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Professional paper

SEASONAL VARIATIONS IN SENSORY CHARACTERISTICS OF TRADITIONAL WHITE BRINED GOAT CHEESE

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Abstract

White brine cheese is a widely consumed and recognized product that is produced in almost all regions of North Macedonia. Traditional white brined cheeses in North Macedonia are typically produced with raw untreated milk and no addition of starter cultures. White brined cheeses are rindless, with soft to semi-hard consistency and more often produced from cow's and sheep's milk than from buffalo or goat milk. Specific sensory attributes such as: flavor, aroma, and texture are fundamental to defining the identity, quality, and consumer acceptability of goat cheese. This study presents a comparative sensory evaluation of spring and autumn-produced goat cheese with the aim of identifying seasonal impacts on sensory quality attributes. Cheese samples from both seasons were assessed by a panel according to a structured scoring system for appearance, consistency, odor, and taste. Spring cheese achieved consistently high scores in all parameters, with mean values approaching the maximum for taste (19.85 ± 0.48), odor (29.37 ± 0.90), consistency (33.75 ± 2.19), and appearance (19.37 ± 0.92), resulting in an overall sensory score of 102.35 ± 2.74 out of 105 (97.48%). In contrast, autumn cheese showed greater variability and generally lower sensory performance, particularly in odor (23.15 ± 3.10) and taste (16.85 ± 1.07), with an overall mean score of 90.92 ± 7.87 (86.59%). The results suggest that seasonality significantly influences the sensory characteristics of cheese, with spring conditions yielding a cheese of higher sensory quality.

Keywords: goat cheese, sensory characteristics, seasons, traditional cheese.

1. Introduction

Dairy products made from locally produced raw milk remain a crucial component of the population's diet (Mojsova et al., 2013). Traditional cheeses are specific products in the Republic of North Macedonia, mainly produced on small farms or farms located in high mountains and rural areas. White brine cheese is a soft or semi-hard cheese, rindless and with a slightly sour taste, due to the action of lactic acid bacteria during ripening, and a salty taste, which comes from storage in brine (10%–18% NaCl) (Hayaloglu, 2017). They are most often produced from cow and sheep milk and ripened in brine for a period of 90 days, but some types of cheeses can have a ripening period from 7-120 days and are produced from buffalo or goat milk (Mateva et al., 2019; Hayaloglu, 2017). The process of making white brine cheese varies from country to country, with different production methods being used, where in North Macedonia traditional white brined cheeses are typically produced with raw untreated milk and no addition of starter cultures.

Milk from various non-bovine species including goats, sheep, buffalo and camel plays a vital role in human nutrition and subsistence across many regions of the world. These alternative milks are gaining popularity and market value, driven by their commercial success and the rising interest of consumers in non-bovine dairy products (Park et al., 2017).

Goats are well-suited for milk production, capable of producing milk equivalent to up to 10% of their weight in milk (ranging from 400 to 1500 liters per lactation) (Grille Peés et al., 2013). Goat milk differs from cow's milk in its composition, containing higher levels of short- and

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medium-chain fatty acids, a lower content of α_{S1}-casein, naturally homogenized fat globules, higher concentration of vitamin A and offers superior bioavailability of minerals such as calcium, phosphorus, potassium, and magnesium. It also contains antimicrobial peptides, demonstrates anticancer and therapeutic properties, and supports brain development (Park et al., 2017; Akshit et al., 2024). This milk can be consumed directly, used to feed kids, or be processed into cheese. The characteristics of cheese largely depend on the chemical composition of the milk from which it is made. Nevertheless, every stage of the manufacturing process influences the nutritional value and sensory qualities of the final product (Raynal-Ljutovac et al., 2011).

Specific sensory attributes like flavor, aroma, and texture are essential in defining the identity, quality, and consumer acceptance of goat cheese (Poveda & Cabezas, 2006). During ripening, the characteristic flavor and texture of the cheese type develop. Three main pathways comprise the biochemistry of cheese ripening: I. metabolism of residual lactose and lactate and citrate, II. lipolysis and fatty acid metabolism, and III. proteolysis and amino acid catabolism (Fox et al., 2017). The primary products of cheese ripening (peptides, amino acids, and fatty acids) are further metabolized to volatile compounds through fatty acid metabolism and amino acid catabolism (McSweeney, 2004).

Different techniques like gas chromatography combined with mass spectrometry technology, ion mobility spectrometry, and olfactory analysis are used to qualitatively analyze aroma compounds and elucidate their contribution to the overall aroma profile in food products (Pu et al., 2025), but the sensory analysis gives valuable insights into cheese's attributes such as flavor, aroma, color, appearance which help to understand consumer acceptability behavior (Drake & Delahunty, 2017). Several factors like breed of the animal, the milk production environment, processing technology and the chemical and microbiological characteristics of the raw material used influence the sensory quality of cheese (Fekadu et al., 2005; Coulon et al., 2004).

Season changes affect the cheese sensory quality by having an impact on the fatty acid composition of milk, which are important flavor precursors in cheese (Kraggerud et al., 2008; Xiang et al., 2023).

Considering the impact of these factors on milk and consequently cheese quality, the aim of this study was to analyze the sensory quality of white brined goat cheese in two different seasons. This knowledge is essential for producers aiming to maintain consistency and for consumers seeking high-quality traditional dairy products throughout the year.

2. Materials and methods

White brined goat cheese was produced traditionally without heat treatment of the milk and no addition of starter culture in a small farm in Seltse Village, Tetovo. After the ripening period the cheese from both spring and autumn season was taken for sensory analysis.

The sensory analysis of the produced white brined goat cheese was carried out using TS 961:2006, according to Sezen Demirci (2012), by 10 panelists, who evaluated the cheese for appearance (score up to 20), consistency (up to 35), odor (up to 30) and taste (up to 20) (Table 1). The test was conducted on two biological samples and two technical replicates. Before the start of the sensory evaluation, the evaluation procedure and the tasting method were explained to each panelist. The cheese samples were presented in random order and assigned codes, so that the samples remained anonymous to the panelists. The panelists were provided with bread and a glass of water to rinse their mouths between the samples.

Table 1. Sensory evaluation methodology

Appearance	**Points**
Unique bright white, homogeneous and smooth prismatic appearance, undistorted mold (cheese body)	20
Matte, pale white color	15
A few holes and pores on the cross-sectional surface	15
Inconsistent color distribution	10
Moldy appearance, cracks and splits	10
Irregular prismatic appearance, distorted mold (cheese body)	10
Numerous holes and pores on the cross-sectional surface	5
Shattered mold (cheese body)	5
Mass and structure	
Uniform, smooth, spotless, homogeneous, not too hard or too soft	35
Stained mold (cheese body), dry hard structure, slippery structure	25
Sandy structure	20
Formation of cracks and splits in the section, elastic structure, soft and wet structure	10
Dispersible structure, molten structure	5
Odor	
Its own distinctive smell	10
Yeast smell	10
Sour smell	5
Animal odor, feed odor	5
Moldy smell	5
Taste	
Its own distinctive taste	35
Yeast taste	25
Cooked taste, sour taste, sweetish taste, bland taste	10
Salty taste	10
Metallic taste, moldy taste, bitter taste	5

3. Results and discussion

The sensory evaluation scores for white brined goat cheeses produced in spring and autumn seasons are presented in Table 2 and Figure 1. Panelists assessed four sensory parameters: appearance, consistency, odor, and taste using a previously formulated and explained scoring system. Each parameter had a different maximum score: appearance - 20, consistency - 35, odor - 30, and taste a maximum of 20, with a total possible score of 105.

Table 2. Results of the sensory evaluation of cheese from spring and autumn production

Parameter	**Season**	**Minimum Score**	**Maximum Score**	**Mean ± SD**	**% of Max Value**
Appearance (20)	Spring	16.0	20.0	19.37 ± 0.92	96.85%
	Autumn	16.0	20.0	18.02 ± 1.33	90.10%
Consistency (35)	Spring	30.0	35.0	33.75 ± 2.19	96.43%
	Autumn	29.0	35.0	32.90 ± 2.37	94.00%

Odor (30)	Spring	27.0	30.0	29.37 ± 0.90	97.90%
	Autumn	16.0	26.0	23.15 ± 3.10	77.16%
Taste (20)	Spring	18.0	20.0	19.85 ± 0.48	99.25%
	Autumn	15.0	18.0	16.85 ± 1.07	84.25%
Total (105)	Spring	91	105	102.35 ± 2.74	97.48%
	Autumn	76	99	90.92 ± 7.87	86.59%

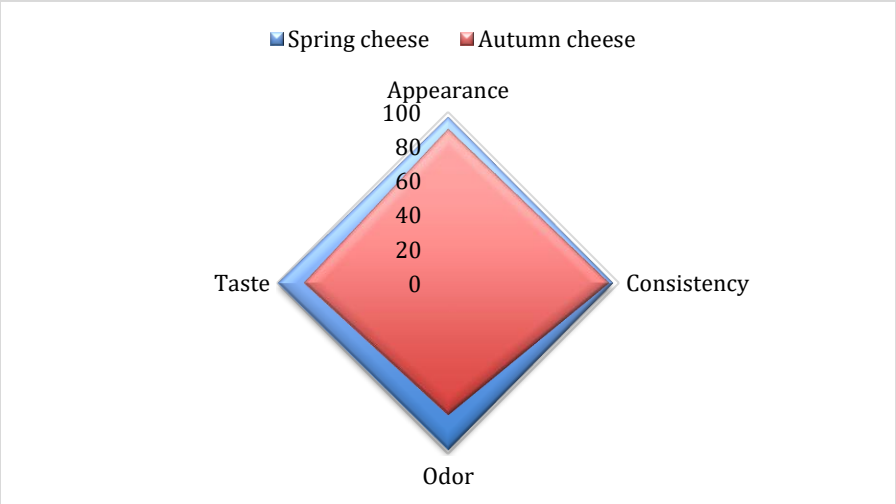

Figure 1. Sensory evaluation results of the cheeses: a graphical comparison between spring and autumn (% of Max Value)

The sensory evaluation results revealed that cheese produced in spring achieved consistently higher scores across all measured parameters compared to cheese produced in autumn. Notably, taste and odor were the most affected by seasonal variation. Spring cheese received a mean odor score of 29.37 ± 0.90 (97.90%) and a taste score of 19.85 ± 0.48 (99.25%), while autumn cheese scored 23.15 ± 3.10 (77.16%) for odor and 16.85 ± 1.07 (84.25%) for taste. These differences resulted in a significantly higher overall sensory score for spring cheese (102.35 ± 2.74, or 97.48%) compared to autumn cheese (90.92 ± 7.87, or 86.59%).

This outcome can be largely attributed to the seasonal variation in animal diet, particularly the availability of fresh pasture during spring. Some studies have reported that spring and early summer forages contribute to improved milk composition, with higher levels of unsaturated fatty acids, and terpenes, all of which are linked to enhanced flavor and aroma development in cheese (Martin et al., 2005). This is consistent with our findings, where odor and taste showed the largest seasonal gap: 97.90% vs. 77.16% for odor and 99.25% vs. 84.25% for taste in spring and autumn cheese, respectively.

The animal diet impacts the milk's composition, which subsequently affects the cheese ripening process that leads to differences in flavor and texture development (McSweeney & Sousa, 2020).

Bugaud et al. (2001) analyzed the sensory characteristics of cheese from ten different types of pasture (mountain and valley pastures), they reported that cheeses from mountain pastures had

greater differences among each other than from valley pastures and attributed these variations to moisture and salt content, but also to the cheesemaking process.
Several factors like breed of the animal, the milk production environment, production and processing technology, and the chemical and microbiological characteristics of the raw material used influence the sensory quality of cheese, which may explain the differences in the sensory qualities of the white brined cheeses compared to other studies (Hayaloglu et al., 2013; Miloradovic et al., 2021; Sezen Demirci, 2012), where the cheeses were evaluated with lower scores for all parameters. However, further detailed research which would considerate all the above mentioned factors is needed to explain these differences.

4. Conclusions

The results of the study show that season has an impact on the sensory quality of the traditionally produced white brined goat cheese. This is mostly observed in odor and taste parameter differences, where spring cheese had higher scores for odor and taste attributes and for all other tested parameters in comparison with autumn cheese. These differences show the role of seasonal variations in animal diet, which in turn shapes the sensory profile of cheeses. To optimize sensory quality of white brined cheese for better consumer acceptability producers should consider to explore feeding strategies during autumn season or to adjust the ripening conditions with the purpose of adapting to seasonal changes. However, further detailed research is needed on animal feeding, milk composition, production and ripening conditions, and consumer preference studies to provide elaborate insights, which can be very helpful for both consumers and producers.

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