Mastitis in a flock of milking sheep

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Mastitis bei einer Herde Milchschafe

Die Bestimmung der somatischen Zellzahl (SCC) gewinnt auch bei Milchschafen immer mehr an Bedeutung. SCC kann für Milchverarbeiter ein nützlicher Indikator für die Milchqualität, für Schafhalter ein Mastitis-Indikator und für Züchter ein wichtiges Auswahlkriterium sein. Ziel unserer Studie war es, grundlegende Informationen über Faktoren zu erhalten, die die SCC-Variabilität bei lammenden Mutterschafen der Rassen Tsigai (T) und Improved Valachian (IV) beeinflussen.

Die SCC wurde in 866 Milchproben in den Jahren 2017 und 2018 beim säugenden Mutterschafen und während der Melkzeit bei Milchschafen bestimmt. Zur Analyse wurde ein Instrument Fossomatic 90 (Foss Electric, Hillerød, Dänemark) verwendet. Die durchschnittliche SCC schwankte zwischen 270 und 1897 × 103 Zellen/ml während der Säugezeit und zwischen 268 und 2139 × 103 Zellen/ml während der Melkperiode. Die Unterschiede zwischen den Probenentnahmezeiträumen waren im Jahr 2017 statistisch signifikant. Ein Anstieg der SCC wurde sowohl am Ende der Säuge- als auch der Melkzeit beobachtet. Die durchschnittlichen SCC über die gesamte Laktation war 364 × 103 Zellen/ml im Jahr 2017 (log(10) SCC – 2,25) und 1091 × 103 Zellen/ml im Jahr 2018 (log(10) SCC – 2,68). Der Indikator log(10) wurde 2017 deutlich von der Rasse beeinflusst (T – 2,61; IV – 2,75). Der Einfluss der Laktationszahl und der Anzahl saugender Lämmer hatte keinen signifikanten Einfluss auf den SCC.

Schlüsselwörter: Schafe, somatische Zellzahl, Milch, Laktation

Summary

Determination of somatic cell counts (SCC) becomes more and more important also for ewe's milk. SCC can be a useful indicator of milk quality for milk processors while it can be a mastitis indicator for sheep keepers and an important selection criterion for breeders. The objective of our study was to acquire basic information about factors influencing SCC variability in lambing ewes of the Tsigai (T) and Improved Valachian (IV) breeds.

Somatic cell counts (SCC) were determined in 866 milk samples in 2017 and 2018, during lamb sucking and during milking period. An instrument Fossomatic 90 (Foss Electric, Hillerød, Denmark) was used for analysis. Average SCC varied from 270 to 1897 × 10^3 cells/ml during lamb sucking and from 268 to 2139 × 10^3 cells/ml during milking period. Differences between the sampling periods were statistically significant in 2017. An increase in SCC was observed at the end of both sucking and milking periods. An overall evaluation of lactation brought about the average SCC at 364 × 10^3 cells/ml in 2017 (log(10) SCC – 2,25) and at 1,091 × 10^3 cells/ml in 2018 (log(10) SCC – 2,68). The indicator log(10) was significantly influenced by breed in 2017 (T – 2,61; IV – 2,75). The effect of lactation number and number of sucking lambs did not have any significant influence on SCC.

Keywords: Sheep, Somatic cell count, Milk, Lactation

Brief communication

Mastitis in a flock of milking sheep

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Mastitis is the main cause of high somatic cell counts (SCC) in milk, although other factors such as oestrus or advanced stage of lactation can act as triggers for high somatic cell counts.[1] Mastitis is defined as an inflammatory reaction of the mammary gland[12] and represents an indicator of the udder health status.[20.] The majority of the mastitis cases are caused by bacteria and are therefore intramammary infections. This disease has a wide impact over animal welfare and production, and produces great economic losses in the ovine dairy industry. This is especially evident in subclinical mastitis, which affects around 50 % of dairy ewes, while clinical mastitis only affects 5 %. Somatic cell count is used as an indicator to evaluate milk quality and to define its price.[11;21] An increase of somatic cells in milk is a sign of an alteration of the milk, resulting in a decreased milk quality. The lack of data in small ruminants can lead to errors in the diagnosis of subclinical mastitis.[20] Diagnostic limits for SCC in ewe's milk are still discussed, especially in European countries.[3;5] Unlike in bovine milk, where SCC limits have been legally established, no EU Directive applies to sheep milk. Consequently, no legal limits to categorize SCC have yet been established for small ruminants.[18;22] There is a great deal of controversy regarding acceptable SCC in ewes' milk. Konig et al. (1985),[14] suggested that SCC around 2000×10^3 cells/ml can be considered normal. Barbosa et al. (1994),[2] recommended a limit of 1500×10^3 cells/ml for bulk tank somatic cell count in small ruminants. In contrary, Boyazoglu and Morand-Fehr (2001),[5] established this same value as a sign of subclinical mastitis. Bianchi et al. (2004),[4] considered a SSC of 500×10^3 cells/ml as subclinical mastitis. Meanwhile, Gonzalo et al. (2000)[10] established 3 sanitary categories regarding bulk tank SCC in sheep: 1) good health condition (SCC< 500×10^3), with an average of 30 % of the flock affected; 2) intermediate health condition (SCC between 500×10^3 and 1000×10^3), with around 40 % of the flock affected; and 3) bad health condition (SCC > 1000×10^3 cells/ml), with an intramammary infection rate above 45 % of the flock.

The aim of the presented work was to obtain general information about changes in SCC in ewes during lactation and factors influencing the variability of SCC especially during the lamb suckling period and the milking period.

The study included ewes of the breed of Tsigai (T) and Improved Valachian sheep (IV) from the special-purpose facility of the Station for Breeding and Grading up of Sheep and Goats in Trencianska Tepla (SK). Ewes were in their 1st – 3rd lactation in 2017 and 1st – 4th lactation in 2018. Ewes with single and twin lambs were included during the lamb suckling period. Ewes were housed and managed under the same conditions during the reporting period. During the lamb suckling period milk samples were taken into standard sample bottles with preservative

(DURAN® GLS 80®, DWK Life Sciences GmbH, Mainz, Germany), after oxytocin injection (5 I.U./ewe, Oxytocin Vet®, Veyx, Lužianky, Slowakia) according to the McCance method (1959)[17]. During the milking period, milk samples were taken as a part of a regular milk yield check-up from morning hand milking. Milk samples were taken under normal operating conditions (stable environment until the weaning of the lambs, shelter during the milking period) so that the sample taken represented the entire ewe throughout lactation. Sampling was

Table 1: Number of somatic cells (x 10^3/ml) during the lamb suckling period and the milking period in Tsigai (T) and Improved Valachian (IV) sheep.

Indicator	Year	Lamb suckling period					Milking period (after weaning of lambs)					Total
		control measurement					control measurement					
		1st	2nd	3rd	4th	5th	1st	2nd	3rd	4th	5th	
n	2017	48	48	45	43	–	40	40	39	36	30	369
x		270	314	274	330	–	457	490	268	465	485	364
Median		138	122	114	158	–	129	139	92	264	114	136
Min.		47	35	25	40	–	44	29	24	22	27	22
Max.		1825	2706	1828	3275	–	4296	4810	1792	1865	1651	4810
x $\log_{10}$ (SCC)		2,23	2,20	2,16	2,25	–	2,26	2,30	2,11	2,43	2,36	2,25 (SE 0,025)
x lactation day		9	23	36	51	–	78	106	135	162	190	–
n	2018	37	48	59	57	57	55	50	45	46	43	497
x		1897	400	585	755	1291	544	991	1837	1037	2139	1091
Median		639	334	407	554	895	165	157	479	659	711	448
Min.		108	75	50	38	134	54	54	76	50	114	38
Max.		14629	2620	2733	3216	9445	6464	8906	37130	5756	28377	37130
x $\log_{10}$ (SCC)		2,92	2,51	2,58	2,71	2,94	2,35	2,45	2,79	2,76	2,91	2,68 (SE 0,021)
x lactation day		6	17	30	44	64	73	101	128	157	185	–

performed at approximately 14-day intervals during the lamb suckling period and at monthly intervals during the milking period. The average lactation days of the monitored ewe group for individual control milk measurements (CMM) are given in Table 1. SCC was determined by fluoro-opto-electronic methods with an automated analyzer (Fossomatic 90, fy Foss Electric, Hillerød, Denmark). During the lamb suckling period four CMM were done in 2017, five CMM were done in 2018 and 5 CMM during the milking period for both years. Basic variational-statistical methods and analysis of variance using the package of mathematical-statistical programs SAS were used to evaluate the obtained data on SCC. The somatic cell score data were transformed using the logarithm (log_{10} SCC) before their use in the analysis of variance.

Basic variational-statistical characteristics of the determined number of somatic cells in 2017 and 2018 are listed in Table 1, separately for the lamb suckling period and the milking period.

However, the difference in SCC between the individual CMM was statistically significant only in 2018 (P<0,01). The highest number of ewes with SCC higher than 700×10^3 cells/ml –was during the last CMM. (2017: n/30 %; 2018: n/52 %) The average SCC during 2017 was 364×10^3 cells/ml (average log $_{10}$ SCC – 2,25) and during 2018 up to 1091×10^3 cells/ml (log_{10} SCC – 2,68). Minimum and maximum values show a wide variability. The highest SCC values were found mainly in 2018. These high SCC might indicate that mastitis sheep without obvious clinical signs were also involved in the study.

During lactation in 2017 no statistical significant differences in log_{10} SCC (both breeds 2,25) were found. In 2018, however, the IV breed had significant higher log $_{10}$ SCC (2,75) than T ewes (2,61) (n= 497, P<0,001). Whether the ewes of the IV breed are more susceptible to mastitis than the T ewes will need to be assessed on a larger study including several different locks.

The effect of lactation number on SCC was not statistically significant (Table 2).

In 2018, we found the highest values of log $_{10}$ SCC in ewes in the 1st lactation (2,88), but only a small number of milk samples were evaluated. Mean values were lower in the 2nd, 3rd, and 4th lactation and increased with the age of the ewes (2nd lactation: 2,62; 4th lactation: 2,74). Differences between ewes rearing single or twin lambs (Table 2) were statistically not significant.

Discussion

Significant differences in the SCC lactation curves can be seen between 2017 and 2018 (Table 1). During the 1st CMM in 2018 up to 46 % of ewes had SCC higher than 700×10^3 cells/ml, which was probably due to the fact that this CMM was made on average on the 6th day of lactation. Also, in the same year, up to 67 % of ewes had SCC higher than 700×10^3 cells/ml during the 5th CMM (on average on 64th day of lactation), which is probably related to possible mechanical udder damage by suckling of lambs. This tendency during the lamb suckling period was evident in 2017. Udder damage by lambs is common at the indicated age of the lambs and the rearing system used. From the presented data, it is needed to wean the lambs sooner if we want to obtain better quality milk, even if the values during the 1st CMM of milk during the milking period in 2018 were significantly lower (see the Table 2) than during the 5th CMM during the lamb suckling period.

Whereas in cattle values of SCC between 250 and 300×10^3 cells/ml are recommended as most satisfactory discrimination thresholds between healthy and infected udders, there is not a widely accepted threshold in sheep. Some evidence has been provided that healthy ewes have normally higher SCC than cows.[8;9;16] Bufano et al. (1996),[6] showed that high SSC (>1 million cells/ml) do occur in healthy sheep and goat milk, especially towards the end of lactation. On the other hand, considering subclinical mastitis, Leitner et al. (2008),[15] suggested that, whereas in dairy cows subclinical mastitis is largely ignored because the increase in SCC in infected glands is modest (about 300–500×10^3 cells/ml) and

Table 2: Somatic cell count (log10 SCC) in Tsigai (T) and Improved Valachian (IV) sheep depending on the effects considered.

Source of variability	Breed		Lactation order				Number of suckling lambs		Lactation stage (control measurement)									
	T	IV	1st	2nd	3rd	4th	1	2	1*	2	3	4	5	6	7	8	9	10
n	194	175	128	139	102	–	–	–	48	48	45	43	–	40	40	39	36	30
2017	2,25	2,25	2,26	2,18	2,32	–	–	–	2,23	2,20	2,16	2,25	–	2,26	2,30	2,11	2,43	2,36
n	248	249	28	184	172	113	411	86	37	48	59	57	57	55	50	45	46	42
2018	2,61 a	2,75 b	2,88	2,62	2,67	2,74	2,69	2,65	2,92 cd	2,51 abc	2,58 abcd	2,71 abcd	2,94 d	2,35 a	2,45 ab	2,79 bcd	2,76 bcd	2,91 cd

Averages with unequal designations are different (P<0,05)
*1st – 5th control measurement – lamb suckling period, 6th – 10th – +++ P<0,001

the mixing with the milk from uninfected quarters is sufficient in most cases to appreciably lower the effect of SCC at the cow level, in sheep and goats, which have only two mammary glands, mixing of milk with high SCC coming from an infected gland with low SCC from a healthy gland might be insufficient to reduce the SCC at the animal level. However, whether these high SCC are a consequence of the fairly generalized lack of preventive management measures against subclinical mastitis in sheep flocks or whether a higher cell discrimination threshold is required for sheep milk has not been established. Some authors[8;13] reported discrimination values between healthy and infected glands ranging from 500 to 1600×10^3 cells/ml, but others[7;19] reported values similar to those for cows (200 to 300×10^3 cells/ml).

Concluding remarks

Somatic cell counts can be a useful indicator of milk quality for milk processors while it can be a mastitis indicator for sheep keepers and an important selection criterion for breeders. We presented basic information about factors influencing SCC variability, namely in lambing ewes of the Tsigai (T) and Improved Valachian (IV) breeds. No information about individual variability of SCC in dairy breeds of sheep kept in Slovakia was previously available. The fact whether the ewes of the IV breed are more susceptible to mastitis than the T ewes will need to be assessed on a larger material and in several flocks. The effect of lactation order on SCC was not statistically significant in our observation.

Mammites dans un troupeau de brebis laitières

La détermination du nombre de cellules somatiques (CCS) devient de plus en plus importante, y compris pour le lait de brebis. Le CCS peut être un indicateur utile de la qualité du lait pour les transformateurs tandis qu'il peut être un indicateur de mammites pour les éleveurs de brebis et un critère de sélection important pour les sélectionneurs. L'objectif de notre étude était d'acquérir des informations de base sur les facteurs influençant la variabilité de la CCS chez les brebis agnelées des races Tsigai (T) et Valachian améliorée (IV). Le nombre de cellules somatiques (CCS) a été déterminé dans 866 échantillons de lait en 2017 et 2018, pendant la tétée des agneaux et pendant la période de traite. Un instrument Fossomatic 90 (Foss Electric, Hillerød, Danemark) a été utilisé pour l'analyse. Le CCS moyen a varié de 270 à 1897×10^3 cellules/ml pendant la tétée des agneaux et de 268 à 2139×10^3 cellules/ml pendant la période de traite. Les différences entre les périodes d'échantillonnage étaient statistiquement significatives en 2017. Une augmentation du CCS a été observée à la fin des périodes de tétée et de traite. Une évaluation globale de la lactation a permis d'obtenir un CCS moyen de 364×10^3 cellules/ml en 2017 (log(10) CCS – 2,25) et de $1\,091 \times 10^3$ cellules/ml en 2018 (log(10) CCS – 2,68). L'indicateur log(10) a été significativement influencé par la race en 2017 (T – 2,61 ; IV – 2,75). L'effet du nombre de lactations et du nombre d'agneaux de lait n'a pas eu d'influence significative sur le CCS.

Mots clés: Ovins, Comptage des cellules somatiques, Lait, Lactation

Mastite in un gregge di pecore da latte

La determinazione della conta delle cellule somatiche (SCC) diventa sempre più importante anche per il latte di pecora. La SCC può essere un utile indicatore della qualità del latte per i produttori, mentre può essere un indicatore di mastite per i detentori e un importante criterio di selezione per gli allevatori. L'obiettivo del nostro studio è stato quello di acquisire informazioni di base sui fattori che influenzano la variabilità della SCC nelle pecore madri delle razze Tsigai (T) e Valacchia migliorata (IV). La SCC è stata determinata in 866 campioni di latte nel 2017 e 2018 in pecore in lattazione e durante il periodo della mungitura. Per l'analisi è stato utilizzato lo strumento Fossomatic 90 (Foss Electric, Hillerød, Danimarca). La SCC media variava da 270 a 1897×10^3 cellule/ml durante il periodo la lattazione e tra 268 e 2139×10^3 cellule/ml durante il periodo della mungitura. Le differenze tra i periodi di campionamento erano statisticamente significative nel 2017. Alla fine del periodo di lattazione e di mungitura è stato osservato un aumento della SCC. La SCC media sull'intera lattazione è stata di 364×10^3 cellule/ml nel 2017 (log(10) SCC – 2,25) e di 1091×10^3 cellule/ml nel 2018 (log(10) SCC – 2,68). L'indicatore log(10) è stato significativamente influenzato dalla razza nel 2017 (T – 2,61; IV – 2,75). L'influenza del numero di lattazione e del numero di agnelli da latte non ha avuto effetti significativi sulla SCC

Parole chiave: pecore, conta delle cellule somatiche, latte, lattazione

Literaturnachweis

[1] Albenzio M, Caroprese M, Santillo A, Marino R, Muscio A, Sevi A: Proteolytic patterns and plasmin activity in ewes' milk as affected by somatic cell count and stage of lactation. J Dairy Res 2005: 72(1): 86–92.

[2] Barbosa M, Barillet F, Berthelot X, Casu S, Foglini A, Gabina D, Jaubert G, Kalantzopoulos G, Ledda A, Perrin G, Poutrel B, Renaud J, Rubino R: Conclusioni del comitato Scientifico International Symposium: «Somatic cells and milk of small ruminants», Bella, Italy,1994.

[3] Bergonier D, De Crémoux R, Rupp R, Lagriffoul G, Berthelot X: 2003. Mastitis of dairy small ruminants. Vet Res 2003: 34(5): 689–716.

[4] Bianchi L, Bolla A, Budelli E, Caroli A, Casoli C, Pauselli M, Duranti E: Effect of udder health status and lactation phase on the characteristics of Sardinian ewe milk. J Dairy Sci: 2004 87(8): 2401–2418.

[5] Boyazoglu J, Morand-Fehr P: Mediterranean dairy sheep and goat products and their quality: a critical review. Small Rumin Res 2001: 40(1): 1–11.

[6] Bufano G, Dario C, Laudadio V: The characterisation of Leccese sheep: variations of chemical composition and lactodynamographic parameters in milk as related to somatic cell counts. Rubino R (Ed.): Somatic Cells and Milk of Small Ruminants. 1996: 301–304.

[7] De la Cruz M, Serrano E, Montoro V, Romeo M, Baselga R, Albizu I, Amorena B: Etiology and prevalence of subclinical mastitis in the Manchega sheep at mid-late lactation. Small Rumin Res 1994: 14:(2) 175–180.

[8] Fthenakis GC, El-Masannat ET, Booth JM, Jones JE: 1991. Somatic cell count of ewes' milk. Br Vet J 1991: 147:(6) 575–581.

[9] Gonzalez-Rodrıguez MC, Gonzalo C, San Primitivo F, Carmenes P: Relationship between somatic cell count and intramammary infection of the half udder in dairy ewes. J Dairy Sci 1995: 78:(12) 2753–2759.

[10] Gonzalo C, Tardaguila A, Ariznabaretta A, Romeo M, Montoro V, Perez Guzman MD: Recuentos de células somáticas en el ganado ovino lechero y estrategias de control. Situación en España. Ovis 2000: 66: 21–27.

[11] Haenlein G: The concept of milk quality in the USA. Int J Anim Sci 2001: 16: 5–8.

[12] IDF. 1987: Bovine mastitis – Definition and guidelines for diagnosis. In: *IDF Bulletin*, vol. 211. International Dairy Federation, Brussels (Belgium).

[13] Jones JET:. Mastitis in Sheep. Owen JB and Axford RFE (ed.): Breeding for Disease Resistance in Farm Animals.. CAB Int., Wallingford, UK, 1991: 412–423.

[14] Konig C, Fieten J, Gelling G: Le mastiti della pecora in Olanda. Selecciones Veterinarias 1985: 26, 216.

[15] Leitner G, Silanikove N, Merin U: Estimate of milk and curd yield loss of sheep and goats with intramammary infection and its relation to somatic cell count. Small Rumin Res 2008: 74:(1–3) 221–225.

[16] Maisi P, Junttila J, Seppanen J: Detection of subclinical mastitis in ewes. Br Vet J 1987: 143:(5) 402–409.

[17] McCance I: The determination of milk yield in the Merino ewe. Aust J Agric Res 1959: 10:(6) 839–853.

[18] Paape M, Wiggans G, Bannerman D, Thomas D, Sanders A, Contreras A: Monitoring goat and sheep milk somatic cell counts. Small Rumin Res 2007: 68:(1–2) 114–125.

[19] Pengov A: The role of coagulase-negative Stahylococcus spp. and associated somatic cell count in the ovine mammary gland. J Dairy Sci 2001: 84:(3) 572–574.

[20] Pinto G, Caira S, Nicolai M, Mauriello R, Cuollo M, Pirisi A, Piredda G, Chianese L, Addeo F: 2013. Proteolysis and partial dephosphorylation of casein are affected by high somatic cell counts in sheep milk. Food Res Int 2013: 53:(1) 510–521.

[21] Raynal-Ljutovac K, Gaboric P, Lauret A: The relationship between quality criteria of goat milk, its technological properties and the quality of the final products. Small Rumin Res 2005: 60:(1–2) 167–177.

[22] Raynal-Ljutovac K, Pirisi A, De Crémoux R, Gonzalo C: Somatic cells of goat and sheep milk: analytical, sanitary, productive and technological aspects. Small Rumin Res 2007: 68:(1–2) 126–144.

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