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Somatic cells of goat and sheep milk: Analytical, sanitary, productive and technological aspects☆

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Abstract

This review covers recent scientific and technical publications on analytical, sanitary, productive, and technological aspects of somatic cell counts (SCC) in sheep and goat milk. It examines SCC as a measurement of sub-clinical and clinical mastitis conditions, SCC analytical methods, the effect of SCC on yield, composition, and physico-chemical parameters of sheep and goat milk, and their related dairy products. The literature shows the detrimental effects of mastitis on milk yield and composition, but also on cheese-making aptitude and quality of the products, especially for ewe milk cheeses. Using low SCC milk it is possible to recover more than 4% more protein in cheese making than from high SCC milk. SCC is a good tool for monitoring hygienic and sanitary quality of milk, but separate SCC standards for sheep and goat milk are necessary to optimize the productive and technological process and to account for the many non-pathological factors that cause wide variation in SCC, and which are different from those in cow milk. Evidence emphasizes the need to implement mastitis control programs in flocks and herds in order to improve the hygienic quality of milk and dairy products, and to increase the economic returns to producers and processors.

Keywords: Somatic cell count; Sheep; Goat; Analytical methods; Milk composition; Cheese quality

1. Introduction

Somatic cell count (SCC) is widely used for evaluating milk quality and to define milk prices (Rubino, 1996; Haenlein, 2001; Kalantzopoulos et al., 2004; Raynal-Ljutovac et al., 2005). An increased SCC is either the consequence of an inflammatory process due to the presence of an intramammary infection (IMI) or under non-pathological conditions due to physiological processes such as estrus or advanced stage of lactation. For this reason the SCC of milk represents a sensitive marker of the health of the udder and is considered a useful parameter to evaluate the relationship between IMI and changes in milk characteristics. However, the systematic extrapolation of dairy cattle research findings to small ruminants leads to errors in the diagnosis of subclinical IMI and in the application of discriminatory standards for sheep and goat milk quality. Even between these two species of small ruminants there are important differences with regards to the significance and interpretation of SCC levels. In order to avoid these problems an in-depth knowledge of SCC of goat and sheep milk is necessary, especially the analytical, sanitary, production and technological aspects.

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Several points require clarification:

- *Analytical*. The effect of the characteristics of ewe and goat milk (mode of secretion, composition of milk) on the counting methods and their accuracy.
- *Sanitary*. The effects of non-infectious factors on the interpretation of SCC and the definition of presumptive diagnosis rules; in particular the role of coagulase negative staphylococci (CNS) and so-called minor and major infectious agents on the inflammatory response of the udder.
- *Control of infections*. Adaptation to small ruminant breeding and management of measures generally adopted for dairy cows.
- *Economics*. The effect of IMI on yield of milk and dairy products and their quality.

Numerous studies mostly on cow milk, have shown that an increase in SCC causes a decrease in milk yield and affects milk composition, which leads to reduced cheese making aptitude (Politis and Ng Kwai Hang, 1988; Barbano et al., 1991). Although sheep and goat milk are mainly used for cheese making, little is known on how SCC affects this important but complex process. This review covers recent scientific publications on the relationships of udder infections to SCC, analytical tools, sanitary controls, and the influence of SCC levels on milk yield and composition, cheese making aptitude and quality of dairy products from goat and sheep milk. The European Union and most other countries around the world have yet to regulate SCC values in sheep and goat milks used for commercial dairy products for various reasons, although the regulation in marketing cow milk products is widely accepted.

2. Sanitary aspects

Breed, parity, stage of lactation, type of birth, estrus, diurnal, monthly, and seasonal variations (Gonzalo et al., 1994, 2002, 2005) contribute significantly to changes of SCC in milk of dairy sheep and goats. These effect may explain 48% of SCC variance (Gonzalo et al., 2002). According to Bergonier et al. (2003), non-pathological factors are responsible for variations of SCC in ewe milk between 40×10^3 and 100×10^3 cells/ml. In dairy goats, these variations are usually larger (De Cremoux, 1995; Paape et al., 2001; Haenlein, 2002), reaching >1 million cells/ml. Stage of lactation is the most important non-infectious factor associated with rising SCC levels (Dulin et al., 1983; Rota et al., 1993; Wilson et al., 1995; Galina et al., 1996; Zeng et al., 1997). In healthy goat udders, SCC progressively increases during lactation, rising from 200×10^3 to $>1 \times 10^6$ cells/ml (De Cremoux, 1995), high SCC being sometimes observed

Table 1
Least squares means of log SCC, geometric means of SCC, prevalence (%) and isolates (%) of the different organisms isolated from half-udder milk of Churra ewes (Gonzalo et al., 2002)

Organism	Log SCC[a]		SCC[b] ($\times 10^3$ ml^{-1})	N	Prevalence (%)	Isolates (%)
	$\bar{X}$	S.E.				
Streptococcus agalactiae	6.54 a	0.10	7104	39	0.41	1.65
Pasteurella spp.	6.29 ab	0.18	7461	9	0.09	0.38
Staphylococcus aureus	6.28 ab	0.05	3035	102	1.06	4.32
Arcanobacterium pyogenes	6.09 bc	0.13	2211	17	0.18	0.72
Novobiocin-sensitive CNS	5.97 c	0.01	1064	1220	12.72	51.63
Enterococcus spp.	5.93 c	0.08	965	49	0.51	2.07
Mixed with major pathogen or NSCNS[c]	5.71 d	0.04	679	140	1.46	5.92
Streptococcus spp.[d]	5.68 d	0.07	699	52	0.54	2.20
Enterobacteria	5.40 de	0.23	949	5	0.05	0.21
Corynebacterium spp.	5.26 e	0.03	187	327	3.41	13.84
Unidentified	5.14 ef	0.05	114	71	0.74	3.00
Mixed with two minor pathogens	5.07 fg	0.07	99	48	0.50	2.03
Micrococcus spp.	5.06 fg	0.08	114	33	0.34	1.40
Novobiocin-resistant CNS	5.02 g	0.03	92	251	2.62	10.62
Negative	4.98 g	0.00	77	7229	75.36	–

Means in the same column with different letters differ ($P < 0.05$).
[a] Least squares means from a mixed model taking into account infectious and systematic factors of variation (flock, half-udder within flock, organisms, stage of lactation, parity, and type of birth).
[b] Geometric means of half udders' SCC.
[c] Novobiocin-sensitive coagulase-negative staphylococci.
[d] Different from *S. agalactiae*.