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SURVEY OF SOMATIC CELL COUNTS AND MILK COMPOSITION IN BULK MILK OF EWES IN DAIRY PRACTICE

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ABSTRACT

We evaluated milk quality during the sheep dairy period in the year 2018. The study was performed at fifteen dairy farms with differed breeds and crossbreds under Slovakian usual practical conditions (milking and pasture). At the first and seventh farm purebred Tsigai (TS) ewes were kept, at the eight to twelve farm there were purebred Lacaune ewes (LC) and the thirteen farm were kept crossbred Improved Valachian x Lacaune ewes (IV/LC, with a higher proportion of Improved Valachian), the fourteen farm crossbred Lacaune x East Friesian ewes and the last farm were ewes of the synthetic population of Slovak dairy ewe (SD). The milk yield recording and milk sampling were performed once a month during evening milking as a part of milk recording services. The basic milk composition was determined by MilkoScan FT120 (Foss, Hillerød, Denmark) and somatic cell count was determined using a Fossomatic 90 (Foss Electric, Hillerød, Denmark) after heat treatment at 40 °C for 15 min. We found the highest incidence of SCC on farm 14 with crossbred LC/EF 3.940 x 103 cells.mL^{-1}. Followed by farms 12 and 9 with purebred LC (SCC value of 3.318 and 2.489 x 103 cells.mL^{-1}). Farm 7 with purebred TS reached the lowest value (831 x 103 cells.mL^{-1}). The highest fat content was reached by the purebred TS, with gradual growth from March to July. Crossbreds and the synthetic population of Slovak dairy ewe (SD) had the lowest average fat content, which could be affected by feeding. Similar tendencies were found in protein content.

Keywords: SCC; fat; protein; lactose; sheep milk

INTRODUCTION

Sheep's milk production accounts for about 3.6% of total world milk production. In the last year 2019, sheep milk production in Slovakia reached 13,524 tonnes, the highest level since entering the European Union. Ewe's milk is mainly used for making cheese in Slovakia. **Bianchi et al. (2004)** presented in their work that SCC was associated with various udder health statutes and lactational phases were evaluated to verify their role in milk quality with regards to its cheese-making properties.

Ewe's milk was much more concentrated with about twice as much fat and 40% more protein than cow and goat milk. That also found that sheep milk responded differently in the cheese-making procedure. It was more sensitive to rennet, coagulated faster, produced a firmer curd, and yielded more cheese per unit of milk than cow milk **(Wendorff and Haenlein, 2017)**.

Although the SCC is not considered a factor influencing the price of milk, it is also an important factor determining the yield and quality of the final product **(Oravcová et al., 2007)**.

Somatic cell count (SCC) in raw milk is widely used to differentiate between healthy and infected mammary glands in ruminants. In the US, Grade A Raw Milk Standards require that the SCC of raw sheep milk shall not exceed 750 000 cells.mL^{-1} **(USPHS, 1999)**. In EU countries there are no standards considering the SCC of raw sheep milk. The quality of raw milk is regularly checked because milk is the ideal environment for developing microorganisms because of its high water and nutrient content. To avoid risks, and to ensure hygiene-sanitary quality and raw cows', sheep's and goats' milk safety, in its Regulations **(EC) No. 852/2004** and **(EC) No. 853/2004** European legislation lays down general food hygiene rules and specific ones for food of animal origin. It also sets out aspects relating to mandatory controls **(EC) No. 853/2004** on raw milk production on farms, and in dairy centres and laboratories. In dairy ewe's instantaneous physiological and pathological thresholds of SCC ranging from (0.25 to 1.0) × 106 cells.mL^{-1} have been available since the early 1990s **(Ariznabarreta et al., 2002)**. **Berthelot et al. (2006)** recommends that a decision rule proposes to consider an udder as healthy if every SCC are lower than 0.500 × 10^6 cells.mL^{-1} and infected if at least two individual SCC are higher than 1 or 1.2 million cells.mL^{-1}. **Arias et al. (2012)** found in manchego sheep that milk yield was always higher for ewe with SCC ≤300 × 10^3 cells.mL^{-1} than for those with SCC > 300 × 10^3 cells.mL^{-1}.

Table 1 Months of test day, SCC*10^3 cells.mL^{-1}.

Farms	March	April	May	June	July	August	Sept.	Decem.	Total
1		2747	1375		2942				**2232**
2		1116	1309	702	1065				**1022**
3		1206	933	915	2002				**1198**
4					881				**881**
5		2147			1049				**1501**
6	1390								**1390**
7		776	840	1456	252				**699**
8		1266				1095		1105	**1153**
9		2552	2307	3037	2059				**2463**
10		771	1307	663	1734				**1037**
11			3262				1667		**2332**
12		2530	4792	2676	3274				**3210**
13					1521				**1521**
14		3627		3266				4926	**3879**
15		2644	2145	2454	1766	2142			**2209**

Note: *SCC – somatic cell count.

Stress factors, for example, lamb separation, the start of machine milking, and sudden change in diet can increase the risk of infection **(Sinapis, 2007)**.

Scientific hypothesis

The period of the year 2018 affects the milk quality of dairy ewes.

MATERIAL AND METHODOLOGY

The study was performed at fifteen dairy farms with differed breeds and crossbreds under Slovakian usual practical conditions (milking and pasture). At the first and seventh farm purebred Tsigai (TS) ewes were kept, at the eight to twelve farm there were purebred Lacaune ewes (LC) and the thirteen farm were kept crossbred Improved Valachian x Lacaune ewes (IV/LC, with a higher proportion of Improved Valachian), the fourteen farm crossbred Lacaune x East Friesian ewes and the last farm were ewes of a synthetic population of Slovak dairy ewe (SD).

At all farms, the ewes were on pasture during the day and housed in the stable during the night. Twice a day the machine milking in the parlor was performed, whereat all animals received concentrates in amounts of 200 g per day.

The milking of ewes started shortly before Easter (suckling lambs were sold) and lambing of the most ewes was within 3 weeks (January/February).

The milk yield recording and milk sampling were performed once a month during evening milking as a part of milk recording services. Milk samples (50 mL) were collected from the whole milk yield into the recording jar (ICAR approved).

The basic milk composition was determined by MilkoScan FT120 (Foss, Hillerød, Denmark) and somatic cell count was determined using a Fossomatic 90 (Foss Electric, Hillerød, Denmark) after heat treatment at 40 °C for 15 min. Milk samples of the sheep were analyzed in the Central laboratory for milk analysis of Breeding Services of the Slovak Republic, s.e. by norm **ISO/IEC 17025 (2017)**. These instruments were calibrated monthly.

The calculation of SCC in the bulk milk tank was evaluated from individual samples by:

$$SCC_T = \frac{\sum_{j=1}^{n} SCC_j * MY_j}{\sum_{j=1}^{n} MY_j}$$

Where:
SCCT - in bulk; SCC1, SCC2, ... SCCj - individual SCC at sampling day; MY1, MY2, ... MYj - individual milk yield per milking at sampling day. We recalculated the basic milk components in the same way.

Statistical analysis

The values were evaluated through mean and standard deviation by Microsoft Excel 2013.

RESULTS AND DISCUSSION

In 2018 we found the highest incidence of SCC on farm 14 with crossbred LC/EF 3.940 x 10^3 cells.mL^{-1}(Table 1). Followed by farms 12 and 9 with purebred LC (SCC value of 3.318 and 2.489 x 10^3 cells.mL^{-1}). Farm 7 with purebred TS reached the lowest value (831 x 10^3 cells.mL^{-1}).

For individual animals, the best approach has been provided by **Berthelot et al. (2006)**. The mentioned author suggested that values <0.5 × 10^6 cells mL^{-1} indicate a healthy mammary gland and values >1.0 × 10^6 cells.mL^{-1}indicate a mammary gland with clinical or subclinical mastitis. Furthermore, there is no need to perform a simultaneous bacteriological examination of milk samples to confirm the problem. Values between 0.5 × 10^6 and 1.0 × 10^6 cells.mL^{-1}, according to those authors, indicate 'suspected disease'. There is a need for performing the bacteriological examination in milk. From a practical point of view, individual milk SCC is used, for subclinical mastitis control; "doubtful" ewes are grouped either with "healthy" (when farmers decide to cull "infected" females) or "infected" ewes (to implement a selective drying-off therapy). The lambs' mouths and milkers' hands are the sources of milk contamination **(Albenzio et al., 2003)**.

Table 2 Months of test day, fat g.100g^{-1}.

Farms	March	April	May	June	July	August	Sept.	Decem.	Total
1		7.98	7.69		8.56				8.08
2		6.77	6.75	7.33	8.08				7.24
3		6.75	7.56	8.69	8.66				7.92
4					9.58				9.58
5		7.44			9.25				8.34
6	6.91								6.91
7		5.96	7.29	8.08	8.37				7.43
8		5.53				4.83		7.84	6.07
9		5.03	4.25	4.64	6.01				4.98
10		5.67	5.74	6.12	7.75				6.32
11			7.36				7.47		7.42
12		7.64							7.64
13					6.08				6.08
14		6.00		6.70				8.20	6.97
15		5.70	5.90	5.75	7.70	6.84			6.38

Table 3 Months of test day, protein %.

Farms	March	April	May	June	July	August	Sept.	Decem.	Total
1		5.59	5.71		6.68				6.00
2		5.33	5.26	5.80	6.01				5.60
3		5.23	5.30	5.65	6.56				5.69
4					6.40				6.40
5		5.30			6.37				5.84
6	5.74								5.74
7		5.84	5.84	6.26	6.71				6.16
8		4.98				5.35		6.56	5.63
9		5.30	5.57	5.53	5.72				5.53
10		5.04	5.28	5.56	6.16				5.51
11			4.92				7.08		6.00
12		5.86							5.86
13					6.20				6.20
14		5.31		5.45				6.41	5.72
15		5.44	5.41	5.15	5.77	5.59			5.47

Table 4 Months of test day, lactose %

Farms	March	April	May	June	July	August	Sept.	Decem.	Total
1		4.73	4.76		4.46				4.65
2		4.87	4.77	4.76	4.62				4.75
3		4.81	4.83	4.69	4.56				4.72
4					4.54				4.54
5		4.80			4.58				4.69
6	4.60								4.60
7		4.94	4.84	4.58	4.65				4.75
8		4.98				5.00		4.69	4.89
9		4.90	4.95	4.82	4.74				4.85
10		4.95	4.99	4.81	4.66				4.85
11			4.55				3.95		4.25
12		4.81							4.81
13					4.68				4.68
14		4.86		4.57				4.57	4.66
15		4.81	4.80	4.78	4.63	4.61			4.73

These authors have found that within 4 weeks lasting experiment there was higher SCC at machine milking of ewes when compared to suckled ones, as a consequence of higher bacterial positive samples at machine milking. **Tomáška et al. (2015)** evaluated the most farms with SCC values >1.0 × 10^6 cells.mL^{-1}. **Pazzola et al. (2014)** stated values of SCC 1.251 ±2.991 x 10^3 cells.mL^{-1}. They were characterized by a very large range of variation. In agreement with the review by **Riggio and Portolano (2015)**, a value of SCC >1.0 × 10^6 cells.mL^{-1} is a normal finding in milk from healthy ewes. **Kuchtík et al. (2017)** founded SCC <0.5 × 10^6 cells mL^{-1}. **Vara Martínez et al. (2018)** evaluated 1.032 x 10^3 cells.mL^{-1}.

The highest fat content was reached by the purebred TS, with gradual growth from March to July (Table 2). Crossbreds and the synthetic population of Slovak dairy ewe (SD) had the lowest average fat content, which could be affected by feeding. Similar tendencies were found in protein content (Table 3). These changes in the milk composition are mainly related and could be also explained by the stage of lactation.

A similar fat content, but higher protein content was observed as compared to the results of **Oravcová et al. (2007)**. From the available publications **Špánik et al. (1996)**, **Margetín et al. (1995)**, **Margetín et al. (1996)**, **Margetín, Hlavatý and Přibil (1998), Tomáška et al. (2014)** and **Oravcová et al. (2005)**, which researched the composition of Tsigai milk rearing in Slovakia, a positive trend of increasing milk production was observed.

These changes in the milk composition are mainly related and could be also explained by the stage of lactation.

It is known that the fat and protein content of milk is dependent on nutrition, and indirectly, nutrition will also affect the solids-non-fat (SNF) of milk. Table 2, Table 3 and Table 4 are presented the basic composition of milk during the milking period. We have found a gradual increase in milk components, except for lactose, which is related to the increasing number of somatic cells during the milking period and consequently the health of the milk udders.

Both fat and protein tend to increase throughout the lactation as well as **Kuchtík et al. (2017)**. This would typically result in higher cheese yields in late lactation milk **(Wendorff and Haenlein, 2017)**. As the SCC increases in the milk supply, the composition of milk also changes. As SCC increased, milkfat and the Casein/Total Protein ratio decreased. The protein recovery rate was lower in the high SCC milk while cheese yield was not significantly different.

Bocquier and Caja (2004) are reported that a high level of nutrition will reduce the level of milkfat but increase milk protein and casein. Conversely, a negative energy balance will decrease milk protein and increase milkfat. Milk protein will increase with an increased level of dietary protein. When feeding higher levels of concentrate in the diet, milkfat will be decreased and milk protein will be increased. The degree of impact from the nutrition of the ewe will be limited by the potential milk production capacity of the animal dictated by genetics. These trends are consistent with our results.

CONCLUSION

We found a high SCC of over 1 million on the farms surveyed, except for two farms with purebred Tsigai. The nutrient content was following the minimum ingredient content in the milk according to Regulation (EC) No 853/2004 European legislation. However, a more detailed study is needed to see the relationship between high SCC and the presence of microorganisms to better understanding the reasons for the physiological and pathological SCC in the udder. Individual milk SCC represents a useful tool for the detection of subclinical mastitis in dairy ewes. It is recommended to evaluate a series of SCC, take into account the stage of lactation, and use two thresholds allowing to distinguish three classes of ewes: healthy, doubtful (or briefly infected), and infected (or persistently infected).

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