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RESEARCH ARTICLE

Characterization of Physicochemical, Colour and Textural Properties of Turkish Type Cheeses

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Abstract

The aim of this study was to evaluate the physicochemical parameters, instrumental colour and texture profile analysis of the most preferred and consumed Turkish cheeses (white cheese, kashar cheese, tulum cheese, and Mihaliç cheese). For this purpose, a total of 200 cheese samples were randomly collected from various markets and bazaars located in İstanbul, Türkiye. The cheese samples were analyzed in terms of the physicochemical parameters (moisture, dry matter, salt, fat, protein, pH and titratable acidity), instrumental colour (CIE *L**, *a**, *b**) and texture profiles (hardness, stringiness, springiness, adhesion, adhesiveness, cohesiveness, gumminess and chewiness). There was a significant difference in proximate composition between cheese types (P<0.001). The differences between the lightness, redness and yellowness values of the cheeses were also significant (P<0.001). The type of cheese showed a strong positive correlation with stringiness, springiness, adhesion and adhesiveness parameters, whereas showed a weak negative correlation with cohesiveness and gumminess, and a weak positive correlation with chewiness. However, there was no significant correlation between hardness and cheese type. All stages in cheese production, such as the type of milk and other ingredients used in cheese production, process conditions, ripening time and conditions, preservation characteristics, which differ according to cheese varieties, directly affect the physicochemical, colour and textural properties of the final product. Correspondingly, the difference between the characteristics of cheese samples was found to be significant.

Key Words: Colour, physicochemical parameters, texture profile, Turkish type cheeses

Türk Tipi Peynirlerin Fizikokimyasal, Renk ve Tekstürel Özelliklerinin Tanımlanması

Öz

Bu çalışmanın amacı, en çok tercih edilen ve tüketilen Türk peynirlerinin (beyaz peynir, kaşar peyniri, tulum peyniri ve Mihaliç peyniri) fizikokimyasal parametrelerini, enstrümantal renk ve tekstür profil analizlerini değerlendirmektir. Bu amaçla, İstanbul'da bulunan çeşitli market ve satış yerlerinden rastgele toplam 200 peynir örneği toplanmıştır. Peynir örnekleri fizikokimyasal parametreler (nem, kuru madde, tuz, yağ, protein, pH ve titre edilebilir asitlik), enstrümantal renk (CIE *L**, *a**, *b**) ve tekstür profilleri (sertlik, liflilik, yaylanma, yapışma, yapışkanlık, bağlayıcılık, sakızımsılık ve çiğnenebilirlik) açısından analiz edilmiştir. Peynir çeşitleri arasında içerik kompozisyonu bakımından anlamlı bir farklılık vardır (P<0,001). Peynirlerin parlaklık, kırmızılık ve sarılık değerleri arasındaki farklar da anlamlıdır (P<0,001). Peynir tipi, liflilik, esneklik, yapışma ve yapışkanlık parametreleri ile güçlü bir pozitif korelasyon gösterirken; yapışkanlık ve sakızımsılık ile zayıf bir negatif korelasyon ve çiğnenebilirlik ile zayıf bir pozitif korelasyon göstermiştir. Bununla birlikte, sertlik ve peynir tipi arasında anlamlı bir korelasyon bulunmamıştır. Peynir üretiminde kullanılan sütün türü ve diğer bileşenler, proses koşulları, olgunlaşma süresi ve koşulları, muhafaza özellikleri gibi peynir çeşitlerine göre farklılık gösteren peynir üretimindeki tüm aşamalar nihai ürünün fizikokimyasal, renk ve tekstürel özelliklerini doğrudan etkilemektedir. Buna bağlı olarak, peynir örneklerinin özellikleri arasındaki fark önemli bulunmuştur.

Anahtar Kelimeler: Fizikokimyasal parametreler, renk, tekstür profili, Türk tipi peynirler

INTRODUCTION

Cheese, which is an important dairy product manufactured in almost every part of the world, is widely consumed by the majority of people due to its high nutritional value, unique taste and flavour (1, 2). In our country, there are many varieties of cheese with different characteristics produced with different regional practices, milk type (sheep, cow or goat) and processing techniques (ripening, brining). Therefore, there are significant variations between the sensorial, chemical and microbiological qualities of cheeses. Among these, the white pickled cheese and kashar cheese are produced in many regions of the country, whereas most of the other types of cheeses (tulum, Mihaliç) are produced in certain regions (3-6). Turkish cuisine boasts a rich diversity of cheeses, each with its own unique flavour, texture, and cultural significance. The most commonly produced cheese is white pickled cheese, followed by kashar cheese, tulum cheese, Mihaliç (Kelle) cheese and herby cheese. In addition to these, other cheese varieties such as dil cheese, örgü cheese, civil cheese, hellim cheese, çerkez cheese, abaza cheese, Urfa cheese, and sıkma cheese have a widespread production and consumption network (7-9).

White cheese, manufactured from cow, sheep, goat's milk or mixtures of these milks, is bright white and non-porous cheese with a high fat content, salty taste and a soft to semi-hard texture. White cheeses manufactured with pasteurized milk are ripened for at least one month, while the best flavour develops in sheep and goat cheeses after one year of ripening (7,10,11).

Kashar cheese (Kashkaval cheese) is a semi-hard, ripened, pasta-filata cheese manufactured primarily from cow's milk, but also from sheep or goat's milk. Although it originates from Türkiye, it is also widely consumed in the Balkans and some parts of the Middle East. Kashar cheese has a mild to slightly sharp flavour, depending on the ripening time and the production techniques used. In addition, it becomes firmer and more elastic as it matures, with a texture that can vary from smooth to slightly grainy (12-14).

Tulum cheese is a traditional Turkish cheese mostly produced in East Anatolian region. Tulum cheese, which differs from other cheeses with its manufacturing method, is traditionally ripened and stored in the skin of animals, especially sheep or goat skins. This aging process gives the cheese a unique flavour and aroma. Tulum cheese has a crumbly texture that can vary from hard to semi-hard. It has a strong and pungent flavour and a highly aromatic taste that develops during the ripening period inside the animal skin. It is traditionally produced from sheep's milk, which contributes to its distinctive flavour and texture. It also has a pale to yellowish colour, depending on the milk used (usually sheep's milk) and the ripening process (4,15,16).

Mihaliç (Kelle) cheese, known for its hard texture and salty flavour profile, is widely produced in Balıkesir, Bursa and Çanakkale region. Mihaliç cheese needs to be ripened for several months (at least 3 months) to develop its flavour and texture. The salty flavour of the cheese has nutty undertones that become more pronounced with age and develop over time to have a characteristic richness and complexity. The cheese has yellowish-cream colour that is influenced by the type of milk used and the ripening process (17,18).

The evaluation of Turkish type cheeses requires a multidimensional approach integrating chemical analysis, colour assessment and detailed texture profiling. This holistic evaluation can help to understand the quality, characteristics and consumer preferences of cheeses. Therefore, the purpose of this study was to evaluate the physicochemical parameters, instrumental colour and texture profile analysis of the most preferred and consumed Turkish cheeses (white cheese, kashar cheese, tulum cheese, Mihaliç cheese) sold in retail.

MATERIAL AND METHODS

Sampling

A total of 200 cheese samples (50 pieces each of white cheese, kashar cheese, tulum cheese and Mihaliç cheese) were randomly obtained from various markets and bazaars located in İstanbul, Türkiye from September 2022 to May 2023. The collected samples (~300 g for each of samples) were immediately transferred to the laboratory under cold chain.

Physicochemical Analysis

The moisture and dry matter contents of cheese samples were determined by drying at 103±2°C to a constant weight using Moisture Analyzer (Sartorious MA45, Germany). Salt (NaCl) content of cheese samples was performed by Mohr method (Method 935.43) and the fat content was determined by the Gerber method (Method 933.05) (19). The total nitrogen (TN) and non-protein nitrogen (NPN) that was soluble in 12% trichloroacetic acid were assayed by the Kjeldahl method (19). The protein content was calculated as 6.38 × (TN - NPN). The pH values were measured at 20±2°C using a pH meter (Hanna HI 1131, Germany) equipped with a combined electrode (HI 9321 Microprocessor pH meter, Hanna Instruments, Germany). The titratable acidity of cheese samples was conducted by the Dornic method (Method 920.124) (19).

Instrumental Colour

The surface colour of cheese samples was determined by measuring Colorflex HunterLab Spectrophotometer (Hunter Associates Laboratory Inc., Reston, VA, USA) in terms of L^* (lightness), a^* (redness) and b^* (yellowness) values using colour difference meter. Colour was evaluated using a diffuse illumination (D65 2° observer) with 8 mm viewing aperture and a 25 mm port size with the specular component excluded. The measurements were performed at five different locations on each cheese and the arithmetic values were calculated (20).

Texture Profile Analysis (TPA)

The textural properties of cheese samples were evaluated using a texture analyzer (Instron Universal Testing Machine, Model 1140, Instron, UK) equipped with a stainless-steel cylindrical probe (diameter 20/36 mm). The texture profile analysis was conducted by a double compression-decompression cycle test with a rest period of 3 s. All measurements were performed at room temperature (20±2°C) by placing 45 × 45 × 25 mm block shape cheese sample (50 g

overweight). The hardness, stringiness, springiness, adhesion, adhesiveness, cohesiveness, gumminess and chewiness characteristics of cheese samples were examined in terms of instrumental texture properties. The arithmetic average of eight measurements was calculated as a mean value for each sample.

Statistical Analysis

The General Linear Model (PROC GLM) in SPSS 21.0 (SPSS Inc., Chicago, IL, USA) was used to determine the least squares means (LSM), standard errors (SE), and the significant differences among means. Duncan's multiple range test was used to evaluate the significance of differences. Pearson's correlation coefficients (r) were used to determine the relation between the textural properties of cheese samples.

RESULTS

Physicochemical Properties

Physicochemical properties of four different Turkish type cheese samples are given in Table 1. The mean moisture value and salt content of cheese samples ranged from 29.16% to 42.33% and 2.71% to 6.15%, respectively. The fat content of the cheese samples varied between 20.39% and 25.62%, while the protein content was between 20.23% and 26.84%. The mean pH and acidity values ranged from 5.19 to 5.63 and 0.69% to 1.29% (LA%) in the analyzed cheese types.

Table 1. Mean values and standard errors of physicochemical properties of cheese samples (n= 200)

Physicochemical properties	Cheese type				
	White cheese (n= 50)	Tulum cheese (n= 50)	Mihaliç cheese (n= 50)	Kashar cheese (n= 50)	P
Moisture (%)	42.33^{a}±0.11	39.09^{b}±0.19	29.16^{d}±0.05	37.25^{c}±0.25	***
Dry matter (%)	57.67^{d}±0.26	60.91^{c}±0.33	70.84^{a}±0.19	62.75^{b}±0.25	***
NaCl (%)	3.89^{c}±0.14	5.04^{b}±0.05	6.15^{a}±0.05	2.71^{d}±0.07	***
Fat (%)	22.48^{b}±0.16	20.39^{c}±0.13	25.62^{a}±0.32	24.55^{a}±0.22	***
Protein (%)	20.23^{c}±0.08	21.73^{b}±0.07	22.05^{b}±0.16	26.84^{a}±0.18	***
pH	5.34±0.12	5.19±0.11	5.46±0.09	5.63±0.10	NS
Acidity (%)	1.16^{b}±0.03	1.29^{a}±0.07	0.94^{c}±0.02	0.69^{d}±0.02	***

n: number of analyzed samples

a-d: Means within a row with different letters are significantly different at P<0.001(***).

There was a significant difference in proximate composition between cheese types (P<0.001). The moisture contents of the cheese samples were significantly different from each other with the lowest in Mihaliç cheese and the highest in white cheese. In addition, kashar cheese was the least salty cheese and Mihaliç cheese had the highest salt content (P<0.001). In terms of fat content, tulum cheese had the lowest content, while Mihaliç and kashar cheeses had the highest contents (P<0.001). Kashar cheese had the highest protein content, whereas white cheese had the lowest protein content (P<0.001). However, tulum and Mihaliç cheeses were found to have similar protein contents (P>0.05). The acidity value, which is an important criterion in the formation of flavour in cheese, showed significant differences among cheese varieties due to differences in production processes. Tulum cheese had the highest acidity value, while kashar cheese had the lowest acidity.

Colour Evaluation

The instrumental colour parameters of different Turkish type cheeses are shown in Table 2. The mean lightness (*L**) values of cheese types ranged from 52.33 to 64.18, the mean redness (*a**) values ranged from -0.78 to 0.39 and the mean yellowness (*b**) values varied between 9.28 and 12.03.

Table 2. Mean values and standard errors of the instrumental colour (CIE *L**, *a**, *b**) parameters of cheese samples (n=200)

Colour parameters	Cheese type				
	White cheese (n=50)	Tulum cheese (n=50)	Mihaliç cheese (n=50)	Kashar cheese (n=50)	P
*L**	60.57^{b}±0.17	64.18^{a}±0.07	59.78^{c}±0.11	52.33^{d}±0.12	***
*a**	-0.25^{b}±0.02	-0.78^{d}±0.03	-0.49^{c}±0.03	0.39^{a}±0.02	***
*b**	9.28^{c}±0.09	10.88^{b}±0.09	11.85^{a}±0.15	12.03^{a}±0.04	***

n: number of analyzed samples

a-c: Means within a row with different letters are significantly different at P<0.001(***).

The colour characteristics of the cheeses varied depending on the content of the raw materials and the production processes of the cheese types. Thus, the differences between the lightness, redness and yellowness values of the cheeses were significant (P<0.001). Tulum cheese had the highest *L** value (the brightest), while kashar cheese had the lowest *L** value (the dullest) (P<0.001). The yellowness values of the cheeses were higher for kashar cheese, while white cheese had the lowest *b** value (P<0.001). However, the differences in the yellowness values of Mihaliç and

kashar cheeses were not significant (P>0.05). In addition, kashar cheese had the highest redness value among the cheese types (P<0.001). The *a** values of white, tulum and Mihaliç cheeses showed a tendency towards a green shade on the axis, whereas kashar cheese was on the red coordinates of the scale.

Texture Profile Analysis

The mean values of TPA parameters (hardness, stringiness, springiness, adhesion, adhesiveness, gumminess, chewiness) obtained from different cheese types are presented in Table 3. The difference between the hardness values of the four different cheese types was significant (P<0.001), whereas white cheese differed from the other three cheese types which were the same with each other in terms of stringiness and adhesiveness values. A significant difference was observed between cheese types in cohesiveness values, while the gumminess of Mihaliç and kashar cheeses were similar to each other. In terms of chewiness values, the difference between tulum and kashar cheeses was not significant, whereas a significant difference was found between other cheese types.

Table 3. Mean values and standard errors (SE) of texture profile analysis of cheese samples

Cheese type	n	Hardness		Stringiness		Springiness		Adhesion		Adhesiveness		Cohesiveness		Gumminess		Chewiness	
		Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE
White cheese	50	2.124^{c}	0.164	4.179^{a}	0.645	4.822^{a}	0.239	0.373^{a}	0.041	0.938^{a}	0.085	0.244^{d}	0.008	0.518^{b}	0.034	2.498^{a}	0.150
Tulum cheese	50	1.489^{cd}	0.046	0.886^{b}	0.114	0.937^{b}	0.184	0.059^{c}	0.008	0.052^{b}	0.008	0.491^{b}	0.008	0.731^{b}	0.033	0.685^{c}	0.174
Mihaliç cheese	50	12.039^{a}	0.440	0.233^{b}	0.066	0.267^{c}	0.040	0.104^{b}	0.039	0.012^{b}	0.009	0.382^{c}	0.035	4.599^{a}	0.281	1.228^{b}	0.185
Kashar cheese	50	6.394^{b}	0.268	0.267^{b}	0.067	0.233^{c}	0.066	0.084^{bc}	0.011	0.020^{b}	0.008	0.650^{a}	0.006	4.156^{a}	0.206	0.968^{c}	0.258
P	200		***		***		***		***		***		***		***		***

n: number of analyzed samples. a-d: Means within a column with different letters are significantly different at P<0.001(***).

Mihaliç cheese had the highest hardness value among the four cheese types analyzed (P<0.001). There was a significant difference in adhesiveness value between white cheese and other three cheese types (P<0.001). A similar difference was observed in stringiness and springiness properties of white cheeses. The firm structure of Mihaliç and kashar cheeses resulted in high gumminess values of these two cheese types (P<0.001).

The Pearson correlation coefficients (r) of textural properties of cheese samples are shown in Table 4. Hardness showed strong correlation with gumminess (r= 0.888, P<0.01) and weak correlation with chewiness (r= 0.400, P<0.05), whereas this value showed a negative correlation with springiness (r= -0.400, P<0.05) and adhesiveness (r= -0.372, P<0.05). Gumminess positively correlated with hardness (r= 0.888, P<0.01), while negatively strong correlated with springiness (r= -0.485, P<0.01) and adhesiveness (r= -0.483, P<0.01), and weakly correlated with stringiness (r= -0.409, P<0.05). Chewiness values showed strong positive correlation with gumminess (r= 0.536, P<0.01) and positive correlation with hardness (r= 0.400, P<0.05). There was a strong positive correlation between cheese types and stringiness, springiness, adhesiveness and adhesion properties, whereas no significant correlation was observed for hardness. There was a weak positive correlation between chewiness and cheese type, while a weak negative correlation was observed for cohesiveness and gumminess.

Table 4. Pearson correlation coefficients (r) among texture profile analysis (TPA) of cheese samples

Textural properties	Hardness	Stringiness	Springiness	Adhesion	Adhesiveness	Cohesiveness	Gumminess	Chewiness	Cheese type
Hardness	1	-0.338	-0.400(*)	-0.210	-0.372(*)	-0.060	0.888(**)	0.400(*)	-0.321
Stringiness		1	0.896(**)	0.723(**)	0.958(**)	-0.660(**)	-0.409(*)	0.295	0.647(**)
Springiness			1	0.882(**)	0.947(**)	-0.702(**)	-0.485(**)	0.276	0.673(**)
Adhesion				1	0.841(**)	-0.792(**)	-0.407(*)	0.093	0.462(**)
Adhesiveness					1	-0.711(**)	-0.483(**)	0.181	0.605(**)
Cohesiveness						1	0.270	-0.095	-0.427(*)
Gumminess							1	0.536(**)	-0.346(*)
Chewiness								1	0.380(*)
Cheese type	-0.321	0.647(**)	0.673(**)	0.462(**)	0.605(**)	-0.427(*)	-0.346(*)	0.380(*)	1

* Correlation is significant at P<0.05. ** Correlation is significant at P<0.01 .

DISCUSSION AND CONCLUSION

According to the Turkish regulations, the maximum limit of moisture content in white, kashar and tulum cheese should be 60-65%, 40-45% and 45% respectively, and salt in dry matter should be maximum 6.5% for white cheese, 3-4% for kashar cheese and 5% for tulum cheese (21). The average moisture contents of the cheese types examined in present study were below the maximum limits specified in the Turkish Food Codex and the cheese samples were within the obligated limits in terms of nutritional components. Salt content, which is one of the determining criteria especially in the formation of product flavour, was found to be 3.89% for white cheese, 2.71% for kashar cheese and 5.04% for tulum cheese and these values were determined to be within the regulations. The salt content of Mihaliç cheese, whose brining and ripening conditions were similar to white cheese, was recorded as 6.15%.

In addition, cheeses are divided into 4 different groups according to fat in dry matter (FDM). These are full-fat cheese (FDM% ≥ 45), half-fat cheese (25 ≤ FDM% < 45), low-fat cheese (10 ≤ FDM% < 25) and non-fat cheese (FDM% < 10) (21). In the present study, it was determined that the cheese samples were in the categories of half-fat and low-

fat cheese according to their fat content. Among cheese types, Mihaliç cheese was found to be more fatty with an average value of 25.62%.

Bilgin et al. (22) stated that the titratable acidity (LA%) of 26 full-fat white cheese samples was between 0.60-3.96% and the average acidity value of white cheeses was 1.19% in accordance with legal regulations. In addition, they reported the average moisture content as 53.70%, the average salt content as 7.71% and the average fat content as 49.03%.

The main differences in the properties of cheeses varied depending on the raw milk composition and physicochemical characteristics (1). Based on this, the acidity of cheeses produced with raw milk is higher than cheeses produced with pasteurized milk (23). The acidity value of cheeses was also influenced by a series of factors such as moisture, lactose and salt contents, ripening process, glycolytic and lipolytic effects (13). During the ripening process of the cheese, the breakdown of the available lactose to lactic acid results in a decrease in pH value, which is followed by changes in pH depending on the type of cheese (5, 24). The salt content of cheese was a delicate physicochemical property that directly affected the water activity and moisture value, ripening process and fermentation attributes of cheese. In addition, a change in salt content could also influence the protein content and pH value (6).

Significant differences were observed between the *L**, *a** and *b** values of the cheese types evaluated in the present study. This difference in colour values between types of cheese may be due to the ingredients, especially the milk used in manufacturing, and the variation in production, ripening and storage processes. There is a positive correlation between the lightness of cheese and moisture content, indicating that cheeses with higher moisture content are lighter and brighter. Furthermore, it was stated that the high lightness value in the cheeses was mainly provided by the yellow component (*b**) and that the white-yellowish hue was responsible for the final colour of the cheese (25).

The increase in salt concentration due to the ripening process causes colour changes in cheeses and thus decreases the lightness value. Additionally, cheese colour varies because of different milk sources and heat treatments during cheese production. The yellow colour of cheeses produced from cow's milk is associated with the transfer of carotenoids in feed to milk resulted the increase in *b** value (18, 24). Also, the decrease in fat content of cheese leads to an increase in lightness value of the product (26).

The texture of cheese was among the most important factors defining the product, determined by the combination of its physical and chemical properties (27). Textural profile of cheeses was also influenced by the processing factors such as water content, processing time and temperature. The changes in texture values such as hardness, springiness, cohesiveness, gumminess and chewiness may be associated with the decrease in moisture values as well as the diffusion of salt into the cheese, decrease in pH and changes in casein matrix. Increasing the water content from 30% to 50%, which caused the most significant change in textural characteristic of cheese, led to a significant decrease in TPA parameters especially hardness, chewiness and gumminess. Besides water content, high pH value, dry matter and protein content lead to a harder texture in cheeses (2,11,28).

Furthermore, the type of milk used in cheese production also affected the hardness of cheeses. Studies have shown that white cheeses produced with goat milk were harder than those produced with sheep milk. This difference in the textural properties of cheeses produced with different milk types was explained by different casein structures or casein concentration in milk. The hardness of cheese depends on the water-binding of casein and the presence of fat (1, 29).

In the present study, Mihaliç cheese with the lowest moisture content had the highest hardness value. On the other hand, the lowest hardness values were recorded in white and tulum cheeses that had higher moisture contents. Moreover, high hardness and springiness values of Mihaliç and kashar cheeses resulted in higher gumminess values. However, the highest chewiness value was recorded in white cheese based on high stringiness and springiness values. Due to these properties, white cheese had to be chewed for a longer time to be swallowed, whereas tulum cheese with the lowest hardness was the easiest cheese to chew.

Among the texture profile parameters, hardness and chewiness were more susceptible to the variation of processing conditions and these two parameters showed similar trends with each other (30). In agreement with our study, Jia et al. (30) and Zheng et al. (31) reported a positive correlation between chewiness and hardness. On the other hand, Boukria et al. (32) reported that the difference in the milk (cow, sheep, goat or camel) used in cheese production, or the length of the storage period did not affect the texture parameters such as adhesiveness, cohesiveness or springiness. Higher moisture content in cheese resulted in a decrease in its hardness, while higher unsaturation of fatty acids was associated with a softer texture. Moreover, casein gels were responsible for fracture and stretch properties of cheeses (32). The coagulation and protein degradation during the ripening of cheese led to an increase in springiness, resulting in a weakening of the protein chains or a low molecular weight peptide network (33). In addition, Tarakçı and Yolaşan (34) highlighted that cohesiveness, adhesiveness and springiness parameters of the texture profile did not differ in terms of cheese varieties.

All stages in cheese production, such as the type of milk and other ingredients used in cheese production, process conditions, ripening time and conditions, preservation characteristics, which differ according to cheese varieties, directly affect the physicochemical, colour and textural properties of the final product. Thus, the difference between the characteristics of cheese samples was found to be significant. Textural properties of cheese types are widely influenced by moisture, fat in dry matter, pH value, ripening of the cheese, type and amount of emulsifying salts, and also by processing conditions such as processing (melting) temperature and rate of cooling of the molten mass. These differences are based on the region and manufacturing process. Consequently, the variety of cheeses obtained through the different applications of the production stages provides the diversity of the product manufactured in a geographical area and responds to the tastes of consumers. In this way, consumers with different palates have the opportunity to consume cheeses with different flavour and textural characteristics.

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CONFLICT OF INTEREST

There is no conflict of interest to be declared by the author.

AUTHOR CONTRIBUTION

Planning, sample collection, analysis and writing of the study were carried out by EA.

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