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Factors of Variation Influencing Bulk Tank Somatic Cell Count in Dairy Sheep

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ABSTRACT

Between January and December 2002, a total of 21,685 records for bulk tank milk somatic cell count (BTSCC) were obtained from 309 dairy ewe herds belonging to the Sheep Improvement Consortium in Castilla-León, Spain. Based on the first statistical model, ANOVA detected significant effects of herd, breed, month within herd, dry therapy, type of milking, contagious agalactia, and installations within machine milking on logBTSCC. A second statistical model was used on herds with machine milking to study the effect of the vacuum level and pulsation rate on BTSCC. Herd and month within herd were important variation factors as they explained 48.4 and 16.1% of the variance in BTSCC. Variability in logBTSCC among breeds ranged from 5.84 (Castellana) to 6.09 (Awassi and Spanish Assaf). Implementing dry-ewe therapy (5.91) significantly reduced logBTSCC compared with when it was not implemented (6.10). Hand milking elicited greater logBTSCC (6.07) than machine milking (5.94). Machine milking of ewes in milking parlors (logBTSCC: 5.88 to 5.94) was associated with better udder health than was the use of bucket-milking machines (6.04). Reduced vacuum levels and elevated pulsation rate during machine milking optimized BTSCC. In all cases, clinical outbreaks of contagious agalactia increased BTSCC. As a result, dry therapy was proposed as the main tool to reduce BTSCC. Optimization of milking-machine standards and parlor systems also improved udder health in dairy sheep.
(**Key words:** bulk tank milk, somatic cell count, mastitis, milking)

Abbreviation key: BTSCC = bulk tank somatic cell count.

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INTRODUCTION

In recent years several studies have focused on SCC and subclinical mastitis in dairy ewes. Subclinical infections caused by coagulase-negative staphylococci and other mammary pathogens elicit elevated SCC (Pengov, 2001; Ariznabarreta et al., 2002), cause severe damage to udder tissue (Burriel, 1997), and result in important losses of milk yield and composition (Gonzalo et al., 2002; Leitner et al., 2004) in dairy ewes. Other studies have revealed predictive values of SCC and its efficacy in diagnosing the infection (Marco, 1994; González-Rodríguez et al., 1995). Additional research has led to the development of strategies for mastitis control in dairy ewes based on antibiotic dry therapy (Marco, 1994; Gonzalo et al., 2004) and optimizing technical characteristics of milking machines (Peris et al., 2003a, b). Other variables with an important effect on ewe milk SCC were breed and flock (Gonzalo et al., 1994; González-Rodríguez et al., 1995), the sampling month (El-Saied et al., 1998), and clinical outbreaks of contagious agalactia (Bergonier et al., 1996).

Bulk tank SCC (**BTSCC**) is the first and principal tool used by technicians and farmers to evaluate udder health in flocks. However, no known studies exist that empirically investigate the effect of some recommended mastitis control practices on BTSCC under field conditions in dairy ewes. These BTSCC are affected by a number of sources of variation, and an attempt should be made to identify them and assess their implications in mastitis control or milk payment schemes. The European Union has yet to regulate BTSCC values in ewe milk used for dairy products sold in its region. Studies need to be carried out to identify the main sources of BTSCC variations in the primary dairy sheep areas of the European Union.

The purpose of this paper was to study BTSCC factors in mastitis control, particularly type of milking (hand or machine), characteristics of machine milking systems, dry therapy practices, and clinical outbreaks of contagious agalactia. In addition, other variables such as herd, breed, and month also were studied.

MATERIALS AND METHODS

Between January 1 and December 31, 2002, 21,685 records of BTSCC were obtained from 309 dairy ewe herds (breeds: 238 Spanish Assaf, 12 Awassi, 41 Churra, and 18 Castellana) belonging to the Sheep Improvement Consortium of Castilla-León, Spain. Average herd size was 350 to 400 ewes, which was representative of the Castilla-León region. In most of the herds, lambing is concentrated in the autumn and spring. Each herd is generally divided into 2 lots, the lambing periods of which alternate every 4 to 6 mo in the herd. Some herds undergo a reproductive intensification to achieve 3 lambings every 2 yr, whereas in others, ewes have only 1 lambing per year. In addition, estrus is synchronized in some herds, but not in others, or only during certain times of the year, and this practice is not consistent within herds. Consequently, lambing periods are different among herds.

Sheep Improvement Consortium herds were enrolled in the Analysis Service of the Dairy Interprofessional Laboratory of Castilla-León (LILCyL). An average of 6 monthly samplings of bulk tank milk for SCC were carried out in each flock. The mean number of repeated records per flock throughout the year was 67. All samples were preserved with azidiol and SCC was determined by the Fossomatic method (A/S N Foss Electric, Hillerød, Denmark).

The information recorded by the Sheep Improvement Consortium veterinary service included the following BTSCC factors: herd, breed, sampling month, dry therapy practice, milking type (hand or machine), and type of installations used for machine milking (buckets and milking parlors: looped milkline, dead-ended milkline, midlevel, and low-level systems). Antibiotic dry ewe therapy was given under veterinary supervision. In herds where dry therapy was implemented, all ewes were treated during dry period (complete dry therapy). In 15% of the herds, dry therapy was carried out in such a way that it only affected part of the year because of different lambing periods within herds. Farmers using dry therapy received the necessary veterinary advice and improved some aspects of milking hygiene and management (milking routines and postmilking teat disinfection) in the subsequent lactation.

Clinical outbreaks of contagious agalactia were reported and *Mycoplasma agalactiae* was isolated in bulk tank milk by microbiological laboratories. Once the clinical outbreak was produced in a herd, it was identified as positive for the time necessary for treatment, vaccination (<15 d after outbreak), and revaccination (20 to 30 d after the first vaccination). During the rest of the year, it was classified as negative.

The technical characteristics of the milking machine were obtained from testing of milking machines carried out by the Sheep Improvement Consortium veterinary service. The following traits were studied: 1) vacuum level (average vacuum measured at the long milk tube with no milk flow); 2) vacuum effective reserve per unit measured at milking vacuum level (L/min free air); 3) pulsation rate (cycles per min); and 4) pulsation ratio (sum of the durations of the increasing vacuum phase and the maximum vacuum phase divided by the duration of the complete pulsation cycle in the pulsation chamber vacuum, expressed as a percentage).

Statistical Analyses

Statistical analyses were carried out for BTSCC records using 2 mixed models in which the herd within breed and the month within herd were included as random factors. The aim of the first model was to study BTSCC factors, whereas that of the second was to study the covariables of the milking machine.

The first analysis was done with 21,685 BTSCC records from 309 herds. A mixed model was used, in which herd and month within herd were random and the remaining effects were fixed. The PROC MIXED procedure (SAS Institute, 1992) was followed, according to the method below:

$$Y_{ijklmnor} = \mu + B_i + H_{j(i)} + T_k + D_l + M_{m(ij)} + A_n + I_{o(k)} + e_{ijklmnor}$$

where $Y_{ijklmnor}$ was the dependent variable logBTSCC, B_i was the fixed effect of breed, $H_{j(i)}$ was the random effect of herd nested within breed, T_k was the fixed effect of type of milking, D_l was the fixed effect of dry therapy, $M_{m(ij)}$ was the random effect of month within herd, A_n was the fixed effect of outbreak of contagious agalactia, $I_{o(k)}$ was the fixed effect of installation type nested within type of milking, and $e_{ijklmor}$ was the random residual effect. The breed effect was divided into 4 levels: Spanish Assaf, Awassi, Churra, and Castellana. Type of milking effect was divided into 2 levels: hand and machine milking. Dry therapy was divided into 2 levels depending on whether it was carried out in each flock during the previous drying-off or not. In 15% of herds, this practice covered a part of year only. The contagious agalactia effect was divided into 2 levels: presence or absence of a clinical outbreak of *M. agalactiae* in bulk tank milk. Finally, the type of installation within machine milking was divided into 3 levels: bucket, parlor with looped milkline, and parlor with dead-ended milkline. In addition to this statistical analysis, the data also were analyzed classifying the milking