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Research Article

Determination of chemical, textural and sensorial properties of civil cheese consumed in Erzurum-Horasan region

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ABSTRACT

Civil cheese is one of the traditional cheese types widely produced and consumed in the Horasan district of Erzurum. This study aimed to investigate some chemical, textural and sensorial properties of civil Cheese sold in Erzurum-Horasan. In this context, a total of 120 civil cheeses sold in the Erzurum-Horasan region were collected in summer and winter. The samples were analysed in terms of pH, acidity, water activity, protein, fat, salt, ash, dry matter and moisture content, and evaluated in terms of sensory characteristics, instrumental colour and textural profiles. Consequently, although the chemical properties of the traditionally or industrially produced civil cheeses were almost similar, they differed in terms of their structural qualities. Production method and seasonality are the main determinants of chemical and textural characteristics of civil cheeses. Moreover, industrially produced civil cheeses were more palatable than traditionally produced cheeses, and in addition, it was concluded that cheese consumed mainly during the summer months was more valuable than that consumed during the winter months.

Keywords: Civil cheese, Chemical properties, Sensorial quality, Textural attributes

Introduction

Cheese is a fermented dairy product formed by the coagulation of casein, a milk protein, which varies significantly in flavour and structure (Kamber, 2006). It is an essential part of a balanced and well-rounded diet, and it is consumed worldwide in various forms. Nowadays, cheese is preferred not only to satisfy hunger, but also to fulfil the body's need for essential nutrients (Hayaloğlu & Özer, 2011).

Cheeses are generally classified according to criteria such as ripening time, milk origin, texture, fat content, production method, and country or regional origin (Fox et al., 2000; Güzeler & Koboyeva, 2020). Technological developments and the diversity of local production have led to the production of many cheeses with different flavours and textures. The most common and traditional classification is based on moisture content, fat content, ripening and curing method. According to the International Dairy Federation, about 500 different types of cheese are produced worldwide (Fox et al., 2000).

The cheese profile in Türkiye varies regionally, and each region has its distinctive cheeses. Civil, çeçil, halloumi and tongue cheeses, whose curds are obtained at high temperatures, mouldy cheeses matured with moulds, and herb cheeses obtained by using local herbs of Anatolia can be mentioned as examples (Şengül et al., 2009; Elmalı & Uylaşer, 2012; Saygılı et al., 2020).

Erzurum civil cheese is one of the local cheeses produced in many provinces such as Kars, Muş, Van, Ağrı and especially Erzurum, which received a geographical indication in 2009 (TPE, 2009; Hayaloğlu & Özer, 2011). Although it contains a high amount of protein, calcium and phosphorus, it has a low-fat content and is characterised by a fibrous appearance and unique texture because of kneading during manufacture (Cakmakci et al., 2012; Baran & Topçu, 2018). In addition to industrial production by dairy plants or small dairy farms, nowadays, civil cheese is still mainly produced according to traditional methods in the Erzurum region, which leads to the emergence of cheeses that differ from each other in appearance and flavour (Cakmakci et al., 2012; Arslaner & Salık, 2017).

In the traditional production of civil cheese, mostly skimmed raw milk is kept until the acidity reaches the desired level. In small family enterprises, the desired level of acidity can be determined by the colour and odour of the milk or by a trial-and-error method by heating it in a small spoon. Moreover, the acidity can be increased by adding whey to the milk whose acidity has not reached the desired level. Then, this milk is taken into a boiler and heated to 25-30°C by adding rennet at a rate of 4 ml per 100 kg of milk (Çetinkaya, 2005; Hayaloğlu & Özer, 2011). While the milk in the boiler is being heated, it is also stirred with the help of a ladle. When the temperature reaches 55-60°C, coagulation begins, and the heating process is terminated. In the meantime, the formed clots are collected with the help of a ladle, and sometimes acidified whey is also added during the collection process. When the cheese has formed a pellet, it is kneaded well in the hot whey, and the spinning process is completed (Çetinkaya, 2005; Hayaloğlu & Özer, 2011; Cakmakci et al., 2012). The cheese pellet is then kept in suspension, and after the complete spinning, it is lightly salted and pressed into plastic drums with curd or packaged in brine and offered for consumption (Çetinkaya, 2005). Finally, civil cheese produced from skimmed milk gains a slightly sour taste, a soft texture (60% moisture), a stringy appearance, a salty flavour, and a white to light yellow colour, and is also known as string or yarn cheese (Tekinşen et al., 1996; Elmalı & Uylaşer, 2012).

The traditional production of civil cheese varies according to the recipes used by small-scale producers, as well as the differences in manufacturing protocols and general chemical composition between domestic and industrial producers in Erzurum province and its surroundings. Thus, traditionally produced cheeses are preferred to those produced industrially in terms of appearance, consistency, flavour, and aroma (Cakmakci et al., 2012).

This study aimed to determine the chemical, textural, and sensorial properties of civil cheese, one of the traditional Turkish cheeses produced and consumed in the Horasan district of Erzurum province, and to reveal the differences between traditionally produced and industrially produced civil cheeses.

Materials and Methods

Civil Cheese Collection

Cheeses were obtained from grocery stores and small-scale producers located in the Erzurum-Horasan region, according to the procedures specified by the International Dairy Federation (IDF, 1980). A total of 120 civil cheese samples (80 pieces of small-scale producer-manufactured cheese and 40 pieces of industrial-manufactured cheese) were collected in summer and winter seasons over one year and transported to the laboratory within 24-48 hours under cold chain in sterile glass jars in appropriate storage conditions. Then, the cheese

samples were categorised and numbered according to the production conditions and production times, as traditional (sold in open packages) or industrial (sold in original packages).

Physicochemical Evaluation

The pH of the cheese samples was measured using a pH meter (Hanna HI-9321, Woonsocket, RI), and an a_w meter (Decagon AquaLab LITE, USA) was used to define the water activity of the cheese samples. A homogeneous mixture was dried at 105±2°C to a constant weight to determine the moisture content of the civil cheeses. The acidity of cheese samples was measured using a titrimetric method. The protein, fat, ash, and salt contents of civil cheeses were determined and calculated using the Kjeldahl, Gerber, Gravimetric, and Mohr methods, respectively, according to AOAC procedures (AOAC, 2005).

Instrumental Colour Analysis

The visual colour of civil cheeses was determined using Color Flex HunterLab instrument (Hunter Associates Laboratory Inc., Reston, VA, USA), in which the colour coordinates for lightness (L^*), redness (a^*) and yellowness (b^*) were assessed on the average of both side areas of four different cheese samples under diffuse illumination (D65 2° observer) with an aperture of 8 mm and a port size of 25 mm, excluding the specular component (AMSA, 2012).

Texture Profile Analysis

Texture profile analysis (TPA) of civil cheese samples was carried out using a texture analyser (Instron Universal Testing Machine, UK) equipped with a compression probe. A crosshead speed of 80 and 200 mm/min for the first and 2nd tests, and a load cell of 0 - 500 N was used for the samples. Eight different measurements from the samples were taken to calculate the arithmetic means. Hardness, cohesiveness, gumminess, chewiness and adhesiveness attributes were used to evaluate the texture profile of the samples (Bourne, 1978).

Sensory Evaluation

The sensory evaluation of civil cheese samples was performed with twelve trained panellists (7 men and 5 women), aged between 25 to 48 years (ISO 8586, 2012). Before the sensorial assessment of cheese samples, a preliminary session (1.5 h) was organised to define the sensory attributes in a round-table discussion using a standardised procedure (ISO 13299, 2016) in a separate session.

The panellists evaluated four main sensory attributes (colour, odour, texture and flavour) in terms of colour hue and intensity, odour intensity and bitter, sweet, fatty, acidic and spicy odours, hardness, elasticity, roughness, adhesiveness, tenderness, chewiness, fattiness, juiciness, flavour intensity and quality, Salty, sweet, bitter, acidic and spicy tastes using a 9-cm unstructured linear scale, in which 1 referred to "slight" and 9 referred to "extremely strong".

The panellists were seated in individual booths in a temperature and light-controlled room. Each sample was served randomly on a separate plate encoded with a three-digit number. The sensory panel was conducted over twelve independent days, depending on the sample collection.

Statistical Evaluation

The general linear model procedure in SPSS 13.0 was used to analyse the data for each parameter. The effects of production method and collection time were determined using one-way analysis of variance (ANOVA), and the significance of differences was verified by Duncan's test at $p<0.05$. A Friedman test followed by a Least Significant Difference test was applied to the sensory data, and all results were expressed as means and standard errors (SE).

Results and Discussion

The distribution of traditionally or industrially produced civil cheeses, according to production and collection seasons, is shown in Figure 1. Although the chemical properties of the traditionally or industrially produced civil cheeses were similar to a certain extent, they were found to differ in their structural characteristics. In particular, the fat and dry matter content of the traditionally produced civil cheeses was lower than that of the industrially produced cheeses; statistical differences were also recorded between the groups in terms of these parameters ($p<0.05$). While the traditionally produced cheeses had higher values than the industrially produced samples in terms of protein, salt, and moisture content, no statistically significant difference was observed between the groups ($p>0.05$).

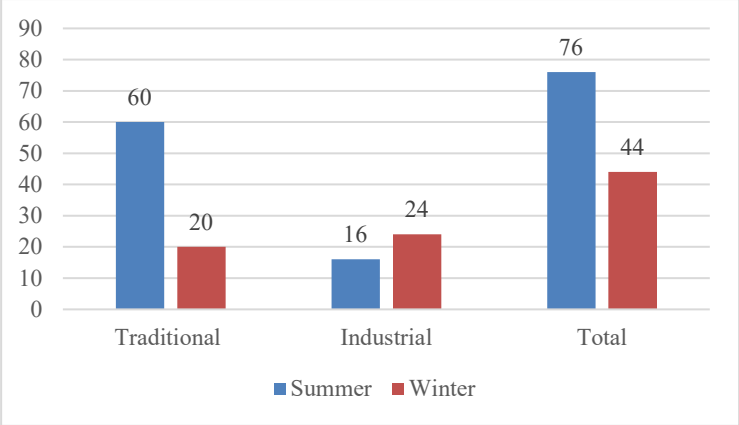

Figure 1. Distribution of traditionally and industrially produced civil cheeses (n=120)

The physicochemical properties of civil cheeses produced by traditional and industrial methods are given in Tables 1 and 2. The acidity, pH and a_w values of civil cheeses produced by traditional methods were higher than those produced by industrial methods; however, statistical significance was recorded only between acidity values, which were much higher (p<0.05). It was also observed that the fat and dry matter ratios of civil cheeses produced by traditional methods were significantly lower than those produced industrially (p<0.05). However, although the amounts of protein, salt and moisture were higher in traditional production than in industrially produced civil cheese, no statistical difference was found between the groups (p>0.05).

The chemical composition of Erzurum civil cheese was reported to vary between pH 4.53-6.32, titration acidity (as lactic acid) 0.73-2.39%, dry matter 35.19-40.35%, protein 22.49-32.40%, fat 0.25-2.30%, ash 7.83%, salt 4.68-6.14% and ripening degree 6.86-9.11% (Cakmakci & Salık, 2021). Yetişmeyen (2005) reported the titration acidity and pH values as 2.39±0.11 and 4.53±0.05, while in the present study, the titration acidity and pH values of industrially produced civil cheeses were found as 0.67±0.17 and 4.62±0.05 in summer and 0.52±0.06 and 4.67±0.05 in winter, respectively. Moreover, the titration acidity and pH values of traditionally produced civil cheeses in this study were recorded as 0.92±0.06 and 4.74±0.05 in summer and 0.92±0.08 and 4.91±0.10 in winter, respectively. Similar results were also reported in other studies stating that the titratable acidity and pH values of civil cheese collected in Ankara were 0.93% and 4.69 (Polat et al., 2001), and the pH value in civil cheeses collected from Erzurum was 4.53 (Yıldız et al., 2010). However, Yetişmeyen et al. (2001), Özdemir et al. (2003), Ayar et al. (2006), Dikbaş et al. (2006), Cambaztepe et al. (2009), and Şengül et al. (2009) reported higher pH values of civil cheeses than the present study, ranging from 5.02 to 5.90. Şengül and Gürses (2006) stated that the acidity values of civil cheeses collected from Erzurum were in a range of 0.63-2.16%, while it was 4.68% in samples sold in Ankara (Yetişmeyen et al., 2001). Parallel to the current study, Arslaner and Salık (2020) and Yangılar and Kızılkaya (2015) also reported the acidity of civil cheeses as 0.21-1.25% in Bayburt and 0.55% in Ardahan, respectively.

The average water activity of civil cheeses sold in Erzurum city centre was found to be 0.96±0.01. It was noted that the water activity values of the samples were higher than those of the other cheeses because they were both fresh (unripened) and unsalted cheeses (Yetişmeyen, 2005). In this study, the a_w values of the industrially produced civil cheeses were 0.924±0.01 in summer months and 0.930±0.01 in winter months, while the a_w values of traditionally produced ones were 0.929±0.01 in summer months and 0.926±0.01 in winter months. Similar to these findings, Tekinşen et al. (1996) stated that the water activity values in civil cheese samples collected from Erzurum and neighbouring cities were 0.92.
Civil cheeses are the most consumed cheeses among people living in the Erzurum-Horasan region. The differences in production techniques and hygienic qualities affect the textural and structural properties, as well as the shelf life, of the products. Even though the chemical properties of traditionally or industrially produced civil cheeses are similar in certain aspects, they differ considerably from each other in terms of their structural properties. In particular, traditional or industrial production as well as seasonal changes were found to be important among the samples (p<0.05).

In other studies, it was reported that the storage time and the characteristics of the raw milk used in production had important effects on the chemical properties of civil cheeses. Atasever (1995) determined that the highest and lowest values obtained from the civil cheeses during the storage period were 28.52-19.67% protein, 53.19%-42.19% moisture, 27.67%-17.00% fat, 5.09%-1.52% salt and 5.78%-2.40% ash, respectively. Besides, Tekinşen et al. (1996) stated the moisture, fat, protein, salt and ash content values in civil cheeses collected from Erzurum was 59.42%, 2.24%, 31.97%, 4.468%, 5.253%, while it was 56.64%, 2.78%, 16.46%, 9.15%, 9.40% in Muş (Bakırcı & Andiç, 1998) and 55.94%, 3.78%, 32.95%, 5.347%, 1.09% in Ankara (Polat et al., 2001), respectively. It was found that the civil cheeses offered for sale were generally low in fat, of substandard quality, high in protein and salt, soft and less matured compared to other cheese types. Although the fat content of civil cheeses in the current study was significantly affected by the

production method of the civil cheeses, ranging from 4.36 in traditionally produced cheeses to 21.73 in industrially produced cheeses, the protein, salt and ash content values remained constant between production methods. Arslaner and Salık (2020) reported that the dry matter, fat, protein, ash, and salt contents of civil cheeses obtained in Bayburt varied from 41.92 to 57.85%, 0.5 to 26.0%, 20.9 to 35.54%, 3.48 to 16.0% and 1.51 to 15.43%, respectively. Besides that, Gülmez and Güven (2001) and Yetişmeyen et al. (2001) stated that the fat content of civil cheese collected from Kars and Ankara was lower, in agreement with the present study. The protein content of civil cheeses collected in this study were also found to be lower (26.26%) than the other studies conducted in Kars (28.3%), in Ankara (32.40%) and in Konya (34.40%), respectively (Kamber, 2005; Yetişmeyen, 2005; Ayar et al., 2006), while it was same as other research performed by Özdemir et al. (2003) and Dikbaş et al. (2006) in Erzurum (26.33-26.40%). Addition to these findings, Şengül and Gürses (2006) declared that the dry matter, fat, fat in dry matter, salt and salt in dry matter values of civil cheeses collected in Erzurum were varied to 31.33-40.12%, 1-7%, 2.49-18.98%, 0.11-0.34% and 0.27-1.04%, respectively, whereas, Cambaztepe et al. (2009) emphasised that the values were 29.11-41.63%, 0.16-0.45%, 0.51-1.09%, 3.27-6.25% and 5.53-9.64%, respectively. Furthermore, Yıldız et al. (2010) determined the average values of dry matter, fat, fat in dry matter and salt content of civil cheeses collected in Erzurum were 35.19%, 2.30%, 6.50% and 35.19%, respectively. Moreover, Demir (2006) observed that in the civil cheeses produced using raw cow's milk, the effects of ripening period on dry matter, salt, salt in dry matter, pH and lipolysis values were statistically significant (p<0.01). In contrast, no significant effect was detected for fat, fat in dry matter, acidity, protein, water soluble protein, ripening index and ash values. This statement was somewhat in agreement with the findings of the present study, where a significant difference was recorded for acidity value, fat, dry matter and moisture content of the civil cheeses (p<0.001). No significant difference was found between the protein, ash, salt, pH, and aw values of the samples according to the different production and collection times.

The instrumental colour values of traditionally or industrially produced civil cheeses differed from each other, and the seasonal effect was found to be not significant in this variation (Tables 3 and 4). Regardless of the production method and season, the lightness values of the cheeses were found to be almost equal to each other. However, differences were recorded in the redness and yellowness values depending on the production method. Neither traditional nor industrial production showed seasonal differences in redness values. However, only the civil cheeses produced by traditional methods were lighter in colour than the other samples collected in summer (p<0.05). It was reported that Erzurum civil cheese, manufactured using local methods, has a white colour due to its low fat content (Özbay & Tüysüz, 2024).

Table 1. Physicochemical characteristics of civil cheeses (n=120)

Production method	n	Protein (%)	Fat (%)	Dry matter (%)	Moisture (%)	Ash (%)	Salt (%)	Acidity (LA%)	pH	a_w
Traditional	80	27.11	4.36	47.26	52.74	4.93	3.76	0.923	4.78	0.929
Industrial	40	24.56	21.73	55.33	44.67	5.09	3.57	0.580	4.65	0.928
TOTAL	120	26.26	10.15	49.95	50.05	4.98	3.70	0.808	4.74	0.928

Table 2. Means and standard errors (SE) of physicochemical properties of civil cheeses according to production method and collection time (n=120)

Civil cheese	n	Protein (%)	Fat (%)	Dry matter (%)	Moisture (%)	Ash (%)	Salt (%)	Acidity (LA%)	pH	a_w
Traditional (Summer)	60	27.81±0.75	4.49^{b}±0.37	47.48^{b}±0.77	52.50^{a}±0.77	4.96±0.44	3.81±0.37	0.92^{a}±0.06	4.74±0.05	0.929±0.01
Traditional (Winter)	20	25.00±0.56	3.99^{b}±0.62	46.59^{b}±1.47	53.41^{a}±1.47	4.81±0.80	3.64±0.69	0.92^{a}±0.08	4.91±0.10	0.926±0.01
Industrial (Summer)	16	25.68±1.25	21.51^{a}±0.86	54.38^{a}±1.43	45.62^{b}±1.42	6.23±1.06	4.83±0.92	0.67^{b}±0.17	4.62±0.05	0.924±0.01
Industrial (Winter)	24	23.81±0.86	21.87^{a}±0.72	55.97^{a}±1.81	44.03^{b}±1.81	4.35±0.34	2.73±0.36	0.52^{b}±0.06	4.67±0.05	0.930±0.01
p	**120**	**0.059**	**0.000**	**0.000**	**0.000**	**0.649**	**0.363**	**0.010**	**0.177**	**0.424**

a-b: Means within a column with different letters are significantly different (p<0.05).

Table 3. The instrumental colour (CIE *L*, a*, b**) values and texture profile analysis (TPA) of civil cheeses (n=120)

Production method	n	*L**	*a**	*b**	Hardness	Cohesiveness	Gumminess	Chewiness	Adhesiveness
Traditional	80	75.65	-0.79	12.69	2.478	0.354	0.801	-2.878	0.310
Industrial	40	74.99	-1.20	13.83	3.292	0.429	1.496	-3.863	0.471
TOTAL	120	75.43	-0.92	13.07	2.749	0.379	1.032	-3.206	0.363

Table 4. Means and standard errors (SE) of instrumental colour values (CIE *L*, a*, b**) and texture profile analysis (TPA) of civil cheeses according to production method and collection time (n=120)

Civil cheese	n	*L**	*a**	*b**	Hardness	Cohesive-ness	Gumminess	Chewiness	Adhesive-ness
Traditional (Summer)	60	75.55±0.37	-0.78^{a}±0.06	12.39^{b}±0.22	1.99^{b}±0.11	0.37^{ab}±0.03	0.68^{c}±0.05	-2.25^{a}±0.18	0.23^{b}±0.03
Traditional (Winter)	20	75.94±0.96	-0.80^{a}±0.03	13.58^{a}±0.46	3.95^{a}±0.20	0.29^{b}±0.02	1.18^{b}±0.11	-4.76^{b}±0.47	0.56^{a}±0.10
Industrial (Summer)	16	73.55±1.06	-1.16^{b}±0.11	13.72^{a}±0.85	1.74^{b}±0.08	0.33^{b}±0.08	0.57^{c}±0.15	-2.13^{a}±0.66	0.74^{a}±0.19
Industrial (Winter)	24	75.94±0.78	-1.22^{b}±0.08	13.90^{a}±0.63	4.33^{a}±0.41	0.50^{a}±0.05	2.11^{a}±0.31	-5.02^{b}±0.60	0.29^{b}±0.13
p	**120**	**0.329**	**0.000**	**0.012**	**0.000**	**0.050**	**0.000**	**0.000**	**0.000**

a-b: Means within a column with different letters are significantly different (p<0.05).

The texture profile analysis (TPA) of civil cheeses produced traditionally or industrially differed from each other, and the effect of season was found to be significant (p<0.05). The hardness, cohesiveness, gumminess, chewiness and adhesiveness properties of the civil cheese samples are summarised in Tables 3 and 4. The hardness, cohesiveness, gumminess, chewiness, and adhesiveness characteristics of traditionally produced civil cheeses differed from those of industrially produced ones. They were found to be softer, easier to chew, less sticky, and less chewy. On the other hand, the high dry matter content in the industrially produced samples made the civil cheeses harder, more cohesive and more resistant to chewing. Additionally, the high fat content also made the product chewier and stickier.

The seasonal variation of the civil cheese samples caused the cheeses collected in summer to be softer, chewier and more elastic, regardless of whether they were traditional or industrial. This is directly proportional to the higher acidity and relatively lower fat content of the cheeses collected in this season.

The sensory evaluation of civil cheeses produced traditionally or industrially also differed from each other, and the effect of season on the values obtained in terms of colour, odour, texture and flavour characteristics was found to be significant (p<0.05; Table 5 and Figure 2).

Demir (2006) observed that the sensory evaluation scores of the civil cheeses produced using raw cow's milk were preferred by the panellists mostly on the 60th day of the ripening period. Tekinşen et al. (1996) scored the average sensory evaluation of civil cheeses as 74.27/100 points and concluded that civil cheese was a fat-free and soft cheese type. In another study, Polat et al. (2001) stated that civil cheeses offered for sale in Ankara were low in fat, high in protein and salt, soft and less matured compared to other cheese types, and had not of uniform standard quality. Yetişmeyen et al. (2001) emphasised that civil cheeses offered for sale in Ankara received 14.95 out of 20 points in terms of sensory properties and added that the collected cheese samples were not of a constant or standard quality, were low in terms of fat content, were high in terms of protein and salt content and inadequately ripened. On the other hand, Özdemir et al. (2003) determined that Çarzof civil cheese type was different from Erzurum civil cheese type in terms of aroma, structure and taste since milk with high fat content was selected for the manufacturing of Çarzof civil cheese, and that it was similar to Erzurum civil and Saç (Tel) cheese in terms of production method. Moreover, Yazici and Dervisoglu (2003) emphasised that civil cheeses produced under the pH value of 5.35 and 5.30 and stored with 9% brine salt obtained more appreciable results in the panellists' evaluations at the end of the 60th day of the ripening process. Salting, which can be done by different methods (such as brine and dry salting) to increase durability, to direct acidity and ripening, to improve flavour and texture of cheese significantly affects the dry matter and ash content of cheese (Guinee & Fox, 2017) that results a product with different palatability and structural quality. Harmankaya and Harmankaya (2020) determined that the average salt, fat and moisture contents of çeçil cheese sold in Kars were 2.48%, 18.48% and 45.51% and out of the 60% and 40% çeçil cheese samples did not meet the Turkish standards in terms of salt and moisture contents, respectively. Since civil cheese is kept in brine in large masses, it retains less salt due to its small surface area in contact with salt. For this reason, it is less salty compared to Saç and Tel cheeses (Güzeler & Koboyeva, 2020).

As a result of the sensory evaluation of civil cheeses in the present study, colour hue and colour intensity values were found to be higher in industrially produced cheeses (p<0.05). This indicates that on a colour scale ranging from white to yellow, industrially produced packaged products have a darker colour, while traditional products sold unpackaged have a creamier colour. Similarly, the appreciation rate for flavour quality was in line with the appreciation for appearance quality; industrially produced civil cheeses were rated higher than those produced traditionally. Mainly, the packaged products produced and sold in summer were found to be more palatable than those sold in winter. In terms of flavour intensity, industrially produced cheeses in summer were rated higher than traditionally produced cheeses, while traditionally produced cheeses in winter were rated higher than industrial ones (p<0.05).

The sensory attributes of the cheese samples differed from each other in terms of texture profile, and the effects of production type and season were found to be distinctive by the panellists (p<0.05). The structure and consistency characteristics of the samples led to a differentiation in the perceived textural quality of the products as a function of their fat and dry matter content. In particular, the hardness of industrially produced civil cheeses with higher fat and dry matter content was rated higher than that of those produced traditionally. On the other hand, the chewiness attribute was rated lower in traditionally produced civil cheeses than in industrially produced ones, due to the lower force required to bite the products. This evaluation is based on the fact that traditionally produced civil cheeses are more easily separated, have a stringy structure, and do not have a homogeneous structure,

unlike industrially produced products. It has also been observed that industrially produced civil cheeses have a higher cohesiveness value due to the greater amount of work required to chew in the mouth before swallowing.

In terms of all sensory characteristics, the industrially produced civil cheeses were found to be more acceptable than the traditionally produced cheeses; in particular, the acceptability of samples collected during the summer months was deemed more desirable than those collected during the wintertime.

Table 5. Means and standard errors (SE) of sensory evaluation of civil cheeses according to production method and collection time (n=120)

Civil cheese	n	Colour Hue	Colour Intensity	Odour Intensity	Hardness	Elasticity	Roughness	Adhesiveness
Traditional (Summer)	60	$3.465^{b}\pm0.17$	$3.363^{b}\pm0.11$	$1.114^{a}\pm0.14$	$5.020^{a}\pm0.15$	$3.104^{c}\pm0.19$	$4.350^{a}\pm0.17$	$2.235^{b}\pm0.12$
Traditional (Winter)	20	$4.665^{a}\pm0.38$	$4.498^{a}\pm0.28$	$1.425^{a}\pm0.32$	$4.262^{b}\pm0.26$	$2.840^{c}\pm0.29$	$3.805^{a}\pm0.27$	$1.173^{b}\pm0.13$
Industrial (Summer)	16	$4.341^{ab}\pm0.35$	$4.781^{a}\pm0.36$	$1.225^{b}\pm0.43$	$5.438^{a}\pm0.66$	$7.563^{a}\pm0.56$	$1.369^{b}\pm0.23$	$3.881^{a}\pm0.72$
Industrial (Winter)	24	$4.996^{a}\pm0.34$	$4.471^{a}\pm0.25$	$0.584^{b}\pm0.17$	$4.446^{b}\pm0.22$	$5.200^{b}\pm0.18$	$1.706^{b}\pm0.16$	$3.523^{a}\pm0.22$
p	**120**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**

Civil cheese	n	Tenderness	Chewiness	Fattiness	Juiciness	Flavour Intensity	Flavour Quality
Traditional (Summer)	60	$3.468^{ab}\pm0.16$	$3.114^{c}\pm0.14$	$2.548^{c}\pm0.13$	$1.800^{c}\pm0.13$	$5.403^{b}\pm0.09$	$3.879^{b}\pm0.13$
Traditional (Winter)	20	$2.900^{b}\pm0.19$	$3.678^{b}\pm0.18$	$2.405^{c}\pm0.13$	$1.415^{c}\pm0.14$	$5.650^{b}\pm0.15$	$3.085^{a}\pm0.24$
Industrial (Summer)	16	$5.169^{a}\pm0.90$	$3.934^{b}\pm0.44$	$7.021^{a}\pm0.38$	$5.131^{a}\pm0.32$	$6.331^{a}\pm0.40$	6.484^{d} 0.34
Industrial (Winter)	24	$4.202^{b}\pm0.21$	$5.054^{a}\pm0.15$	$5.669^{b}\pm0.25$	$3.667^{b}\pm0.14$	$5.225^{b}\pm0.24$	$5.575^{c}\pm0.30$
p	**120**	**0.000**	**0.000**	**0.000**	**0.000**	**0.005**	**0.000**

a-d: Means within a column with different letters are significantly different ($p<0.05$).

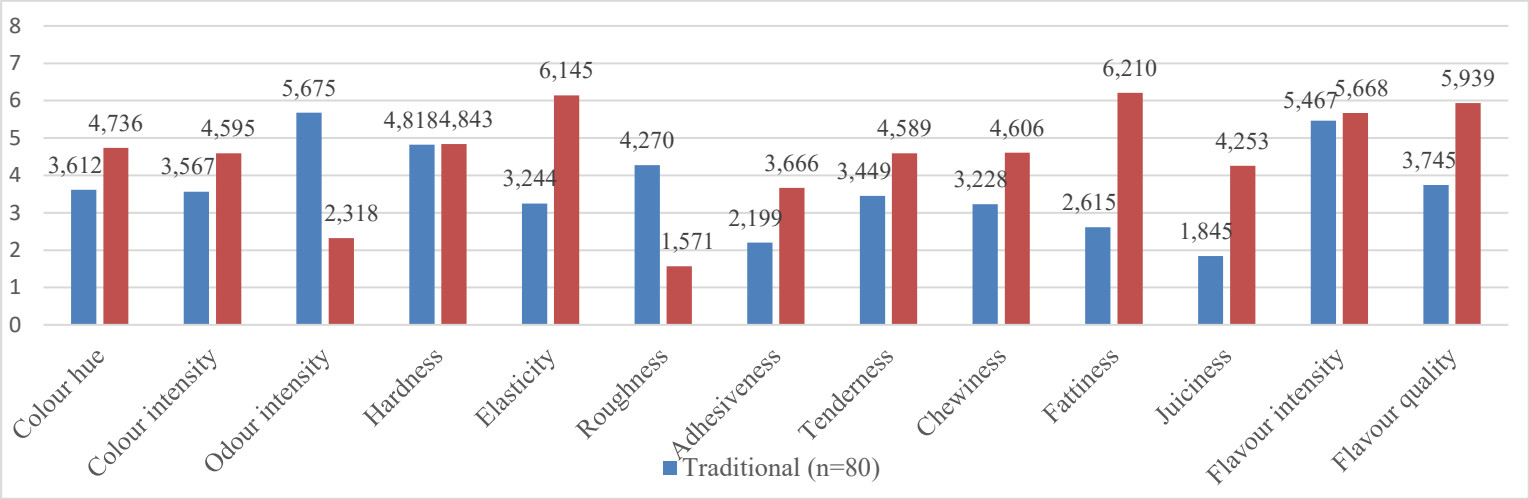

Figure 2. Sensory evaluation of civil cheeses (n=120)

Conclusion

In conclusion, it was revealed that the production method and seasonal effect are the main determinants of the chemical and textural properties of civil cheeses. Industrially produced civil cheeses are more acceptable than traditionally produced cheeses in terms of sensorial properties. Moreover, especially the cheeses collected in the summer months can be consumed with greater appreciation compared to those collected in the winter months. The development and standardisation of product quality in civil cheese, which plays a significant role in the local population's nutrition by preserving its original characteristics, is crucial for public health and the socio-economic development of the region. In this regard, there is a need to support the production of civil cheeses, which are produced and widely consumed in the Erzurum-Horasan region, under controlled conditions, to raise awareness among producers and to enhance control mechanisms.

Compliance with Ethical Standards

Conflict of interest: The author(s) declare that they have no actual, potential, or perceived conflicts of interest related to this article.

Ethics committee approval: The authors declare that this study does not involve experiments with human or animal subjects, and therefore, ethics committee approval is not required.

Data availability: Data will be made available at the request of the author(s).

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Disclosure: -

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