameters. Tukey comparison test was used to determine the statistically significant differences between means.

RESULTS AND DISCUSSION

Physiochemical properties

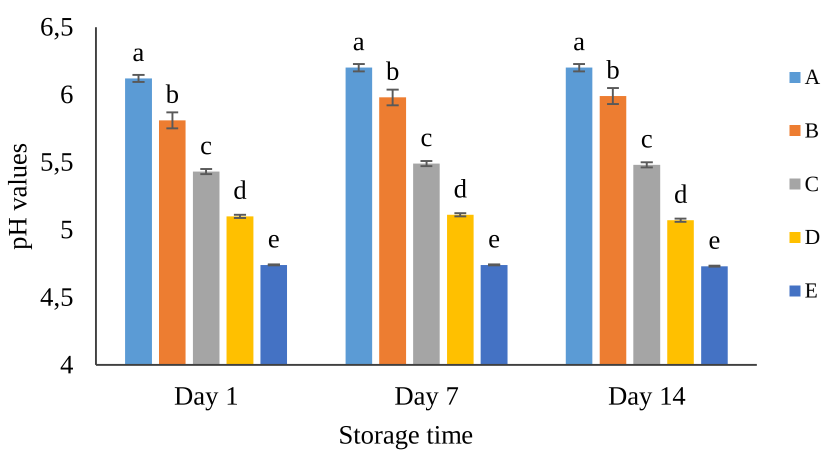
Table 2 shows the mean composition of dessert samples on the 1st day of storage. No significant differences (P>0.05) in dry matter and ash contents of whey-based dairy dessert samples were observed. However, there were significant differences (P<0.05) in protein contents of the samples. As expected the protein content in samples A and B were higher than the other samples since they contain higher amount of milk (Table 2).

Table 2 Mean composition of whey-based dairy dessert samples

Parameters (%, g/100 g)	Samples				
	A	B	C	D	E
Dry matter	19.65±0.40^{a}	18.40±1.32^{a}	19.39±0.78^{a}	18.01±0.18^{a}	18.60±0.47^{a}
Protein	4.301±0.14^{a}	3.75±0.07^{a}	3.00±0.71^{ab}	2.11±0.02^{b}	1.47±0.46^{b}
Ash	0.99±0.14^{a}	0.90±0.12^{a}	0.89±0.01^{a}	0.93±0.03^{a}	0.87±0.01^{a}

Lower cases (^{a,b}) indicate that the values in the same line differ significant at P<0.05.

The pH and titratable acidity analysis results for whey-based dairy dessert samples are presented Figure 3. The pH values of dessert samples ranged between 4.74 and 6.12 at day 1 and there was no significant difference (P>0.05) in the pH values during 14 days of storage. This indicates that the addition of whey and carob powder results in a stable pH in the dairy dessert samples under refrigerated conditions. However, differences in terms of pH values between whey-based dairy dessert samples were statistically significant (P<0.05). Lower pH values were obtained in samples (B, C, D and E) in accordance with added whey level. On the other hand, during the storage period some changes were observed in the titratable acidity of samples compared to pH values. The presence of exogenous buffer constituents in samples derived from milk and whey can cause the variations in pH were less pronounced than the variations in acidity (Tamime and Deet, 1980). The effect of addition of whey in different ratios and storage time on the titratable acidity values of dairy dessert samples were found to be statistically significant (P<0.01). Titratable acidity values of all dessert samples decreased until day 7 but increased at the end of 14 days of storage.



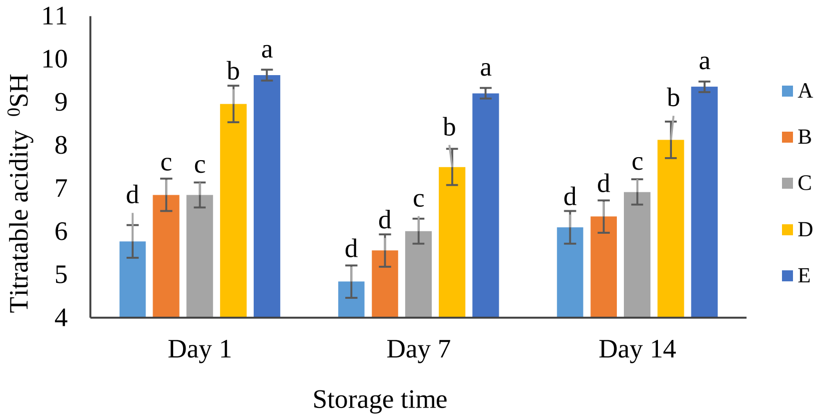


Figure 3. pH and titratable acidity of whey-based dairy desert samples
Error bars denote standard deviations. Different letters above the bars indicate significant differences (P<0.05) between dessert samples.

WHC is a useful tool to describe the ability of a food matrix to retain free water (Granato et al., 2012). WHC of the whey-based dairy dessert samples ranged from min 85.89% (sample E) to max 92.42% (sample A). In Figure 4, it is observed that the WHC was negatively affected (P< 0.05) by whey addition. The lowest WHC was determined in the E sample, which contains 100% whey with lower acidity. The highest value of WHC was determined in the dessert sample with no whey (sample A). However, WHC values of whey-based dessert samples formulated carob powder were not affected significantly (P>0.001) by the storage time and no significant difference was observed in sample and storage time interaction (P>0.05). This result may be due to effect of the carob powder which is a rich source of fiber (Srour et al., 2016; Moreira et al., 2017). It is known that the water absorption and water holding characteristics of fiber in food formulation would not only enhance nutritional value but also improve stability of the food during storage (Loullis and Pinakoulaki, 2018). These results were in agreement with the results obtained by Staffolo et al. (2017) who studied effect of plant fibers on some properties of low-calorie dairy desserts.

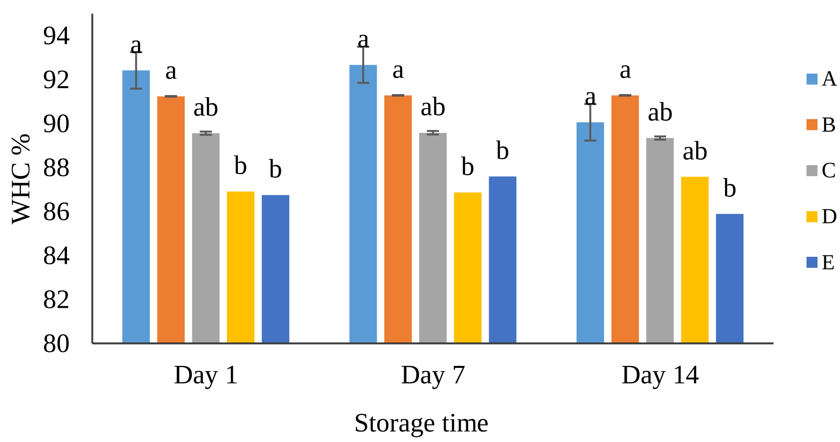


Figure 4. Water holding capacity (WHC) of whey-based dairy desert samples
Error bars denote standard deviations. Different letters above the bars indicate significant differences (P<0.05) between dessert samples.

Color evaluation

Color properties have a remarkable influence on consumer acceptance (Chudy et al., 2020). The changes in instrumental color parameters determined using L^*, a^* and b^* values are presented in Table 3. As can be seen, L^* (lightness) and b^*(yellow/blueness) values of whey-based dairy dessert samples were significantly different. The highest L^* value (41.45) was determined in sample A containing 100% milk, while the lowest L^* value (34.69) was found in sample E 100% whey. Depending on the amount of added whey, B, C, D and E samples exhibited lower L^* values. Carob powder resulted in darkening effect in color of the samples depending on its original color. The results for b^* values of dessert samples were ranging from 5.36 to 6.59, which represented a color in the yellow region. The negative a^* values of the samples changed between -3.65 and -4.70 were perceived as green. No significant (P>0.05) difference was observed among a^*(red/greenness) values of samples. But use of different whey ratio in the formulation created a significant difference in both L^* and b^* values of the samples (P<0.05) (Table3). The values of L^*, a^* and b^* were not affected significantly (P>0.05) by the storage time. Consequently, the total color difference (ΔE) for samples was significantly influenced by whey addition and storage time (P<0.05). Higher total color difference values (ΔE) were obtained in dessert samples with increasing whey ratios, but samples became less different than control (A) in terms of color; that is ΔE decreased from day 1 to day 14 in the samples. (Figure 5).

Table 3 Color parameters of whey-based dairy desert samples

Parameters	Storage time (days)	Samples					ANOVA		
		A	B	C	D	E	p-group	p-time	p-groupX time
L^*	1	41.45±0.14^a	39.69±0.87^a	37.53±1.05^b	36.82±0.81^b	34.69±0.66^c	***	NS	NS
	7	40.98±0.81^a	39.13±0.35^a	36.28±0.11^b	37.81±1.04^c	35.19±1.10^b			
	14	39.42±1.01^a	38.36±0.57^{ab}	36.72±1.41^{bc}	37.34±0.81^c	35.87±1.53^{bc}			
a^*	1	-4.49±0.32	-4.49±0.32	-4.50±0.49	-4.38±0.13	-4.70±0.24	NS	NS	NS
	7	-3.91±0.48	-3.91±0.91	-4.29±0.34	-4.51±0.21	-4.39±0.13			
	14	-3.65±0.28	-4.25±0.50	-4.25±0.50	-4.41±0.23	-4.35±0.12			
b^*	1	5.78±0.33^b	6.01±0.23^b	6.37±0.11^a	6.54±0.1^a	5.36±0.38^b	***	NS	NS
	7	6.12±0.35^a	6.37±0.23^a	6.01±0.11^a	6.59±0.0^a	5.37±0.09^b			
	14	5.47±0.12^b	6.09±0.68^a	5.54±0.25^b	6.40±0.0^a	5.49±0.16^b			

Lower cases (^{a,b,c}) indicate that the values in the same line differ significant at P<0.05.
*** P<0.0001, NS: not significant P>0.05, group: sample, time: storage time, group x time: interaction between sample and storage time

Texture properties

It is well recognized that the structure of foods greatly affects their textural properties (Almeida Neta et al., 2018). The results for textural parameters of whey-based dairy dessert samples were presented in Table 4. There were significant differences in textural properties between whey-based dairy desserts (P<0.05) Firmness is defined as the force necessary to achieve a given deformation in the product (Rosa et al., 2015). The firmness, consistency and viscosity index values of samples ranged from 2.65 to 6.04 (N), from 66.98 to 149.34 (N x s) and from 1.22 to 2.27 (N x s), respectively. In Table 4, it can be seen that dessert sample A (100% milk) got the highest values in terms of texture parameters except cohesiveness. Similarly, all texture parameters decreased in the samples associated with amount of whey used. As the amount of whey used in the formulation increased, texture values decreased and a softer structure was obtained in the samples (e.g. sample E with 100% whey). Table 4

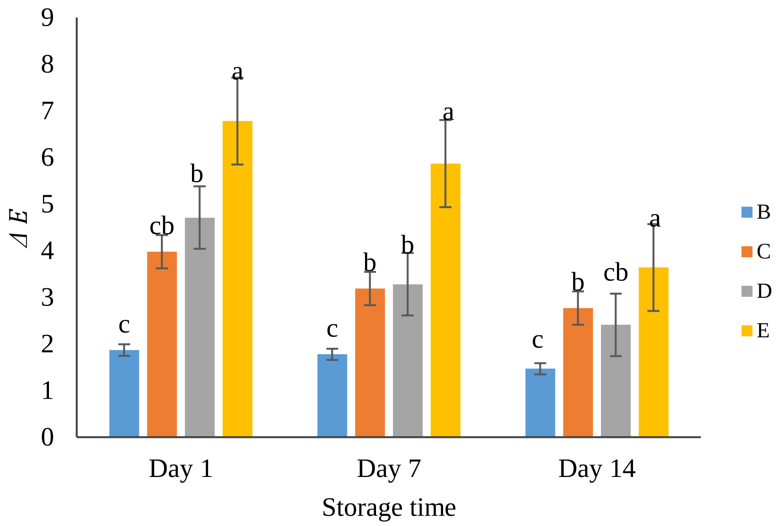


Figure 5. Total color difference values (*⊿E*) of whey-based dairy desert samples
Error bars denote standard deviations. Different letters above the bars indicate significant differences ($P<0.05$) between dessert samples.

Table 4 Textural parameters of whey-based dairy desert samples

Parameters	Storage time (days)	Samples					ANOVA		
		A	B	C	D	E	*p*-group	*p*-time	*p*-groupX*p*-time
Firmness (N)	1	5.50±013^{Ba}	4.75±0.13^{Cb}	3.5±0.14^{Cc}	2.81±0.04^{Bd}	2.65±0.13^{Bd}	***	***	***
	7	6.04±0.01^{Aa}	5.63±0.09^{Ab}	4.3±0.06^{Ac}	3.48±0.41^{Ad}	3.34±0.06^{Ad}			
	14	4.95±0.04^{Ca}	5.20±0.14^{Ba}	3.86±0.00^{Bb}	3.54±0.14^{Ac}	3.29±0.03^{Bc}			
Consistency (N x s)	1	134.54±3.52^{Ba}	115.57±2.09^{Cb}	96.97±10.51^{Bc}	70.47±1.43^{Bd}	68.71±3.14^{Bd}	***	***	**
	7	149.34±2.16^{Aa}	142.38±0.04^{Aa}	106.77±0.04^{Ab}	73.79±0.74^{Ac}	86.20±1.36^{Ad}			
	14	126.02±4.74^{Ca}	129.05±0.76^{Ba}	92.91±4.56^{Bb}	66.98±0.52^{Bc}	83.84±1.34^{Ad}			
Cohesiveness (N)	1	1.11±0.02^{A}	1.06±0.05	1.11±0.09	1.09±0.01	1.11±0.03^{A}	NS	*	NS
	7	1.12±0.01^{A}	1.09±0.04	1.04±0.04	1.08±0.05	1.05±0.01^{B}			
	14	1.02±0.01^{B}	1.07±0.03	1.06±0.02	1.05±0.01	1.04±0.01^{B}			
Viscosity index (N x s)	1	2.27±0.13^{a}	1.97±0.04^{Ab}	1.82±0.02^{Ac}	1.70±0.03^{Ac}	1.65±0.06^{Ac}	***	***	*
	7	2.19±0.01^{a}	1.8±0.04^{Bb}	1.75±0.06^{Ab}	1.67±0.03^{Ac}	1.52±0.06^{Bd}			
	14	2.16±0.00^{a}	1.79±0.04^{Bb}	1.59±0.06^{Bc}	1.42±0.02^{Bd}	1.22±0.06^{Ce}			

Upper cases (^{A,B,C}) indicate that the values in the same column differ significant at $P<0.05$
Lower cases (^{a,b,c,d,e}) indicate that the values in the same line differ significant at $P<0.05$.
* $P<0.05$, ** $P<0.001$, *** $P<0.0001$, NS: not significant $P>0.05$, group: sample, time: storage time, group x time: interaction between sample and storage time

Cohesiveness is an important textural property of dairy products and depends on the internal structure of the products. It is defined as ratio of positive force area during the second compression to that during the first compression (Rosa et al., 2015). The cohesiveness of dessert samples determined in this study range from 1.02 to 1.11 (N). Differences in cohesiveness values were not significant (*P*>0.05) between the whey-based dairy dessert samples.

The texture values obtained for carob powder added whey-based desserts were remarkably higher than determined in studies carried out on dairy desserts by Zarzycki et al., (2019), Rosa et al., (2015) and Almeida Neta et al., (2018). It is believed that the difference was related to presence of fiber-rich carob powder in the formulations.

There were significant increases in firmness, consistency and cohesiveness values of all dessert samples on day 7 and decreases were observed significantly at the end of storage. These results were similar those obtained by Almeida Neta et al., (2018) who carried out a study on fermented dessert with whey for 21 day. However, it was found that viscosity index values of all dessert samples were maximum on 1 day and decreased slightly during storage period (Table 4).

Sensory evaluation

The results of sensory analyses were given in Figure 6. Although, statistical data not shown in the figure; the flavor, color - appearance, textural and general acceptability scores of samples were detected as significantly different statistically (*P*<0.001). Results showed that the flavor scores of dessert samples were significantly affected by storage time (*P*<0.05). Besides that, the interaction between sample type and storage time significantly affected the flavor scores of dessert samples (*P*<0.001). Storage time was not found statistically significant in terms of appearance, textural and overall acceptability characteristics of the samples (*P*>0.05). The highest flavor scores (5 like extremely) were given for sample C (%50 milk and %50 whey) at days 1 and 7 of storage time. On the other hand, for samples C and D slight decrease were observed in flavor from day 7 to day 14, while there were significant increase in flavor scores of samples A, B, and E (P <0.05). Generally, flavor scores of samples A and E were remarkably lower than others (Figure 6).

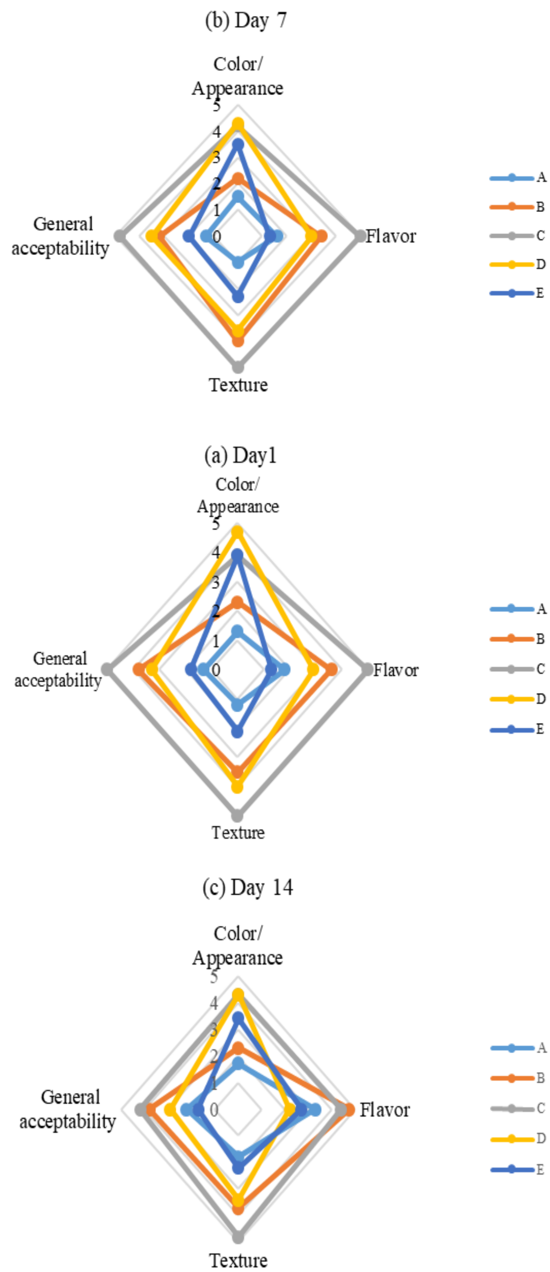


Figure 6. Sensory scores of whey-based dairy dessert samples with carob powder

Color-appearance attributes of sample C (50% milk and 50% whey) and D (25% milk and 75% whey) received higher scores and rated as "like" in 5-point scale. Although highest L^* (lightness) values were obtained in instrumental color analysis of sample A and sample B containing larger amount of milk (>50%), appearance scores were remarkably lower (Figure 6). This result indicated that darker color in whey-based dairy dessert with carob powder were more appreciated by panelists. The texture scores given for A, B, D and E with different milk and whey ratios (Table 1) were lower than sample C. The lowest texture scores were given for sample A and sample E but the highest and lowest firmness in instrumental texture analysis were also observed for sample A and sample E, respectively. In overall assessment, sample C, whey-based dairy dessert with equal amounts of milk and whey, exhibited better overall acceptability compared to other samples containing more than 50% of whey in the formulation.

CONCLUSION

This study focused on probability of using whey in dairy dessert production with different ratios together with carob powder and determining the characteristics of desserts during storage period. The use of whey in dairy dessert did not cause difference in mean composition of the product except protein content. Whey use in dessert formulation affected WHC, L^*, b^* and ΔE values of dairy dessert samples. However, carob powder use in the formulation was thought to improve WHC of whey-based dairy desserts during storage period. In general, the sensory analysis of whey based dairy with carob powder dessert indicated that sample C (50% milk and 50% whey) was more acceptable for panelists in terms of color-appearance, textural, flavor and overall acceptability. The results of this study demonstrated that, it is possible to use whey in proper ratios in dairy dessert formulations and also carob powder can be a good healthy ingredient alternative for dairy desserts. In further studies, it is valuable to examine the functional properties of the whey-based dairy desserts' characteristics with regarding health effects.

CONFLICT OF INTEREST
The authors have declared no conflict of interest.

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