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Effects of different types of dried fruit on sensory and texture properties of white cheese

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A B S T R A C T

In the study, five kinds of white cheese produced, one of which was a control sample (CC). According to the amount of curd used in the production of cheese, black mulberry (C1), blackberry (C2), black grape (C3) and raspberry (C4) dried fruit added to the curd at a rate of 2%. The cheeses packed with a vacuum packaging machine and left to ripening for 90 days at 7±1°C. During the ripening period (3rd, 30th, 60th, 90th days) samples were taken from cheeses, sensory analyses were performed, and textural parameters including resilience, hardness, springiness, gumminess, cohesiveness, adhesiveness, and chewiness were determined using texture profile analyses (TPA). It was observed that neither cohesiveness, adhesiveness and springiness parameters of texture profile differed in terms of cheese type, nor important statistical difference was identified ($p>0.05$), differences regarding the ripening process found out though ($p<0.05$).

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1. Introduction

With their high antioxidant capacity, unique taste, color and smell, raspberries, blackberries, black grapes and black mulberries have a wide range of uses in the field of food. In the last few decades, there has been a constant increase of rich sources of biochemical compounds with health benefits popularity and interest regarding research of all fruit species. Fruits have a special importance among other fruits due to their unique color, taste and smell, rich vitamin and mineral contents and various usage possibilities in the food industry (Güneşli et al., 2019). Dried fruits are a concentrated form of fresh fruits, although they have lower moisture content than their fresh counterparts, as most of their moisture content has removed through various modern drying techniques such as sun drying or mechanical devices (Chang et al., 2016). The fruit pineapple, peach and pear are added to fresh cheese to obtain cheese desserts of different flavor variations and thus offer a product that would approach consumers, especially children, who are eating more and more unhealthy foods at the time (Brčina et al. 2017). When we look at the fruit types, berries such as black mulberries, raspberries, blackberries, and black grapes distinguished from other fruits by the organic and inorganic components in their chemical composition, and thanks to their high antioxidant structures, they reduce the damage caused by oxidative stress in the body (Tosun and Yüksel, 2003). The phenolic compounds contained in black mulberry increase body of resistance against diseases with their high antioxidant properties. Its high antioxidant content is due to the anthocyanins found in the composition of black mulberry. Anthocyanins give black mulberry its red color. When consumed, black grapes, which contain fruit sugars used as an energy source in the body, help the body to recover the energy it spends during the day in a short time. It contains color pigments, phenolic substances, flavonoids, flavones and vitamins, and its fibrous structure is higher than other fruit types. Anthocyanins constitute most of the phenolic compounds found in blackberries. They used in the food industry to produce functional products with high antioxidant capacity and to increase the shelf life of products (İstek et al., 2021). Raspberry, which has sweet, red fruits that ripen in summer and autumn, belongs to the Rosacea family in the berry group. The aim of this study is to create a new cheese variety with the addition of dried black mulberry, blackberry, black grape and raspberry and to determine the nutritional, sensory, functional, aroma and structural properties of these cheeses.

2. Materials and methods

Cow milk obtained from a local dairy plant in Ordu, Türkiye. Commercial rennet (1/16000) obtained from Mayasan Company®, Istanbul. All dried fruit samples were products of Bağdat Baharat Company, Kahramanmaraş, Türkiye.

2.1. Cheesemaking

Raw milk pasteurized at 75 °C for 30 s and cooled to 32 °C. Then milk coagulated with rennet for 75 min. After coagulation, the curd cut into 8-10 mm cubes with a wire knife and pressed for 120 min. According to the amount of curd used in the production of cheese, black mulberry, blackberry, black grape and raspberry dried fruit added to the curd at a rate of 2%. Five kinds of white cheese produced, one of which was a control sample (CC), black mulberry (C1), blackberry (C2), black grape (C3) and raspberry (C4) dried fruit added. After the pressing process was completed, the cheeses were removed from the cloth and dry salted to 4% salt by weight. The cheeses packed with a vacuum packaging machine and left to mature for 90 days at 7±1°C. During the ripening period (3^{rd}, 30^{th}, 60^{th}, 90^{th} days) samples were taken from cheeses, sensory analyses were performed, and textural parameters including resilience, hardness, springiness, gumminess, cohesiveness, adhesiveness, and chewiness were determined using texture profile analyses (TPA). Two replicates of cheese samples were prepared for each cheese type.

2.2. Texture profile analysis

For the texture analysis, the temperature of the cheeses adjusted to 20±2 °C. The cheeses cut into cubes with the dimensions of 20x20x20 mm with a cutting wire. Texture profile analyses (hardness, springiness, gumminess, cohesiveness, adhesiveness, resilience and chewiness) of cheese samples performed using TA-XT2 (Stable Micro Systems Ltd., Surrey, UK). Analysis conditions: P/36 aluminum cylinder probe (36 mm diameter, AACC) and cell strength 25 kg weight, test speed 0.4 mm/s, initial test speed 1.0 mm/sec, print 40 %, hold time 5 s (Everard et al., 2006).

2.3. Sensory analysis

In the study, five kinds of white cheese produced, one of which was a control sample, other four samples, black mulberry, blackberry, black grape and raspberry dried fruit added to cheese curd. Sensory evaluations of cheese with dried fruit made by a panel of ten graduate students, experienced in the sensory evaluation of cheeses. Before evaluation, each cheese cut into 20 g cubes, left at room temperature (20 °C) for 2 h, and randomly served to the panelists. Overall sensory quality was assessed using a hedonic scale method (1-10 points), with 1 being unacceptable and 10 being very good for color and appearance, smell, structure and texture, taste and flavor. The panelists given a glass of water to rinse their mouths between cheese samples (Gezmiş and Tarakçı, 2020). Panelists also asked to report any flaws in color and appearance, texture, odor, taste, and overall acceptability.

2.4. Statistical analysis

All analyses performed in duplicate. Minitab 16.0 Statistical Software (Minitab Inc.) used for all statistical calculations, and the results presented as mean ± standard deviation. Analysis of variance (ANOVA) used to determine significance, followed by Tukey's multiple range tests. The significance level of $p<0.05$ was used for statistical differences.

3. Results and discussion

3.1. Texture profile analysis (TPA) in cheese samples

Texture profile analysis (TPA) used to obtain information about the physical and sensory properties of cheeses. With texture profile analysis, properties of cheeses such as flexibility, hardness, springiness, gumminess, cohesiveness, adhesiveness, stability, and chewiness are examined (Günasekaran et al., 2003). In the other method, cheeses placed on the device probes with the help of devices and information about their texture obtained by applying pressure on them in various ways. In texture analysis, properties vary depending on the type of cheese, and changes occur in sensory properties (Hort and Grysç, 2001).

3.2. Hardness values in cheese samples

Hardness defined as the pressure that applied between the teeth to shatter and deform the cheese (Baysal, 2019). To determine the hardness level of the cheese, a sample placed in the device and the first compression process is applied. This compressive force applied on the cheese is an indicator of the hardness level of the cheese. Hardness varies depending on the salt, water, pH and acidity values in the cheese and the ripening time (Özcan and Delikanlı, 2011). The change in hardness values of cheeses with various dried fruits added to the curd during their ripening periods is shown in Table 1. In the study, the hardness values of cheeses with added dried fruits, analyzed during their ripening periods, were found to be between 15.28 and 28.52. The highest hardness degree was measured in the C4 sample on the 5^{th} d, and the lowest hardness degree was measured in the control sample on the 90^{th} d. When the hardness values analyzed during the ripening periods of cheeses with added dried fruit are evaluated statistically; In the variation analysis, variety and period factors affected the hardness values of the cheeses significantly ($p<0.05$) independently of each other. When variety and period factors were evaluated together, their effects on the hardness values of cheeses were found to be significant ($p<0.05$). It is thought that the decrease in the hardness values of cheeses is affected by factors such as ripening time, ripening conditions, type of milk used and cheese production technique. It is also thought that proteolysis reactions during cheese ripening will affect the hardness values (Okumuş, 2016, 2019).

3.3. Adhesiveness values in cheese samples

Adhesiveness defined as the degree to which food deforms in the mouth without falling apart or breaking (Altuğ and Demirbağ, 1993). The change in the adhesiveness values analyses during the ripening period of cheeses produced by adding dried fruit to curd shown in Table 1. The adhesiveness degrees of the cheeses varied between -1.29 and -26.74 during ripening periods. When the stickiness values of cheeses with added dried fruits are evaluated statistically during their ripening period; In the variation analysis, the effect of type and period factors on the adhesiveness values of cheeses was not found to be significant ($p<0.05$), regardless of each other.

When variety and period factors were evaluated together, their effects on the adhesiveness values of cheeses were found to be significant ($p<0.05$). It thought that the increase in stickiness values in the samples is due to the high acidity rates of dried fruit varieties affecting the cheese and decreasing the pH values. Studies show that cohesiveness decreases, and adhesiveness increases at the end of the ripening period in cheeses. Proteolysis during ripening periods, increased lipolysis levels and moisture content of the cheese are factors that affect stickiness.

3.4. Cohesiveness values in cheese samples

Cohesiveness, it refers to the pressure that must be applied to break down a semi-soft food product (Akan and Kinik, 2018). The change in the cohesiveness values of cheeses with added dried fruits analyses during their ripening periods, shown in Table 1. In the statistical study, the consistency values during the ripening times of cheeses with added dried fruits varied between 0.25 and 0.83. While the highest cohesiveness measured in the control sample and the C2 sample on the 5th d, the lowest cohesiveness value measured in the C4 sample on the 90th d. When the cohesiveness values of dried fruit added cheeses analyses during their ripening periods are evaluated statistically; In the variation analysis, variety and period factors significantly ($p<0.05$) affected the cohesiveness values of the cheeses independently of each other. When variety and period factors were evaluated together, their effects on the cohesiveness values of cheeses were found to be significant ($p<0.05$).

Cohesiveness, it is an indicator of the strength and durability of the bonds in the internal structure of the cheese. There is a positive relationship between the moisture content of cheeses and their cohesiveness values. As the ripening time of cheese samples increases, the cohesiveness values decrease. This decrease is due to the increase in the levels of proteolysis and lipolysis that occur during the ripening process and the decrease in the rates of casein and peptide, which are breakdown products (Çelebi and Şimşek, 2020).

3.5. Springiness values in cheese samples

Springiness stated as the rate at which the cheese returns to its original form after the first compression (Tarakçı and Bayram, 2020). Akan and Kinik (2018) stated that the amount of salt added to cheese reduces the springiness of cheese samples during the storage process.

The change in the springiness values analyses during the ripening period of cheeses with added dried fruit shown in Table 1. Elasticity values analyses during ripening periods of cheeses with added dried fruits varied between 0.66 and 0.94. The highest springiness value measured in the control sample on the 5th d, and the lowest value measured in the C2 sample on the 90th d. When the springiness values during the ripening periods of cheeses with added dried fruits are evaluated statistically; In the variation analysis, variety and period factors affected the springiness values of the cheeses significantly ($p<0.05$) independently of each other. When variety and period factors were evaluated together, the effects of cheeses on springiness values were found to be significant ($p<0.05$).

3.6. Gumminess values in cheese samples

It defined as the energy required breaking down a semi-solid food into swallow able sizes (Kahyaoglu et al., 2005). The change in the gumminess values of cheeses with added dried fruit analyses during their ripening periods, shown in Table 1. The gumminess values of cheeses with added dried fruits, measured in textural analysis, varied between 9.86-28.85. The highest gumminess value measured in the C2 sample on the 5th d, and the lowest value measured in the control sample on the 3rd d. When the gumminess values of cheeses with added dried fruits, analyses during their ripening periods, are evaluated statistically; In the variation analysis, variety and period factors independently affected the gumminess values of the cheeses significantly ($p<0.05$). When variety and period factors were evaluated together, their effects on the gumminess values of cheeses were found to be significant ($p<0.05$). The gumminess values of the control sample were lower than the values of cheeses with added dried fruit. The gumminess values of cheeses are affected by factors affecting hardness, internal and external stickiness. The gumminess values of the cheeses generally increased until the 60th d of ripening and decreased in the following period.

3.7. Chewiness values in cheese samples

The degree of chewiness defined, as the pressure-energy required deforming the product and breaking it into

pieces and putting the disintegrated product into a suitable shape for swallowing. It has observed that the degree of chewiness in some cheeses increases as the protein content increases (Erbay et al., 2010). The change in the chewiness values of cheeses with added dried fruit analyses during their ripening periods, shown in Table 1. Chewiness degrees of cheeses with added dried fruit varied between 10.36 and 26.60. The highest chewiness value measured in the C2 sample on the 3rd d, and the lowest chewiness value measured in the control sample on the 3rd d. The most important factor in chewiness is the moisture content of the cheese. The fat and protein ratio of cheese also affects its chewiness values. When the chewiness values of cheeses with dried fruit added, analyses during their ripening periods, are evaluated statistically; In the variation analysis, while the variety factor significantly affected the chewiness values of the cheeses ($p<0.05$), the period factor did not have a significant effect on the chewiness values of the cheeses ($p>0.05$). When the variety and period factors were evaluated, their effects on the chewiness values of cheeses were found to be significant ($p<0.05$).

Table 1. Changes texture profile values during the ripening of white cheeses

	Cheese Types	Ripening Times (Days)			
		3	30	60	90
Hardness	CC	24.17±0.54$^{c, B}$	23.20±0.057$^{b, C}$	23.70±1.20$^{b, C}$	15.28±0.32$^{a, A}$
	C1	26.95±0.18$^{c, C}$	16.61±0.83$^{a, A}$	19.63±0.31$^{b, A}$	17.26±0.68$^{a, A}$
	C2	22.24±0.53$^{c, A}$	26.43±0.56$^{d, D}$	21.27±0.40$^{b, A}$	19.06±1.09$^{a, B}$
	C3	24.30±0.49$^{b, B}$	20.35±0.43$^{a, B}$	27.20±0.06$^{c, D}$	20.01±0.67$^{a, C}$
	C4	28.52±0.42$^{d, D}$	24.95±0.23$^{b, C}$	22.16±1.14$^{a, B}$	27.15±0.10$^{c, D}$
Adhesiveness	CC	-1.85±0.16$^{d, BC}$	-16.87±0.36$^{a, B}$	-15.13±0.34$^{b, BC}$	-12.01±0.12$^{c, C}$
	C1	-3.97±0.18$^{b, A}$	-18.96 ±1.17$^{a, AB}$	-22.14±2.34$^{a, AB}$	-17.03±0.25$^{a, B}$
	C2	-3.24±0.33$^{b, AB}$	-22.41±0.77$^{a, C}$	-25.46±2.88$^{a, A}$	-21.86±0.41$^{a, A}$
	C3	-1.29±0.26$^{b, C}$	-26.74±4.41$^{a, A}$	-18.41±1.66$^{a, AB}$	-18.32±0.42$^{a, B}$
	C4	-4.39±0.64$^{c, A}$	-15.09±0.99$^{a, B}$	-10.79±0.01$^{b, C}$	12.33±0.40$^{ab, C}$
Cohesiveness	CC	0.83±0.005$^{c, B}$	0.45±0.1$^{a, B}$	0.61±0.002$^{b, A}$	0.51±0.01$^{ab, BC}$
	C1	0.80±0.01$^{c, B}$	0.40 ±0.01$^{a, B}$	0.74±0.09$^{bc, C}$	0.58±0.00$^{b, C}$
	C2	0.83±0.02$^{d, B}$	0.28±0.00$^{a, A}$	0.62±0.00$^{c, AB}$	0.44±0.02$^{b, BC}$
	C3	0.80±0.03$^{d, B}$	0.47±0.00$^{b, B}$	0.69±0.04$^{c, ABC}$	0.38±0.07$^{a, AB}$
	C4	0.51±0.06$^{b, A}$	0.61±0.02^{c,C}	0.73±0.02$^{d, BC}$	0.25±0.00^{a,A}
Springiness	CC	0.94±0.002$^{b, C}$	0.90±0.07$^{ab, A}$	0.89±0.007$^{ab, A}$	0.88±0.021$^{a, B}$
	C1	0.84±0.004$^{b, A}$	0.81±0.012$^{b, A}$	0.82±0.06$^{b, A}$	0.66±0.08$^{a, A}$
	C2	0.92±0.008$^{a, C}$	0.90±0,.57$^{a, A}$	0.85±0.043$^{a, A}$	0.86±0.006$^{a, B}$
	C3	0.89±0.001$^{a, B}$	0.86 ±0.021$^{a, A}$	0.83±0.027$^{a, A}$	0.84±0.038$^{a, B}$
	C4	0.92±0.007$^{b, C}$	0.86±0.021$^{b, A}$	0.88±0.000$^{b, A}$	0.75±0.023$^{a, AB}$
Gumminess	CC	9.86±0.53$^{a, A}$	12.49±0.08$^{b, A}$	11.64±0.24$^{b, A}$	11.61±0.39$^{b, A}$
	C1	13.1±0.86$^{a, B}$	17.5 ±0.35$^{b, B}$	27.01±0.11$^{d, D}$	24.8 ±0.35$^{c, D}$
	C2	28.85±0.12$^{b, D}$	24.17±0.45$^{a, C}$	24.70±0.99$^{a, C}$	21.64±1.63$^{a, CD}$
	C3	19.15±0.70$^{a, C}$	19.13±0.93$^{a, B}$	18.26±0.60$^{a, B}$	18.36±0.73$^{a, BC}$
	C4	14.07±0.29$^{b, B}$	11.33±0.12$^{a, A}$	13.55±0.46$^{b, A}$	15.68±0.18$^{c, B}$
Chewiness	CC	10.36±0.167$^{a, A}$	17.99±0,793$^{b, B}$	25.21±0.80$^{c, C}$	22.11±1.10$^{c, C}$
	C1	19.18±0.16$^{b, C}$	19.15±0,31$^{b, B}$	22.08±0.72$^{c, B}$	17.76±0.14$^{a, B}$
	C2	26.60±0.15$^{b, D}$	22.01±0,89$^{a, C}$	21.82±1.09$^{a, B}$	25.44±2.07$^{b, C}$
	C3	19.15±0.70$^{a, C}$	19.13±0,93$^{a, B}$	18.26±0.60$^{a, A}$	18.36±0.73$^{a, B}$
	C4	14.07±0.29$^{b, B}$	11.33±0,12$^{a, A}$	18.36±0.73$^{c, A}$	15.68±0.18$^{b, A}$
Resilience	CC	0.50±0.007$^{c, C}$	0.41±0.006$^{b, C}$	0.43±0.007$^{b, C}$	0.34±0.21$^{a, C}$
	C1	0.23±0.004$^{d, A}$	0.18±0.005$^{c, A}$	0.15±0.009$^{b, A}$	0.10±0.00$^{a, A}$
	C2	0.30±0.034$^{a, B}$	0.30±0.026$^{a, B}$	0.30±0.007$^{a, B}$	0.33±0.023$^{a, C}$
	C3	0.33±0.02$^{b, B}$	0.31±0.01$^{b, B}$	0.34±0.04$^{b, B}$	0.21±0.03$^{a, B}$
	C4	0.30±0.045$^{d, B}$	0.19±0.001$^{c, A}$	0.16±0.012$^{b, A}$	0.10±0.004$^{a, A}$

a–d indicate differences ($p<0.05$) between columns. A–C indicate differences ($p<0.05$) between rows. Mean values ± standard deviation of two trials.

3.8. Resilience values in cheese samples

The change in the resilience values of cheeses with added dried fruits during their ripening periods shown in Table 1. Resilience values of cheeses with added dried fruits, analyses during their ripening periods, found to be between 0.10-0.50. The highest resilience value measured in the control sample on the 3rd day, while the lowest value measured in the C1 and C4 samples on the 90th day. When the elasticity values of cheeses with

added dried fruits, analyses during their ripening periods, are evaluated statistically; In the variation analysis, the effect of variety and period factors on the resilience values of cheeses was found to be significant ($p<0.05$), independently of each other. When variety and period factors were evaluated together, their effects on the resilience values of cheeses were found to be significant ($p<0.05$).

3.9. Sensory scores in the cheese samples storage ripening

Sensory analyses carried out by 10 different panelists who previously informed about the subject, according to the criteria specified in the sensory evaluation form, throughout the ripening period of the cheeses. Color and appearance scores of the white cheese samples we produce during storage shown in Table 2.

3.10. Color and appearance scores of cheese samples

The color and appearance scores given by the panelists in the sensory analyses carried out during the ripening periods of cheeses with dried fruits shown in Table 2. In sensory analysis, color and appearance evaluation, the C3 sample received the highest score from the panelists on the 90th d, and the C1 sample received the lowest score on the 30th d. When the changes in color and appearance values of cheeses with added dried fruit during their ripening period are evaluated statistically; In the variation analysis, while the variety factor significantly affected the color and appearance values of the cheeses ($p<0.05$), the period factor did not significantly affect the color and appearance values of the cheeses ($p>0.05$). When the variety and period factors were evaluated together, their effects on the color and appearance values of the cheeses were not found to be significant ($p>0.05$). The color and appearance scores of cheeses with added dried fruits found to be lower than the color and appearance scores of Tarakçı and Küçüköner (2006) herby cheeses samples, and higher than the color and appearance scores of Gezmiş and Tarakçı (2019) for traditional Circassian cheeses. Dried fruit types added to curd affected the sensory properties of cheeses such as taste, smell and aroma during ripening. While the control sample group was the most liked cheese in terms of color and appearance, the cheeses with black mulberries and blackberries less appreciated. It thought that the reason for this is that dried black mulberries and blackberries completely cover the unique color of the cheese. Among the cheeses, cheeses with dried raspberries received the highest scores from the panelists. It is that the panelists appreciated dried raspberries more because they affect the characteristics of the cheese less than other dried fruits.

3.11. Odor scores of cheese samples

According to the sensory evaluation results carried out by the panelists, the change in the odor value of the cheeses during their ripening periods shown in Table 2. In the sensory analysis of cheeses produced by adding dried fruit, the odor values found to be close to each other. While the panelists gave the highest score to the control sample at the 3rd, 60th and 90th d maturation periods, the C1 sample received the lowest score at the 30th and 90th d.

When the odor values given by the panelists during the ripening period of cheeses with added dried fruits are evaluated statistically; In the variation analysis, while the variety factor significantly affected the odor values of the cheeses ($p<0.05$), the effect of the period factor on the odor values of the cheeses was not found to be significant $p>0.05$). When the variety and period factors were evaluated together, their effects on the odor values of cheeses were not found to be significant ($p>0.05$). The odor scores of cheeses produced by adding dried fruit received from the panelists in sensory analyses are lower than the odor scores of Tarakçı and Deveci (2019) in spicy cheeses.

3.12. Structure and texture values of cheese samples

The structure and change in texture values of cheeses produced by adding dried fruit to curd during their ripening period shown in Table 2. In the structure and texture evaluation of the cheeses during ripening, C3 sample received the highest score from the panelists, and C1 sample received the lowest score. Black mulberry, black grape and dried blackberry used in C1, C2 and C4 samples negatively affected the texture and structure values of the cheeses. When the structure and texture values of cheeses with added dried fruits are evaluated statistically during their ripening period; In the variation analysis, while the variety factor significantly ($p<0.05$) affected the taste and aroma values of the cheeses, the period factor did not significantly ($p>0.05$) affect the structure and texture value of the cheeses. When variety and period factors were evaluated together, their effects on the structure and texture values of cheeses were found to be significant ($p<0.05$). The

Table 2. Sensory scores for the cheese added dried fruit

	Cheese Types	Ripening Times (Days)			
		3	30	60	90
Color and appearance	CC	7.00±0.66$^{a, B}$	7.00±0.66$^{a, B}$	7.00±0,66$^{a, B}$	7.00±0.65$^{a, B}$
	C1	6.00±0.81$^{a, A}$	5.60±1.07$^{a, A}$	6.70±0,67$^{a, AB}$	5.90±1.10$^{a, A}$
	C2	6.30±0.67$^{a, AB}$	5.80±0.63$^{a, A}$	5.80±0,63$^{a, A}$	5.80±0.63$^{a, A}$
	C3	7.10±0.56$^{a, B}$	7.10±0.73$^{a, B}$	7.10±0,73$^{a, B}$	7.40±0.51$^{a, B}$
	C4	6.50±0.52$^{a, ABC}$	6.80±0.63$^{a, B}$	6.90±0,56$^{a, AB}$	6.60±0.51$^{a, BC}$
Odor	CC	6.90±0.31$^{a, A}$	6.60±0.96$^{a, A}$	6.90±0.31$^{a, A}$	6.90±0.31$^{a, C}$
	C1	6.22±0.66$^{a, A}$	6.00±0.70$^{a, A}$	6.33±0.86$^{a, A}$	6.00±0.70$^{a, A}$
	C2	6.63±0.80$^{a, A}$	6.18±0.40$^{a, AA}$	6.27±0.46$^{a, A}$	6.18±0.40$^{a, AB}$
	C3	6.80±0.63$^{a, A}$	6.80±0.63$^{a, A}$	6.70±0.67$^{a, A}$	6.70±0.67$^{a, BC}$
	C4	6.70±0.82$^{a, ABC}$	6.60±0.96$^{a, AB}$	6.90±0.56$^{a, AB}$	6.80±0.42$^{a, BC}$
Structure and texture	CC	7.00±0.66$^{a, B}$	7.00±0.66$^{b, B}$	7.00±0.66$^{b, B}$	7.00±0.66$^{b, BC}$
	C1	5.56±1.13$^{a, A}$	5.88±0.78$^{b, A}$	6.55±1.13$^{b, B}$	6.44±0.72$^{c, ABC}$
	C2	6.45±0.68$^{a, AB}$	6.36±0.67$^{a, AB}$	6.45±0.82$^{a, B}$	6.36±0.67$^{a, AB}$
	C3	7.10±0.56$^{a, B}$	7.10±0.56$^{ab, B}$	7.00±0.66$^{b, B}$	7.20±0.42$^{b, C}$
	C4	6.9±1.19$^{a, B}$	6.90±1.19$^{b, AB}$	6.35±0.82$^{bc, A}$	5.90±0.73$^{c, A}$
Taste and flavor	CC	6.60±0.96$^{a, A}$	6.90±0.31$^{a, A}$	7.00±0.81$^{a, A}$	6.60±0.96$^{a, A}$
	C1	6.00±0.70$^{a, A}$	6.11±0.78$^{a, A}$	6.33±0.70$^{a, A}$	6.33±1.00$^{a, A}$
	C2	5.81±0.75$^{a, A}$	6.63±0.80$^{b, A}$	6.63±0.80$^{b, A}$	6.63±0.80$^{b, A}$
	C3	6.80±0.63$^{a, A}$	6.80±0.63$^{a, A}$	6.80±0.63$^{a, B}$	6.80±0.63$^{a, A}$
	C4	6.20±0.78$^{a, A}$	6.30±0.67$^{a, A}$	6.20±0.42$^{a, A}$	6.50±0.52$^{a, A}$
General acceptability	CC	7.00±0.66$^{a, C}$	7.10±0.56$^{a, B}$	7.10±0.56$^{a, B}$	7.00±0.66$^{a, A}$
	C1	6.00±0.70$^{a, A}$	6.00±0.70$^{a, A}$	6.22±0.83$^{a, A}$	6.44±0.52$^{a, A}$
	C2	6.18±0.40$^{a, AB}$	6.36±0.67$^{a, AB}$	6.45±0.68$^{a, AB}$	6.36±0.67$^{a, A}$
	C3	6.80±0.42$^{a, BC}$	7.00±0.47$^{a, B}$	6.80±0.63$^{a, AB}$	7.00±0.47$^{a, A}$
	C4	6.60±0.51$^{a, ABC}$	6.70±1.05$^{a, AB}$	6.50±0.52$^{a, AB}$	6.60±0.51$^{a, A}$

a–d indicate differences ($p<0.05$) between columns. A–C indicate differences ($p<0.05$) between rows. Mean values ± standard deviation of two trials.

structure-texture scores of cheeses with added dried fruits in sensory evaluations are lower than the structure and texture scores of Tarakçı et al. (2005) herby cheese, Tarakçı, and Deveci (2019) spicy cheeses, but higher than the structure and texture scores of Sekban and Tarakçı (2021) for golot cheeses.

3.13. Taste and aroma values of cheese samples

The change in taste and aroma values of cheeses produced by adding dried fruit to curd during their ripening period shown in Table 2. In the sensory analyses carried out on the taste and aroma of dried fruit cheeses, the control sample received the highest score and the C2 sample received the lowest score by the panelists. Dried fruit seems negatively affect the taste-aroma scores of the cheeses to which they added. It said that the reason for the negativity is that the unique taste, smell, aroma and color of the cheese have changed greatly.

3.14. General acceptability values of cheese samples

The change in acceptability scores of cheeses produced by adding dried fruit to curd during their ripening period shown in Table 2. In the sensory evaluations of cheeses with added dried fruit during their ripening period, the panelists to the control sample gave the highest general acceptability score, while the C1 sample received the lowest score during the 30th and 60th d ripening periods. When the general acceptability values of cheeses with added dried fruits are evaluated statistically during their ripening periods; In the variation analysis, while the variety factor significantly ($p<0.05$) affected the general acceptability values of the cheeses, the period factor did not significantly ($p>0.05$) affect the general acceptability values of the cheeses. When the variety and period factors were evaluated together, their effects on the general acceptability values of cheeses were found to be significant ($p<0.05$). The general acceptability scores of cheeses with added dried fruits were lower than the general acceptability scores of Tarakçı (2004) for herby cheeses, Tarakçı, and Deveci (2019) for spicy cheeses.

4. Conclusion

In the study, five types of cheese produced, one of which was a control sample, 2.0% of dried forms of different fruits added to the curd cheese. Sensory and textural analyses carried out on the cheeses during ripening periods. Textural values of cheeses with added dried fruit examined during their ripening period. When the values obtained in the texture profile analyses are evaluated statistically; In the variation analysis, variety and period factors affected the hardness, adhesiveness, cohesiveness, springiness, chewiness, chewiness, and resilience values of the cheeses significantly ($p<0.05$), independently of each other, and the variety and period factors together. The sensorial analyses carried out in this study, it has significant effects on color-appearance, smell, taste, aroma, structure, texture in addition, general acceptability values of cheeses in sensory evaluations. Cheeses containing dried fruit varieties less appreciated in sensory analysis than the control sample. Textural analyses showed that they negatively affected the cheese texture. Future studies expanded to investigate the effects of antioxidants found in the chemical structure of dried fruit on cheese. By combining the anthocyanin contained in dried fruits with cheese as a natural colorant, healthy cheeses with colors that will appeal to the consumer produced.

Compliance with Ethical Standards

Conflict of Interest

The authors declare that they have no conflict of interest.

Authors' Contributions

Zekai TARAKÇI: Methodology, Investigation, Conceptualization, and Writing - original draft, Visualization. **Murat YOLAŞAN**: Formal analysis, Data curation, Statistical analysis

Ethical approval

Not applicable.

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Data availability

Not applicable.

Consent for publication

We humbly give consent for this article to be published.

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