JMBFS

Journal of Microbiology, Biotechnology and Food Sciences

International peer-reviewed scientific online journal

Published by Faculty of Biotechnology and Food Sciences

THE IMPACT OF PROCESSING TECHNOLOGY ON THE QUALITY OF TRADITIONAL SLOVAK SHEEP CHEESES

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https://doi.org/10.55251/jmbfs.12714

ARTICLE INFO

Received 22. 4. 2025
Revised 13. 5. 2025
Accepted 13. 5. 2025
Published 1. 6. 2025

Regular article

OPEN ACCESS

ABSTRACT

This study evaluates the impact of different processing technologies on the quality characteristics of traditional Slovak sheep cheeses, with a focus on steamed and whey-based varieties. The effects of processing temperature and salt application were examined in relation to dry matter (DM), fat in dry matter (FDM), moisture on fat-free basis (MFFB), NaCl content, malondialdehyde (MDA) levels, and microbiological quality. Cheeses such as Korbáčik and Parenica, which undergo longer heating at higher temperatures, showed the lowest DM values, while cheeses like Oštiepok and Stored sheep cheese, processed at lower temperatures or only salted, had higher DM content. Urda, a whey cheese, had distinct characteristics with significantly lower fat and DM content but the highest MFFB. NaCl content varied with processing method, being highest in Stored sheep cheese. MDA content was reduced in thermally processed cheeses, indicating improved oxidative stability. Microbiological analysis revealed a decrease in total bacterial count (TBC) following heat treatment. These findings highlight how processing variables influence the nutritional and microbiological quality of traditional sheep cheeses, contributing to improved understanding of their technological and health attributes.

Keywords: traditional Slovak sheep cheeses, processing temperature, NaCl content, microbiological quality, malondialdehyde, steamed cheeses

INTRODUCTION

Pasta filata and steamed cheese are two terms often used in connection with cheese production, that is, the process by which their characteristic properties, texture, and flavor are achieved. Pasta-filata cheeses are produced by the process of stretching the raw material heated in hot water. During heating and shaping, the amorphous protein structure of the lump cheese changes to an oriented structure composed of parallel protein fibers. The changes are conditioned by the appropriate combination of pH and calcium content in the lump cheese during heating and stretching. The change is influenced by the activity of starter cultures (acidification of milk with organic acids) in the production of the lump cheese (**Zimanová *et al.*, 2016).** The resulting plastic mass is easily formed into various forms and shapes **(Medved'ová *et al.*, 2020).** Pasta-filata cheeses include a wide range of cheeses mainly from the northern Mediterranean region. For the preservation of the national gastronomic heritage, the production of pasta-filata type cheeses (Parenica, Oštiepok, Zázrivské vojky, Zázrivský korbáčik, Oravský korbáčik) is of great importance in Slovakia. Traditionally made from sheep's lump cheese, which is also made from raw milk. in Slovak mountain huts immediately after milking. In the production of lump cheese, milk is curdled with rennet, fermented with native lactobacilli and matured for 24 hours at 20°C. After ripening, the cheese is cut and heated in hot water (60–70 °C) for 5–10 minutes. After forming, it is usually cooled in salt water **(Licitra *et al.*, 2017).** In comparison to Dutch-type or Cheddar cheeses, pasta-filata cheeses represent technologically and sensory a special cheese **(Salek *et al.*, 2017).**
Sheep milk is traditionally processed into lump cheese, which is the main raw material for special sheep cheeses mainly in Slovakia and Poland. The traditional production of sheep lump cheese in Slovakia is an important factor of the local economy **(Kováčová *et al.*, 2021),** and also of cultural heritage **(Makovický and Margetín, 2017; Janto, 2019).**
In northern Slovakia and Poland, traditional cheeses such as Bryndza Podhalańska, Oscypek, Redykołka are made from mountain sheep's milk in Poland, and Bryndza cheese, Slovenská Parenica cheese, Slovenský Oštiepok cheese, and sheep's lump cheese in Slovakia **(Marcinčák *et al.*, 2022; Migdal *et al.*, 2024).**
From raw sheep's milk is Oscypek (traditional Polish scalded-smoked cheese) manufactured without starter cultures near Slovakia in the Tatra Mountains region **(Alegria *et al.*, 2012).**
Oscypek is hard originally formed, salted and smoked cheese produced traditionally from May to September mainly from ewe's milk. Also can be made from mixed ewe's and cow's milk **(Najgebauer-Lejko *et al.*, 2022).**
Korbacze (Korboce) are a type of semi-hard, steamed cheese pulled into threads and tied into the shape of a braid. They are very popular in Poland (Korbacze) and in Slovakia, mainly in Orava region (Korbáčik), especially among tourists. Korbáčik cheese has a distinctly salty taste and can be smoked or unsmoked **(Kokotkiewicz *et al.* 2018).** In the past, they were made from sheep's milk lump cheese, and now also from cow's milk lump cheese.
Parenica cheese is traditionally produced from sheep's lump cheese and is a steamed rolled into a roll and can subsequently be lightly smoked or unsmoked. The rolled cheese is usually edged with cheese string and traditionally two rolls are tied together with a cheese ribbon **(Semjon et a., 2019).**
In recent times, there has been an increased interest in quality and safe foods, and there is also a growing consumer interest in natural products, especially those that belong to the "quality recognition" and the recognition of "geographical indications and also traditional specialities" referred to as PDO, PGI and TSG **(Todaro *et al.*, 2017).**
According to **Zajác *et al.* (2025)** the highest content of Palmitic acid, C16:0 in sheep's lump cheese is from 22.19 to 35.44, Oleic acid, C18:1 from 18.71 to 23.8. Stearic acid, C18:0 from 11.05 to 15.82 of the nutritionally important fatty acids, the content is Eicosapentaenoic acid, C20:5n3 from 0.05 to 0.12 Caproic acid, C6:0 is from 1.76 to 2.58, and Capric acid, C10:0 from 3.06 to 8.78 ($g.100g^{-1}$).
The content of crude protein in sheep's lump cheese is 23.52%, non-protein N, 0.63%, true protein 19.47%, casein 18.59%, and percentage of casein from true protein 95.48% (**Zajác *et al.*, 2025).**
The aim of the work was to analyze the quality of traditional Slovak sheep cheeses and compare the influence of different processing methods on their basic quality indicators.

MATERIALS AND METHODS

This study was conducted to evaluate the quality of traditional Slovak sheep cheeses produced using different processing technologies. The experiment focused on comparing fresh sheep's lump cheese, ripened lump cheese, and cheeses derived

from this raw material, including whey cheese (Urda), with attention to the chemical composition, salt content, acidity, oxidative stability, and microbiological quality. Sheep's lump cheese was made from raw milk. From weaning of lambs (early April) to the end of September, 3 samples were taken each month (n=18).

Sample Collection and Cheese Production

Sheep's milk was processed into lump cheese (a semi-soft fresh cheese) immediately after milking. The lump cheese was analyzed 1 day and 7 days after production to observe maturation effects. After one week of ripening, the lump cheese was used as the base material for the production of four cheese types: Oravský Korbáčik, Slovenská Parenica, Slovenský Oštiepok, and Stored sheep's cheese. A by-product of cheese production, whey, was used to produce Urda whey cheese.
Each cheese type was produced under traditional conditions simulating artisanal practices in Slovak mountain regions. Cheese samples were stored and analyzed under controlled laboratory conditions. All experiments were carried out in triplicate to ensure reproducibility.

Chemical Composition Analysis

The chemical composition **of sheep's lump cheese and** and Oravský Korbáčik cheese, Slovenská Parenica cheese Slovenská Oštiepka cheese and stored sheep's cheese were determined using Fourier Transform Infrared (FT IR) spectroscopy (Nicolet 6700, Thermo Scientific). Approximately 50 g of homogenized cheese sample was analyzed per test. The parameters measured included dry matter (DM), fat content, fat in dry matter (FDM), and moisture on a fat-free basis (MFFB).

Salt (NaCl) Determination

Approximately 2 g of cheese sample was mixed with 2 ml of potassium chromate indicator and titrated with a standard solution of silver nitrate until a light orange endpoint was reached. The amount of silver nitrate used was divided by the sample weight to calculate NaCl concentration.

Titratable Acidity

A 50 g homogenized cheese sample was used to determine titratable acidity. The sample was titrated with 0.25 mol.L^{-1} NaOH and expressed in degrees Soxhlet-Henkel (°SH).

Malondialdehyde (MDA) Determination

MDA, a marker of lipid peroxidation, was measured following the method described by **Marcinčák *et al.* (2011).** Absorbance was measured at 532 nm using a UV-VIS spectrophotometer (Jenway 7305). Results were expressed as mg MDA per kg of sample.

Microbiological Analysis

Total bacteria counts (TBC) were determined using Plate Count Agar (PCA, Oxoid, Basingstoke, UK). Petri dishes were inoculated and incubated for 72 ± 3 hours at 30°C. Coliform counts (CC) were determined using Violet Red Bile Lactose Agar (VRBL, Oxoid, Basingstoke, UK) as described by **Kunová *et al.* (2024),** with incubation for 24–48 hours at 37°C.

Quality Control and Standardization

All measurements were performed under standardized laboratory conditions with calibration of instruments prior to testing. Analytical replicates were used for each sample type. Standard operating procedures (SOPs) were followed to ensure consistency in sample preparation and data accuracy across all cheese types.
Statistical Analysis
The data were statistically analyzed using SAS software (SAS 9.3, Enterprise Guide 4.2). Results are reported as means ± standard deviation. Differences between groups were evaluated using appropriate statistical tests with significance set at $p < 0.05$.

RESULTS AND DISCUSSION

The main raw material for the processing of sheep cheeses was sheep lump cheese. We analyzed sheep lump cheese on the 1st day after production and one week after production.
From the whey immediately after the production of the lump cheese, was produced Urda whey cheese.
From sheep lump cheese, which matured for one week, was produced Korbáčik cheese, Parenica cheese, Oštiepok cheese and Stored sheep's cheese.
Sheep's lump cheese was matured for 1 week because, based on previous experiments, we found that it has the best technological and sensory properties. However, in common practice, maturation is used only in the production of Stored sheep cheese.

Water content of Sheep lump cheese on the 1st day after production was 45.57g.100g^{-1} and 1 week after production it was not significantly lower 43.62g.100g^{-1} (Table 1). The FDM content was almost the same, 50.74g.100g^{-1} and 50.67g.100g^{-1} respectively. Both cheeses were classified as semi-soft cheeses according to **Commission Decision 96/16/EC.** The MFFB content was 62.96g.100g^{-1} on the 1st day after production and 60.92g.100g^{-1} one week after production. Both cheeses were classified as semi-soft cheese according to **Commission Decision 96/16/EC.** The titratable acidity increased statistically significantly from 87.33°SH to 95.26°SH. The MDA content also increased to 0.49 mg.kg^{-1}.

Table 1 Physico-chemical parameters of fresh raw material (sheep's lump cheese) and after the 1st week of ripening

Parameter	Water (g.100g^{-1})	DM (g.100g^{-1})	Fat (g.100g^{-1})	FDM (g.100g^{-1})	MFFB (g.100g^{-1})	NaCl (g.100g^{-1})	TA (°SH)	MDA (mg.kg^{-1})
Raw material 1 day after production								
x	45.57	54.43	27.62^{a}	50.74	62.96	0.39	87.33^{a}	0.42
SD	1.89	1.97	0.58	0.82	1.95	0.07	5.22	0.04
Raw material - after 1 week of maturation								
x	43.62	56.08	28.43^{b}	50.69	60.92	0.41	95.26^{c}	0.49
SD	1.46	1.48	1.65	1.82	1.57	0,.7	0.70	0.13

DM- Dry matter, FDM - Fat in dry matter, TA - Titrating acidity, MFFB - moisture content on a fat free basis, MDA – Malondialdehyde

In comparison to our results, **Contò *et al.* (2024)** found a higher dry matter (DM) content in fresh sheep's cheese (57.09 g.100g^{-1}) and the same fat content of 27.4–28.6 g.100g^{-1}. Also**, Muñoz-Tébar *et al.* (2019)** found a dry matter content of 58.5 g.100g^{-1} and a fat content of 29.27 g.100g^{-1}. Also, **Marino *et al.* (2021)** found a higher dry matter content in sheep's cheese compared to our results, 61.2 g.100g^{-1}, but the fat content varied from 26.5 to 31.9 g.100g^{-1}. Similarly **Branciari *et al.* (2020)** found a lower water content of 42.58 g.100g^{-1} but also a lower fat content of 26.1 g.100g^{-1} in fresh sheep's cheese. Compared to our results, **Martino *et al.* (2019)** found the same fat content in sheep's lump cheese (25.08-28.44g.100g^{-1}). **Gaglio *et al.* (2021)** report approximately the same dry matter content of 55.34 g.100g^{-1} but a lower FDM content (46.41 g.100g^{-1}) compared to our results. **Zajác *et al.* (2025)** found in sheep's lump cheese a lower fat 24.60% (from 20.36 to 28.85) and dry matter content 48.02% (from 44.47 to 51.87) compared to our results. But according to **Zajác *et al.* (2023),** the fat content in sheep's lump cheese is consistent with our results at 28.6g.100g^{-1}, but the salt content was significantly higher (from 1 to 2.34g.100g^{-1}). In contrast to our results, **Martino *et al.* (2019)** found a lower MDA content in fresh cheese of 0.25 mg.kg^{-1}, however, after 30 days of ripening, the content increased significantly and reached a value close to 1 mg.kg^{-1}. **Contò *et al.* (2024**) found an MDA content of 0.06 mg.kg^{-1}. but in sheep's cheese after 15 days of ripening. **Gaglio *et al.* (2021)** report an MDA content of 18.74 µg MDA.kg^{-1} but in contrast to our results in DM. Compared to our results, **Milišić *et al.* (2022)** report a higher MFFB content in fresh sheep cheese of up to 75.15 g.100g^{-1}.
Sheep's lump cheese is a food but also a raw material from which a whole range of cheeses are traditionally made. For the purposes of this work, we analyzed cheeses with different processing technologies. Steamed cheeses are most often made from them. The traditional method is to steam leavened and partially overripe lump cheese in hot water. Korbáčik cheese and Parenica cheese are made using a similar technology, but Korbáčik cheese is formed into threads about 2-3 mm in diameter and Parenica into strips about 5 cm wide.
Korbáčik cheese. Cheese (raw material) is cut into smaller pieces, which are grated and steamed in hot water (water temperature 70 – 95 °C), then salted in a saturated salt solution so that the resulting salt content does not exceed 4.5% in the case of non-smoked products or 5.5% in the case of smoked products. The threads of Korbáčik cheese is traditionally tied into a braid.
Parenica is made by forming hot cheese into a ribbon that is 2 - 3 mm thick, 5 - 8 cm wide and 4 - 6 m long.
The cheese (raw material) is placed in water at a temperature of 60 - 70 ºC and spread until a soft cheese dough is formed. The processed cheese dough, stretched into a ribbon, is placed in the prepared cold saturated salt solution. Requirements

for dry matter content: minimum 53%, fat in dry matter: minimum 50% and NaCl: max. 3%. The ribbon is then rolled into a cylinder.

Oštiepok cheese is a cheese, steamed or unsteamed, smoked or unsmoked. The matured sheep's lump cheese is pressed into a form and is most often steamed and smoked to obtain the desired consistency and sensory properties.

During this process, the cheese is soaked in whey, the temperature of which is 55 - 60°C. The Oštiepok is formed and dipped again in hot whey (60°C - 70°C). After being removed from the hot water and salted for a maximum of 24 hours.

In the past, it was steamed and smoked to increase its shelf life. The characteristic feature of Oštiepok cheese is the peculiar shape of a large egg, a cone or an elliptical shape decorated with ornamentation.

Stored sheep's cheese is a mixture of matured sheep lump cheese and salt. Stored sheep cheese is a raw material for the processing of Bryndza cheese during the period when sheep do not produce milk. The matured cheese is cut, ground and 4-6% salt is added. It is left to stand for 1-2 hours and mixed subsequently. The mixed mixture is filled into airtight containers and matured for at least 2 and at most 11 months at a temperature of up to 10°C. The matured stored sheep cheese is used in the winter to produce Bryndza cheese, which is mixed with Cow's lump cheese in a ratio of 1:1 and the salt content is reduced to an acceptable value.

Urda cheese is obtained from whey by heating it to 80-90°C. The precipitated whey proteins in the form of flakes are filtered and the Urda cheese is allowed to drain. Because Urda cheese is made from sweet whey, it is not preserved with lactic acid and has a short shelf life.

Table 2 Physico-chemical parameters of the cheese Korbáčik, Parenica, Oštiepka,Stored sheep's cheese and Urda

Parameter	DM (g.100g^{-1})	Fat (g.100g^{-1})	FDM (g.100g^{-1})	MFFB (g.100g^{-1})	NaCl (g.100g^{-1})	Titrating acidity (°SH)	MDA (mg.kg^{-1})
Korbáčik cheese							
x	54.41^{b}	27.92^{a}	50.38^{a}	61.86^{a}	3.79^{a}	92.61^{a}	0.35^{b}
SD	4.55	2.76	3.39	3.26	0.33	12.51	0.08
Parenica cheese							
x	54.62^{b}	27.88^{a}	51.04^{a}	62.21^{a}	2.94^{b}	95.73^{a}	0.31^{b}
SD	4.39	3.32	4.18	5.42	0.49	15.05	0.07
Oštiepok cheese							
x	57.51^{a}	29.54^{a}	51.36^{a}	60.31^{a}	4.12^{a}	79.25^{a}	0.45^{b}
SD	4.82	5.85	4.25	5.92	1.12	12.87	0.12
Stored sheep's cheese							
x	57.52^{a}	28.92^{a}	50.27^{a}	59.76^{a}	4.93^{b}	90.45^{a}	0.52^{a}
SD	2.53	4.52	4.12	6.12	0.85	10.02	0.16
Urda cheese							
x	35.28^{c}	5.71^{c}	16.18^{c}	68.64^{a}	0.23^{c}	15.03^{c}	0.12^{c}
SD	4.12	1.25	3.28	5.16	0.02	2.16	0.02

DM- Dry matter, FDM - Fat in dry matter, TA - Titrating acidity, MFFB - moisture content on a fat free basis, MDA – Malondialdehyde

The dry matter (DM) content was 56.08 g.100g^{-1} in the raw material (sheep's lump cheese) and increased to 57.51 g.100g^{-1} in the production of Oštiepok cheese, because after forming Oštiepok cheese is dried and smoked (Table 2). The DM also increased in Stored sheep's cheese (57.52 g.100g^{-1}) but due to the addition of salt, because salt is important for long-term preservation and achieving sensory properties. In Korbáčik and Parenica cheeses, the DM decreased due to long heating in hot water until the desired consistency was reached to create the desired shape. Statistically significant differences between Korbáčik and Prarenica cheeses on the one hand and Oštiepok and Stored sheep's cheese on the other hand result from different production technology. Urda cheese had statistically significantly the lowest dry matter content (35.28 g.100g^{-1}) but whey cheese is a by-product of cheese production.

In agreement with our results **Maľová *et al.* (2017**) determined DM from 53% to 68 g.100g^{-1} in Ukrainian steamed cheeses, from 44% to 60 g.100g^{-1}in Slovak steamed cheeses, but lower in Polish steamed cheeses (52 g.100g^{-1}).

So **Semjon *et al.* (2017)** found significant effect of smoking on values of DM, smoking on the DM values found also in the Parenica cheeses from the farm and industrial dairies.

The fat content in the raw material 28.43 g.100g^{-1} and in the analyzed cheeses with exception of the Urda cheese was approximately the same, the lowest fat content was in Parenica cheese 27.88 g.100g^{-1} and the highest in Oštiepok cheese 29.54 g.100g^{-1}. However, the differences were not statistically significant. Statistically, the lowest fat content was in Urda cheese (5.71 g.100g^{-1}), which results from the different production technology, because a significant part of the milk fat passes into the cheese and very little remains in the whey.

The FDM content in the raw material was 50.69 g.100g^{-1} and in cheeses made from the raw material (sheep's lump cheese after seven days of ripening) the lowest was 50.27 g.100g^{-1} (Stored sheep's cheese) and the highest (51.36 g.100g^{-1}) in Oštiepok cheese. The FDM content in Urda cheese was statistically significantly lower (16,18 g.100g^{-1}).

By **Semjon *et al.* (2017)** the smoking process no significant effected the acidity of the cheeses.

Ayyash *et al.* (2013) found out a positive correlation between high salt level and osteoporosis, kidney stones and hypertension has been found. Therefore, there is a societal demand for reducing salt content.

Semjon *et al.* (2017) analysed salt content in cheese, declared content of NaCl in Parenica cheeses from farms was 2 g.100g^{-1}, no unsmoked Parenica cheese, and only 33.3% of smoked Parenica cheeses were in accordance with declared salt content. But of salt content in the Parenica cheeses from an industrial dairy, where 33% of the unsmoked cheeses and 25% of smoked cheeses were in accordance with declared salt content (1.8 g.100g^{-1}).

But **Maľová *et al.* (2017)** unlike our results stated that the Slovak smoked and unsmoked steamed sheep cheeses were in accordance with declared salt content (1.5 to 2.5 g.100g^{-1}). In contrast to our results and the salt content in steamed cheeses in Slovakia in Ukrainian smoked and unsmoked sheep's cheeses, the salt content is very high (7.2 to 9.2 g.100g^{-1}) and exceeded the declared content of salt by two to three times. Salt is traditionally used in cheeses processing as preservative and flavor enhancer.

The MFFB content was the lowest in Stored sheep's cheese (59.76 g.100g^{-1}) and the highest in Parenica cheese (62.21 g.100g^{-1}), the differences were not statistically significant. According to **Commission Decision 96/16/EC** and **NV SR 343/2016**. Korbáčik, Parenica, and Oštiepok cheese and Stored sheep's cheese belong to semi-hard cheeses (54-63% MFFB). Urda cheese with MFFB content of 68.64 g.100g^{-1} belongs to semi-soft cheeses (requirement 61-69%MFFB). Compared to our results report **Paskas *et al.* (2024)** higher content of MFFB in sheep's cheese (67.44 g.100g^{-1}).

According to **Mazzocca *et al.* (2024)** the MDA content in sheep cheese gradually increases, on the day of production it was 0.02 mg.kg^{-1}, 30 days after production it was 0.06 mg.kg^{-1} and 90 days after production it was 0.09 mg.kg^{-1}.

Table 3 Microbiological quality of the cheese Korbáčik, Parenica, Oštiepka, Stored sheep's cheese and Urda (log CFU.g^{-1})

Parameter	Raw material 1 day after production		Raw material 1 week after production		Korbáčik cheese		Parenica cheese		Oštiepok cheese		Stored sheep's cheese		Urda cheese	
	TBC	CC	TBC	CC	TBC	CC	TBC	CC	TBC	CC	TBC	CC	TBC	CC
x	4.55	2,28	5,57	2.35	4.55	0	4.56	0	4.81	2.01	5,23	0	4.08	0
SD	2,48	1,01	3,15	1.55	2,48	0	2.78	0	3.35	1.35	3,66	0	1.01	0

Total Bacterial Count (TBC), Coliform Count (CC**)**

Total Bacterial Count (Tab. 3) in sheep's lump cheese on the 1st day after production was 4.55 log CFU.g^{-1} and after one week of ripening it increased to 5.57 log CFU.g^{-1}. In all types of steamed cheese, the Total Bacterial Count content decreased due to processing. The lowest TBC content was found in Korbáčik cheese (4.55 log CFU.g^{-1}) and the highest in Oštiepok cheese (4.81 log CFU.g^{-1}). This fact is related to the processing method, because in the production of Korbáčik, the cheese must be heated to a temperature that allows it to be shaped into threads with a diameter of 3 mm. On the other hand, in the production of Oštiepok cheese, the cheese is shaped and then heated in its entire volume. The lowest TBC was in Urda cheese (4.08 log CFU.g^{-1}).

The highest TBC content was in the stored cheese (5.23 log CFU.g^{-1}), although it was slightly lower compared to the raw material (sheep's lump cheese). Urda

cheese, as a type of whey cheese, also has raw materials, in this case whey, heated to a temperature at which whey proteins coagulate.

The CC content was 2.48 log CFU.g^{-1} in fresh cheese, 3.15 log CFU.g^{-1} in cheese after 1 week of ripening, and after processing, we did not detect any CC in Korbáčik cheese, nor did we detect their content in Parenice cheese. In Oštiepok cheese, their content was 1.35 log CFU.g^{-1}. We did not detect their content in Urda cheese.

Crespo *et al.* (2022) reported a higher TBC content in matured sheep cheese of 8.6 log CFU.g^{-1} and also CC of 5.5 log CFU.g^{-1} compared to our results.

Alegría *et al.* (2012) found 9.37 log CFU.g^{-1} TBC in fresh sheep cheese and its content was reduced to 8.82 log CFU.g^{-1} by smoking. However, according to the mentioned work, almost the entire number of TBC was formed by lactic acid bacteria. Also, **Gaglio *et al.* (2021**) found 9.44 log CFU.g^{-1} TBC on the 1st day after production and 8.73 log CFU.g^{-1} on the 15th day after production. The mentioned authors also state that the majority was formed by lactic acid bacteria. Also, **Tripaldi *et al.* (2018),** in contrast to our results, found in sheep cheesea higher TBC on the 1st day after production 6.6 log CFU.g^{-1} and 5 days after production 7.5 log CFU.g^{-1}, also found a higher cc 1.5 log CFU.g^{-1} (1st day) and 2.2 log CFU.g^{-1} (5th day). **Muñoz-Tébar *et al.* (2021)** also reported a higher TBC content (9.53 log CFU.g^{-1}) in fresh sheep cheese, but the highest content was formed by lactic acid bacteria. In comparison with our results, **Berthold-Pluta, *et al.* (2011)** reports a higher TBC content in Oštiepok cheese. **Fuentes *et al.* (2015)** found that in pasta filata cheese the CC content on the 1st day after production was 5.65 log CFU.g^{-1} and during ripening (1 week) its content decreased to 5.52 log CFU.g^{-1}, in contrast to our results. **Maľová *et al.* (2017)**, in agreement with our results, found the absence of CC in Korbáčik produced in the Slovak Republic and Ukraine, but in Korbáčik produced in the Slovak Republic, they found a TBC of 3.98 log CFU.g^{-1}, in agreement with our results, but in Korbáčik produced in Ukraine, the TBC was as high as 5.13 log CFU.g^{-1}.

CONCLUSION

This study demonstrated that processing technology significantly influences the physico-chemical and microbiological properties of traditional Slovak sheep cheeses. The type and intensity of heat treatment, as well as salting techniques, affected key quality indicators such as dry matter, fat content, salt concentration, lipid oxidation (MDA), and total bacterial count (TBC).

Cheeses processed by stretching in hot water (Korbáčik, Parenica) exhibited lower dry matter and higher moisture retention, while cheeses like Oštiepok and Stored sheep cheese, which undergo milder or no heating but longer salting or drying, had higher dry matter and salt content. Urda cheese, derived from whey, showed distinct characteristics with the lowest fat, dry matter, and MDA content, but the highest MFFB.

Salt content varied considerably among cheese types and reflected both technological practices and traditional preferences. Heat processing had a positive effect on microbiological safety, as it significantly reduced total bacterial and coliform counts.

Overall, the findings provide a clearer understanding of how traditional processing methods shape the nutritional and safety profiles of Slovak sheep cheeses. These insights are valuable for producers seeking to maintain traditional practices while meeting modern quality and safety standards, and for consumers and researchers interested in authentic regional dairy products.

Acknowledgements: This research was funded by the project APVV SK-PL-23-0053 Diverzita tradičných syrov typu Oscypek / Oštiepok vyrábaných v Poľsku a na Slovensku

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