

EFFECT of CHERRY LAUREL MARMALADE on PHYSICOCHEMICAL and SENSORIAL CHARACTERISTICS of THE STIRRED YOGURT DURING STORAGE TIME

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Received / Geliş tarihi: 01.08.2013

Received in revised form / Düzeltilek Geliş Tarihi: 18.11.2013

Accepted / Kabul tarihi: 28.11.2013

Abstract

The objective of this study was to investigate the effect of Cherry laurel marmalade (0%, 5%, 10%, 15%, and 20%) on the physico-chemical and sensorial characteristics of yogurts during the storage time. Increasing marmalade concentrations into the yogurts affected titratable acidity, a^* values and overall acceptability positively, and viscosity, syneresis and L^* values negatively. During storage time pH, viscosity, syneresis, b^* values, flavour and overall acceptability scores ($P<0.05$) decreased significantly compared to control, while titratable acidity and a^* values ($P<0.05$) increased significantly. When compared to L^* values at the end of storage time with the first day L^* values, at the marmalade added samples were observed an increasing but, at the control samples a decreasing were observed. 15% cherry laurel marmalade would be recommended in the production of fruit yogurts.

Keywords: Yogurt, cherry laurel, syneresis, viscosity, color, sensorial properties.

DEPOLAMA SÜRESİNCE PIHTISI KIRILMIŞ YOĞURTLARIN FİZİKOKİMYASAL VE DUYUSAL ÖZELLİKLERİ ÜZERİNE KARAYEMİŞ MARMELADININ ETKİSİ

Özet

Bu çalışmanın amacı, depolama süresince yoğurtların fizikokimyasal ve duyuşal özellikleri üzerine karayemiş marmeladının (%0, %5, %10, %15 ve %20) etkisini incelemektir. Yoğurtlara ilave edilen marmelat konsantrasyonunun artırılması titrasyon asitliğini, a^* değerini ve genel kabul edilebilirliği pozitif olarak, viskozite, su salma, L^* değerlerini ise negatif olarak etkilemiştir. Depolama süresince pH, viskozite, su salma, L^* ve b^* değerleri tat ve genel kabul edilebilirlik puanları kontrolle karşılaştırıldığında önemli düzeyde azalırken ($P<0.05$) titrasyon asitliği ve a^* değeri önemli düzeyde artmıştır ($P<0.05$). Depolamanın 1. günündeki L^* değerleri depolama sonundaki L^* değerleriyle karşılaştırıldığında, marmelat ilaveli örneklerde bir azalma gözlemlenmiş fakat kontrol örneklerinde bir artış belirlenmiştir. Meyveli yoğurtların üretiminde %15 karayemiş marmeladı tavsiye edilebilmektedir.

Anahtar sözcükler: Yoğurt, karayemiş, Su salma, Viskozite, Renk, Duyusal özellikler.

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INTRODUCTION

Cherry laurel (*Laurocerasus officinalis*) belongs to the *Rosaceae* family and is a popular fruit, mainly distributed in the coasts of the Black Sea region of Turkey and is locally called “Karayemis” (1). It is mostly consumed as fresh fruit in local markets although it may also be dried, pickled, and processed into pekmez, jam, marmalade, and fruit juice products (2). Besides its use for food, both fruit and seeds of cherry laurel are well known as traditional medicines in Turkey and have been used for many years for the treatment of stomach ulcers, digestive system complaints, bronchitis, eczemas, hemorrhoids, and as a diuretic agent, among others (3, 4). For years, food analysts and plant physiologists have been interested in the effects of maturation on the chemical components in the edible parts of fruits because of their impact in the market quality of the food product (5, 6).

The plant-derived edible and non-edible products contain a wide range of phenolic compounds such as phenolic acids, flavonoids, anthocyanins, tannins, lignans, and catechin that possess antioxidant activities. These phenolics provide protection against harmful free-radicals, and have been known to reduce the risk of certain types of cancer, coronary heart disease, cardiovascular disease, stroke, atherosclerosis, and other degenerative diseases associated with oxidative stress (5, 7).

Yogurt is a fermented dairy product obtained by lactic acid fermentation of milk, and is a popular product throughout the world (8-11). The origin of yogurt is not known definitely; but, historical records say that yogurt was firstly made by Turks in the Middle East (12).

Fruit-flavored yogurts are produced by adding fruit concentrates or flavored syrups to the cultured milk after or before the incubation process. Fruit added yogurts are now widely consumed both by infant and adult populations (13). At the same time, fruit leads to an increase in the nutritional value and causes product variability in the markets (14, 15). The objective of this study was to develop a new type of stirred fruit-flavored yogurt by adding Cherry laurel marmalade and to determine the effect of the marmalade on the physicochemical and sensorial properties of the yogurts during storage time.

MATERIALS and METHODS

The Cherry laurel fruit was collected from the coasts of the Black Sea Region of Turkey. Raw cow’s milk used in the manufacture of yogurt obtained from the dairy farm in Ordu, Turkey. Commercial freeze-dried starter culture (Y-080 F, a blend of *Streptococcus thermophilus* and *Lactobacillus delbrueckii* ssp. *bulgaricus*) was provided by Sacco, Cadorago, Italy and was used in the production of yogurt.

Production of Cherry Laurel Fruit Pulp

Decayed and unripe fruits were separated then the rest of the fruits were washed. Seeds were removed manually and the pulp was homogenized with an Ultra Turrax homogenizer (Cat X120, Germany). 30% sugar was added to the pulp. The pulp was then pasteurized at 90 ± 1 °C for 5 min and transferred to sterile glass jars. After cooling they were kept at ambient temperature until their use in the experimental yogurts.

Manufacture of Experimental Yogurts

The total solid of milk was adjusted 14% with nonfat milk powder (Pinar AS, Dairy Product Company, Pinarbasi, Izmir, Turkey) at 40°C. Then milk was pasteurized at 95 °C for 10 min, cooled to 45 °C, and divided into five equal parts (250 g sterile glass cups). Commercial freeze-dried yogurt starter culture was reactivated by inoculation in sterilized reconstituted milk and incubated at 44 ± 1 °C before being used in the yogurt production. Then, milk was inoculated with 2% (v/v) reactivated yogurt cultures, and incubated at 43 ± 1 °C until the pH reached 4.6 (approximately 3.5 h), and were stored for 24 h at 4°C. One batch of yogurt was then taken as control, and the remaining batches were prepared with one of the mixtures of 5%, 10%, 15% and 20% Cherry laurel marmalade, and samples were coded as CY, K1, K2, K3 and K4, respectively. All experimental yogurts were stored at 4 °C for 21 days. Samples were analyzed for physicochemical and sensorial properties after 1, 7, 14 and 21 days of storage. Experiments were replicated twice.

Analytical Methods

The color of yogurt samples was measured using the CIELAB system with a colorimeter (Minolta CR 400, Japan), calibrated with a white tile (Minolta calibration plate, No. 21733001, Y=92.6, x=0.3136, y=0.3196) at 2° observation angle with a C illuminant source (16).

Ash, fat, and titratable acidity were determined using the method given by Case et al. (17), and titratable acidity results were expressed as lactic acid. Nonfat dry matter (NFDm) contents of yogurt samples were calculated. The pH of each sample was measured with a digital pH meter (digital pH meter, Hanna, Italy) equipped with a glass electrode that was inserted directly into the yogurt sample for the measurement. The syneresis was determined at 5 ml of yogurt centrifuged at 5000 rpm for 20 minutes at 4°C. The syneresis rate (%) was expressed as volume of separated whey per 100 ml of yogurt (18). Viscosity measurements were taken at 15 °C with a Brookfield viscometer (Model DV-1±; Brookfield Engineering Laboratories, Inc., MA)

Sensorial Characteristics

The panelists were asked to evaluate each sample in turn covering a list of judged parameter attributes using a hedonic scale with 1 being the worst (5 = like very much; 3 = neither like nor dislike; 1 = dislike extremely). The qualities judged were: exterior appearance (by looking to yogurt sample in daylight directly), consistency by spoon (by gentle mixing yogurt with a spoon) and by mouth, smell and taste intensity, perceived fruit. For consistency by mouth, odor and taste intensity, and perceived fruit and sweetness, a spoon of yogurt is taken and spread out by tongue. The overall acceptability was calculated as sum of the scores of the parameters judged. The yogurts were evaluated on 1, 7, 14, and 21 days of storing by eight panelists familiar with yogurt. Water was provided for mouth washing between samples.

Statistical Analysis

Statistical analyses of data for effects of fruit marmalade on physicochemical and sensory properties of yogurt were analyzed by ANOVA procedures using SPSS statistical software (19). The differences between means were evaluated by the Duncan's multiple range tests.

RESULTS and DISCUSSION

Table 1 shows the total solid, ash, fat and nonfat dry matter (NFDm) contents of the yogurt samples. As shown at Table 1, marmalade rates significantly ($P<0.05$) affected total dry matter and the highest score were observed in the samples with 20% marmalade (20.28 g/100 g) while the lowest score (13.77g/100 g) observed in samples (control yogurt) without marmalade. The average fat contents of the yogurts ranged from 2.90% to 2.55%. Expectedly, the adding of marmalade decreased the fat contents of the samples significantly when compared to control samples ($P<0.05$). The mean fat content of the stirred yogurts was similar to that found by Tarakçı and Küçüköner (20), Rahman et al. (21) and Cinbaş and Yazıcı (22) for yogurts addition blueberries, but lower than that reported by Yazıcı and Akgün (23). Nonfat dry matter (NFDm) contents of yogurts increased significantly with added marmalade, but decreased ash contents especially after added 15% marmalade ($P<0.05$). This decreasing in ash contents of yogurts might be due to decreasing ash content of Cherry laurel marmalade.

Figure 1 shows titratable acidity of yogurts during storage time. Titratable acidity of yogurts detected between 0.87 and 1.56, and increased significantly up to 14th day of the storage ($P<0.05$), and did not show any statistical difference on 14th and 21st day for all treatments. Çelik et al. (14) found that through three weeks of storage in refrigeration, yogurt flavored with berries significantly increased its acidity. Singh and Muthukumarappan (24) reported a similar increase in acidity of control and calcium enriched fruit yogurt during storage. Marmalade concentrations were not affected titratable acidity of yogurts ($P>0.05$).

The pH values decreased significantly ($P<0.05$) in each yogurt sample during the storage time. The pH of all yogurts decreased gradually up to 14 days, and after a slightly increase was observed

Table 1. The mean values of some properties of yogurts

Yogurt	Total solid (%)	Ash (%)	Fat (%)	NFDm (%)
CY	13.77±0.13 ^e	0.97±0.03 ^a	2.90±0.00 ^a	10.87±0.13 ^e
K1	14.93±0.19 ^d	0.94±0.01 ^a	2.75±0.07 ^{ab}	12.17±0.14 ^d
K2	16.91±0.21 ^c	0.95±0.03 ^a	2.75±0.07 ^{ab}	14.15±0.27 ^c
K3	19.14±0.39 ^b	0.87±0.02 ^b	2.60±0.14 ^b	16.54±0.53 ^b
K4	20.28±0.23 ^a	0.81±0.02 ^c	2.55±0.07 ^b	17.73±0.16 ^a

CY (Control), K1 (5% marmalade), K2 (10% marmalade), K3 (15% marmalade) and K4 (20% marmalade)

^{abcde} Letters indicate significant differences among yogurts with added marmalade, $P<0.05$.

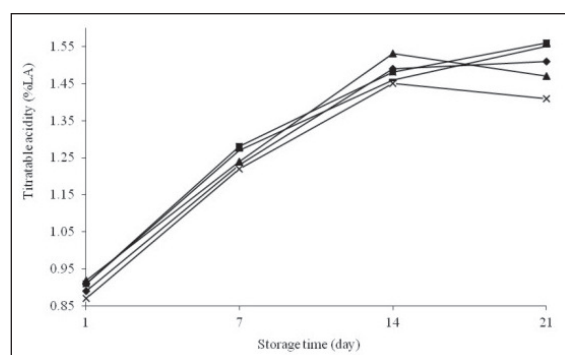


Figure 1. Effect of marmalade concentration on titratable acidity of yogurts. ◆ CY: control, X K1: 5%, ▲ K2: 10%, ◻ K3: 15% and ■ K4: 20% marmalade.

for control and K1 samples (Figure 2). The increase at 14 and 21 days of storage was not significant ($P>0.05$). The lowest pH was reached after 14 days of storage. Especially, K4 sample had greater pH value (4.25), when compared to other samples. In a similar experiment, Öztürk and Öner (25) observed that the pH decreased during storage at 4 °C for 21 days. Similar results were reported by Cueva and Aryana (16), Küçükçetin (26), Sahan et al. (27), Kailasapathy et al. (28), and Ramirez-Sucre and Velez-Ruiz (29). In other study on yogurt added with banana (30), the acidity increased (0.93, 0.96, 0.98 g/100 mL) while pH decreased (4.38, 4.37, 4.36) with storage time (0, 7, 14 days, respectively). In consequence of fermentation of lactose by bacteria, lactic acid and galactose increases. Decreasing of pH may be due to use sugar and organic acids of yeasts. As sugar sources finish, microorganisms begin to consume proteins, and which results in some by products that increase pH (31).

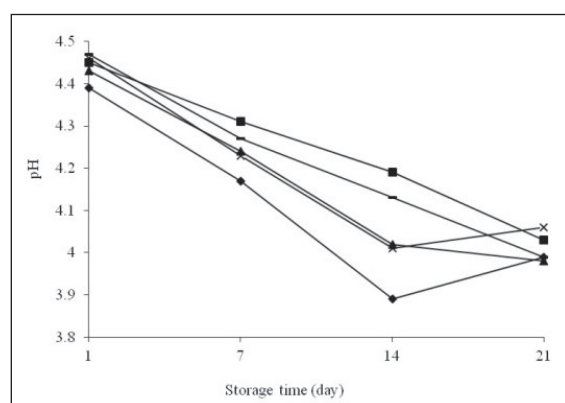


Figure 2. Effect of marmalade concentration on pH of yogurts. ◆ CY: control, X K1: 5%, ▲ K2: 10%, ◻ K3: 15% and ■ K4: 20% marmalade

Syneresis is defined as spontaneous water release from the gel caused by contraction. The most important causes for syneresis in fermented products include the use of high temperatures of incubation, low solid content or inadequate storage temperatures (32). There were significant ($P<0.05$) differences in syneresis over 1, 7, 14, 21 days. Values decreased on 14th days and increased on 21st day (Figure 3). Similar results were reported by Boeneke and Aryana (32) for lemon yogurt. The addition of marmalade caused a decrease of syneresis values in all samples of the yogurt, and differences between the control and the other samples were significant ($P<0.05$). Yogurt formulated with K1 showed the highest syneresis (45.75 mL/100 g), while the sample formulated with K4 showed the lowest syneresis (39.00 mL/100 g), even lower than the control sample (48.25 mL/100 g). This could be attributed to the availability of fiber from cherry laurel fruit, which has higher water-holding capacity (33). These results indicated that the fruit concentration used in marmalade had an important effect on the syneresis of yoghurt. Similar results were reported by Cueva and Aryana (16). Storage times also affected syneresis significantly ($P<0.05$). In general, syneresis value of all yogurt samples decreased until 14 days of storage, and then increased except for K3. Similar results were reported for yogurt prepared with jack fruit juice (21) and for yogurt prepared with banana pure and sugar combinations (34). Those results were similar to that reported by Küçükçetin (26) which reported that the levels of syneresis decreased as the final fermentation pH decreased.

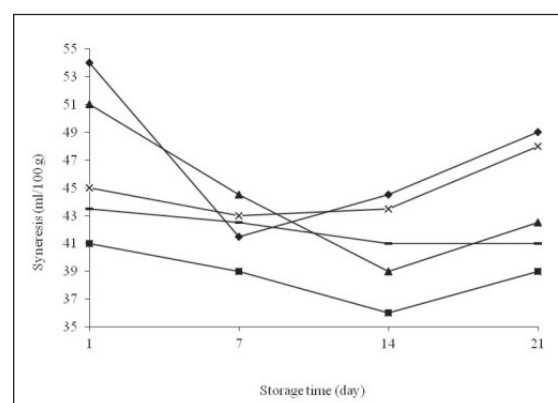


Figure 3. Effect of marmalade concentration on syneresis of yogurts. ◆ CY: control, X K1: 5%, ▲ K2: 10%, ◻ K3: 15% and ■ K4: 20% marmalade

The viscosity is one of the typical major parameters for semiliquid food products. Viscosity measurement was applied successfully in the evaluation of yogurt texture (32). The viscosity of yogurt was affected significantly ($P<0.05$) by both marmalade concentration and storage time (Figure 4). The viscosity of the control and fruit-flavored yogurt decreased rapidly up to the day 14, and then remained constant during the other period of storage.

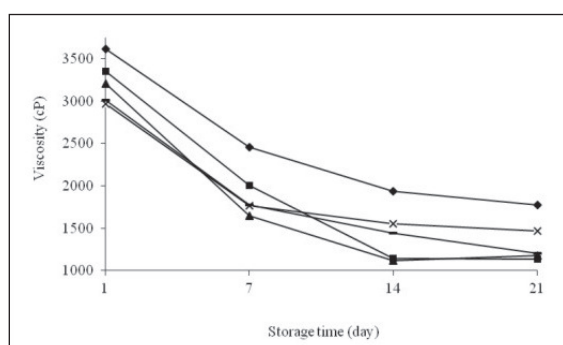


Figure 4. Effect of marmalade concentration on viscosity of yogurts. ◆ CY: control, X K1: 5%, ▲ K2: 10%, — K3: 15% and ■ K4: 20% marmalade

Yogurt formulated with fruit marmalade K4 showed the highest viscosity while the sample formulated with K2 showed the lowest viscosity, and even lower than the control sample at 1 and 14 days of storage time. But viscosity values were detected at the lower levels for K3 and K4 yogurts when compared to other treatments at 14 and 21 days of storage time (Figure 4). Similar results were reported by Çelik et al. (14). On the other hand, the viscosity of the fruit-flavored

yogurts was influenced by the rates of the fruit addition. The addition of the fruit marmalade reduced the mean viscosity values when compared to control samples. The addition of large amounts of concentrated fruit juices decreases the water-holding capacity of protein (i.e. diluting the protein content in the milk base); thus the viscosity of the yogurt decreases (35).

The color characteristics of the yogurts are shown in Table 2. Although the L^* (whiteness-darkness) and b^* (yellowness/blueness) color values of yogurts decreased by marmalade addition, a^* (greenness-redness) values increased significantly ($P<0.05$). The L^* value for the control was significantly higher than the L^* values of the other treatments. Increasing marmalade ratios in yogurts had a darker yellow color with a higher degree of luminosity than that of the control yogurt. These results are agreement to the findings of Calvo et al. (35) on the perception of color in various fruit-flavored yogurts. This situation was also acceptability in the industrial production of fruit added yogurt, for which color intensity does meet the consumers' acceptance. In the present study, L^* , a^* and b^* values were fluctuated during the storage time. But b^* values of the all samples increased at the end of storage time which might be due to conversion of the coloured flavylum cation of anthocyanin into colourless or yellowish forms. Similar results were reported by Needs et al. (36), Scibisz et al. (7) and Cinbaş and Yazıcı (22) for yogurts addition blueberries.

Table 2. Effect of marmalade concentration on color values of yogurts

Properties	Yogurt	Storage periods (day)			
		1	7	14	21
L^* value	CY	93.93±0.19 ^{a,A}	93.05±0.29 ^{a,A}	93.22±0.29 ^{a,A}	89.82±1.99 ^{a,B}
	K1	76.93±1.33 ^{b,B}	76.08±0.51 ^{b,B}	80.25±0.91 ^{b,A}	83.04±1.64 ^{b,A}
	K2	62.17±1.61 ^{c,B}	72.07±3.76 ^{b,A}	73.53±0.74 ^{c,A}	71.10±0.45 ^{c,A}
	K3	52.45±0.57 ^{d,B}	66.98±1.73 ^{c,A}	67.03±0.04 ^{d,A}	65.30±0.67 ^{d,A}
	K4	47.15±0.34 ^{e,B}	60.81±0.16 ^{d,A}	61.18±0.65 ^{e,A}	60.36±1.02 ^{e,A}
a^* value	CY	-2.84±0.08 ^{a,A}	-2.81±0.09 ^{a,A}	-2.88±0.23 ^{a,A}	-3.48±0.21 ^{e,B}
	K1	4.81±0.54 ^d	4.17±1.04 ^d	3.85±0.06 ^d	3.25±0.08 ^d
	K2	6.85±0.01 ^c	6.61±0.20 ^c	6.62±0.03 ^c	6.88±0.39 ^c
	K3	8.29±0.11 ^{b,B}	9.02±0.28 ^{b,A}	8.51±0.13 ^{b,AB}	9.01±0.14 ^{b,A}
	K4	9.10±0.31 ^{a,B}	10.54±0.19 ^{a,A}	9.85±0.56 ^{a,AB}	9.91±0.17 ^{a,AB}
b^* value	CY	11.11±0.23 ^{a,B}	10.50±0.56 ^{a,B}	10.01±0.12 ^{a,B}	13.59±0.82 ^{a,A}
	K1	7.06±0.38 ^{b,AB}	6.51±1.20 ^{c,B}	7.81±0.12 ^{d,AB}	8.39±0.35 ^{b,A}
	K2	6.31±0.16 ^{c,B}	8.13±0.60 ^{bc,A}	8.51±0.03 ^{c,A}	8.57±0.38 ^{b,A}
	K3	6.32±0.23 ^{c,C}	9.12±0.04 ^{ab,A}	8.75±0.06 ^{bc,B}	9.15±0.08 ^{b,A}
	K4	6.25±0.24 ^{c,B}	9.69±0.02 ^{ab,A}	9.40±0.53 ^{ab,A}	9.59±0.48 ^{b,A}

CY (Control), K1 (5% marmalade), K2 (10% marmalade), K3 (15% marmalade) and K4 (20% marmalade)

^{abcde} Letters indicate significant differences among yogurts with added fruit marmalade (in columns), $P<0.05$.

^{ABC} Letters indicate significant differences among storage times (in lines), $P<0.05$.

Yogurt texture characterization is important for product and process development, and quality control to ensure consumer acceptability (37). Sensory evaluations have indicated a marked preference for the fruity and sweet characteristics of yoghurt (38). This characterization can be done using either instrumental or sensory measurements (39). The sensorial evaluation results of the fruit-flavored yogurts are illustrated in Table 3. Results of sensorial evaluation showed that significant differences were observed among yogurt samples ($P<0.05$). The addition of marmalade at different rates to yogurt affected the scores for appearance and color significantly ($P<0.05$), and overall acceptability, whereas no significant effect ($P>0.05$) was observed for body and texture, and flavour. The lowest overall acceptability scores from marmalade-added yogurts were detected for K1 samples, while the higher overall acceptability scores were detected for K3. Storage times affected flavour and overall acceptability scores significantly ($P<0.05$). Flavour scores were similar to 1st and 7th day and then decreased significantly ($P<0.05$). In general, the flavour scores at the day 21 were lower than the other days. Similar results were reported by Cueva and Aryana (16). The overall

acceptability scores decreased significantly ($P<0.05$) during storage time. At the 21st day the yogurts had become the lower overall acceptability scores. Because, the acidity values at the 21st day reached to the higher values. Diacetyl, lactic acid and acetaldehyde contribute most to the final flavour, and their concentrations and relative levels determine the 'general quality' of the product and its acceptance by consumers (40). With respect to sensorial scores, in the production of fruit marmalade yogurt, it can be concluded that the addition of 15% and 20% fruit marmalade would be recommended.

CONCLUSION

Effects of cherry laurel marmalade on physico-chemical and sensorial properties of yogurts were investigated. The addition of cherry laurel marmalade to the yogurts led to a remarkable decrease of the viscosity, syneresis, L^* , and b^* values of the yogurts. During storage, yogurt pH and syneresis decreased, but the titratable acidity, L^* and b^* increased. Sensory evaluations showed that appearance and color, body and

Table 3. Effect of marmalade concentration on sensorial scores of yogurt

Properties	Yogurt	Storage periods (day)					YTX
		1	7	14	21		
Appearance and color	CY	4.63±0.52	4.50±0.54	4.50±0.53	4.50±0.53	4.53 ^a	
	K1	4.12±0.84	3.37±0.74	3.87±0.99	3.75±0.71	3.78 ^b	
	K2	4.25±0.89	4.25±0.83	3.87±0.64	4.25±0.71	4.12 ^b	
	K3	4.25±0.88	4.62±0.74	4.00±0.92	3.88±0.64	4.19 ^{ab}	
	K4	4.12±0.84	3.87±0.99	4.13±0.83	4.00±0.92	4.03 ^b	
	RTX	4.27	4.10	4.07	4.07		
Body and texture	CY	4.50±0.53	4.50±0.53	4.25±0.46	4.50±0.53	4.44 ^a	
	K1	3.37±0.50	3.50±0.76	3.75±0.46	3.50±0.53	3.53 ^b	
	K2	3.87±0.64	3.62±0.52	3.75±0.46	3.75±0.89	3.75 ^b	
	K3	3.75±0.71	3.75±0.46	3.75±0.46	3.62±0.74	3.72 ^b	
	K4	3.50±0.53	3.87±0.64	3.63±0.51	3.25±0.71	3.56 ^b	
	RTX	3.80	3.85	3.82	3.72		
Flavour	CY	4.25±0.35	4.25±0.46	4.63±0.52	4.37±0.46	4.37 ^a	
	K1	3.75±0.46	3.87±0.64	3.37±0.59	3.62±0.74	3.65 ^b	
	K2	3.62±0.74	3.50±0.75	3.25±0.46	3.75±0.88	3.53 ^b	
	K3	4.37±0.52	3.87±0.35	3.50±0.53	2.87±0.83	3.65 ^b	
	K4	4.00±0.53	4.00±0.76	3.37±0.52	3.25±0.71	3.66 ^b	
	RTX	4.00 ^a	3.90 ^a	3.62 ^b	3.57 ^b		
Overall acceptability	CY	13.39±1.37	13.25±1.46	13.37±2.05	13.38±1.27	13.34 ^a	
	K1	11.24±2.34	10.74±1.85	10.99±2.07	10.87±2.54	10.96 ^e	
	K2	11.74±1.86	10.87±2.28	10.89±2.45	11.04±1.87	11.13 ^d	
	K3	12.37±2.46	12.24±2.75	11.24±2.94	11.13±2.42	11.74 ^b	
	K4	11.62±2.84	11.73±2.60	11.13±3.15	10.76±2.17	11.31 ^c	
	RTX	12.07 ^a	11.77 ^b	11.51 ^c	11.31 ^d		

CY (Control, with no marmalade), K1 (5% marmalade), K2 (10% marmalade), K3 (15% marmalade) and K4 (20% marmalade)

^{abcde} Letters indicate significant differences among yogurts with added fruit marmalade (YTX), $P<0.05$.

^{ABCD} Letters indicate significant differences among storage times (RTX), $P<0.05$.

texture were not affected significantly by storage time, while flavour and overall acceptability values affected significantly. In the sensorial evaluations, K3, containing 15% cherry laurel marmalade was preferred over other marmalade-added samples. The results revealed that Cherry laurel fruit can be used in manufacture of yogurt for increasing consumption, but further investigations are needed to achieve the best physico-chemical and sensory characteristics of the final product, and in particular, the effect of different stabilizing agents should be investigated for fruit-flavored yogurts.

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