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EFFECT OF TEAT END HYPERKERATOSIS ON MILK SOMATIC CELL COUNTS IN BULGARIAN BLACK-AND-WHITE DAIRY CATTLE

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Abstract

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The aim of the study was to investigate the relationship between teat end hyperkeratosis score and somatic cell counts in milk in dairy cattle at different lactations. Five hundred Holstein cattle from 16 farms were included in the research. The Teat end hyperkeratosis was evaluated with a four-point scoring system. The parity number and the position of teats (front/rear) had a significant effect on teat end hyperkeratosis score and somatic cell counts in milk ($P<0.001$). The presence of keratin deposits and alterations of teat ends in cows with score 3 and 4 were related to higher somatic cell counts, 195.7 thousand/ml and 235.4 thousand/ml, respectively, which is at and over the threshold indicating a bacterial infections. Rear teats exhibited a higher proportion of teat end hyperkeratosis score 3 (41.2 vs 28.8%) and score 4 (1.2% vs 0%), and higher somatic cell counts than front ones. Cows at their 4th and 5th lactation demonstrated higher percentage of teats with hyperkeratosis scores 3 and 4 and respectively, higher somatic cell counts, compared to second and third lactation cows.

Key words: teat end; hyperkeratosis; somatic cell count; dairy cows

Introduction

The teat canal sphincter and keratin layer are natural physical and chemical obstacles to the penetration of bacterial pathogens inside the udder. Between milking sessions, the teat canal is firmly closed and does not permit the entry of microorganisms towards the glandular tissue. After multiple milking, teat end undergoes certain changes, which could result in not so tight teat canal closure. Predisposing factors could be congenital, as teat end shape, position and length of teats, milk yield, period of lactation, parity etc. (Shearn and Hillerton, 1996; Neijenhuis et al., 2000a). Teat end changes could occur also under the influence of external factors, most commonly related to machine milking of cows, such as vacuum level, pulsations, milking time, milking system type etc. (Mein and Thompson, 1993; Rasmussen, 1993; Neijenhuis et al., 2000b).

A number of systems have been developed for visual assessment of teat end as a predictor of mastitis risk (Shearn and Hillerton, 1996; Seykora and MacDaniel, 1985; Neijenhuis et al., 2000a). Furthermore, the teat end assessment system is an indicator of the milking equipment and milking process quality.

The purpose of the present study was to investigate the relationship between the teat end hyperkeratosis score and milk somatic cell counts in dairy cows in different parities.

Material and Methods

The investigation included 500 Bulgarian Black-and-White cows from 16 farms. It was carried out between March 2010 and March 2011. Included cows were at their second to fifth lactation. First-lactation cows were not included as in them; serious teat end changes could not be detected because of the short milking effect duration. Only cows without clinical mastitis were assessed.

Teat end assessment was performed between the 30th and the 150th lactation days. After the evaluation,

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milk samples were obtained from each teat for somatic cell counts determination.

A portable Ekomilk Scan apparatus in farms determined somatic cell counts in milk. Milk samples (20 ml) were collected immediately after the milking of each animal.

Teat end hyperkeratosis was assessed on a 4-point scale (Mein et al., 2000), as followed: 1 – smooth teat orifice, with a slight roughness and irregularity of teat orifice lumen; this is the normal teat end status at the beginning of lactation; 2 – smooth slightly raised ring around the teat orifice at about 2 mm, smooth or slightly rough ring surface without keratin deposits around the orifice; 3 – rough ring with keratin growths spreading at 1–3 mm around the teat sphincter; 4 – very rough ring, with rough keratin deposits, raised up to 4 mm and more, ring border is rough and broken, the sphincter appears as a flower.

The results were statistically processed with Stat Soft 1984-2000 Inc (Copyright 1990-1995 Microsoft Corp.)

The model evaluated the effect of various factors:

$Y_{ijklm} = \mu + L_i + T_j + TECS_k + e_{ijkl}$

where:

Y_{ijkl} - dependent variable (SCC and THS); μ - population mean; L_i - effect of parity, T_j – effect of teat position (front or rear), $TECS_k$ – teat end hyperkeratosis score, e_{ijkl} – random effect.

The data was analyzed using the LSMLMW software (Harvey, 1987). Through analysis of variance (ANOVA), the least square means (LSM) and the least square estimates (LSE) that are sums of the squares of deviations from means derived by the model are calculated.

Table 1
Statistical data for somatic cell counts in milk (SCC) and teat end hyperkeratosis scores (THS) by parity

Number of lactation	Number of cows	Number of assessed teats	Mean THS x ± Sx	Mean SCC x ± Sx
IInd lactation	167	668	1.86 ± 0.02	148.8 ± 0.64
IIIrd lactation	155	620	2.18 ± 0.03	166.5 ± 0.67
IVth lactation	136	544	2.47 ± 0.03	188.8 ± 0.64
Vth lactation	42	168	2.64 ± 0.05	209.8 ± 1.17
Total	500	2000	2.19 ± 0.04	170.3 ± 0.72

Results

Mean teat end hyperkeratosis scores (THS) and somatic cell counts (SCC) by parity increased paralleled with lactation number (Table 1). The differences between lactations were statistically significant for both parameters at P<0.001. SCC in fifth-lactation cows was at the threshold indicating risk of bacterial infection – subclinical mastitis.

The analysis of variance for the effect of factors included in the model is presented in Table 2. All factors had a significant effect on SCC: the parity and THS at P<0.001 and teat position (front or rear) at P<0.05.

A considerable influence of parity and teat position on THS was also observed (P<0.001).

The main purpose of this study was to establish whether the THS was related to a dangerous increase in somatic cell counts of milk. Figure 1 presents the LS means of SCC for the respective milk quarters depending on THS. Teat with THS score 3 exhibited SCC of 195.7 thousand/ml that is at the threshold indicating bacterial infection, whereas those with score 4 had a SCC over the threshold – 235.4 thousand/ml.

One of sources for statistically significant influence of teat position on SCC was the difference between the relative share of teat ends with hyperkeratosis scores 3 and 4 depending on teat position (Figure 2). Rear teats exhibited lower number of normal teat ends (score 1) and 1.2% of them were with THS 4. There were no front teats with THS 4, whereas normal ones were 25.6%.

The predominance of THS 3 and 4 in rear teats resulted in respectively higher milk SCC compared to

Table 2
Analysis of variance for the effect of studied factors on somatic cell counts in milk (SCC) and the teat end hyperkeratosis score (THS)

Sources of variation	Degrees of freedom (n – 1)	Milk SCC F	P	THS F	P
Total for the model	2000	4330.8	***	98.34	***
μu - y μ	1	1319.2	***	34.09	***
Number of lactation	3	2815.2	***	123.32	***
Front/rear teats	1	4.2	*	121.74	***
Hyperkeratosis score	3	3935.9	***	–	

form teats (Figure 3). Although teats with THS 4 were only 1.2%, they were related to SCC over 200 thousand/ml, i.e. to a high probability for subclinical mastitis development.

Figure 4 presents the distribution of teats with a given THS by parity. Teats with score 4 were not detected in second- and third-lactation cows, those with score 2 were prevailing. Cows at their fourth and fifth lactation exhibited teat ends with THS 4: 0.74% and 4.8%, respectively. At the same time, teats with score 3 were predominant with 58.1% and 57.1%, respectively.

Figure 5 presents the LS means of somatic cell counts according to the lactation. The highest SCC was observed in fifth-lactation cows – 209.3 thousand/ml (mean of all teats of fifth-lactation cows).

Discussion

Among factors, predisposing dairy cows to increased risk of mastitis is teat end alteration due primarily to milking. Keratin deposits and formation of a ring around teat orifice with different size and shape, renders difficult post-milking sanitation and limits its efficacy, which, together with the loose closure of the sphincter poses a serious risk for infection of the respective milk quarters. Such conditions are present in

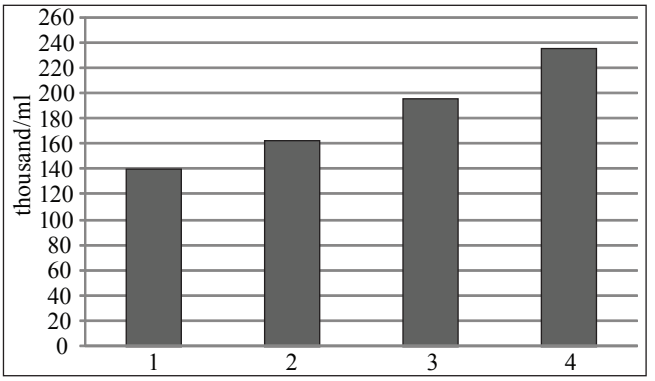

Fig. 1. Somatic cell counts distribution depending on teat end hyperkeratosis scores

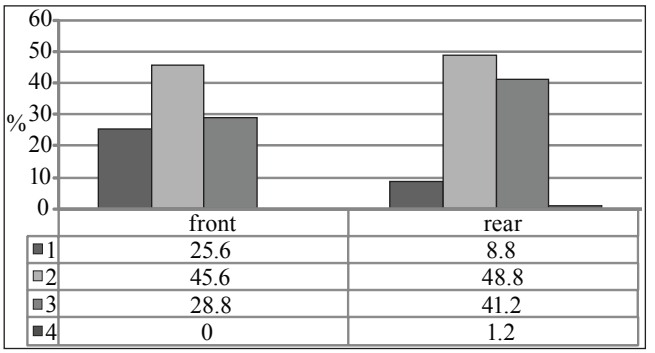

Fig. 2. Relative share of front and rear teats depending on teat end hyperkeratosis scores

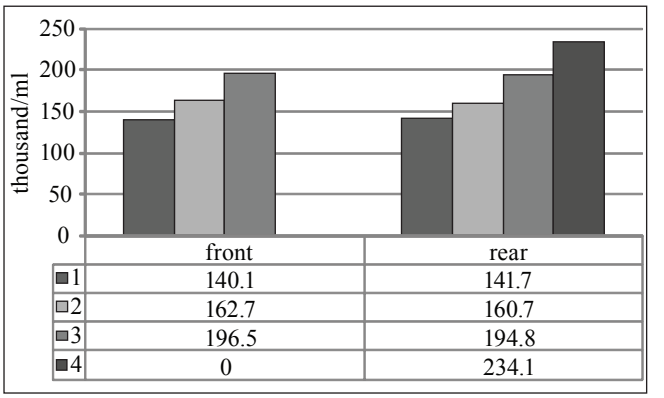

Fig. 3. Somatic cell counts on front and rear teats depending on teat end hyperkeratosis score

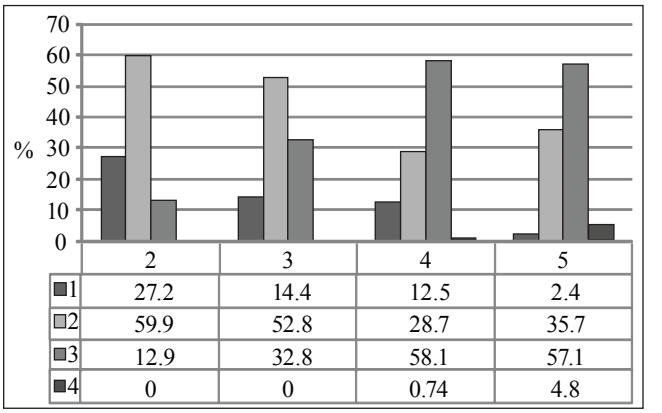

Fig. 4. Relative share of cows at a given parity depending on teat end hyperkeratosis score

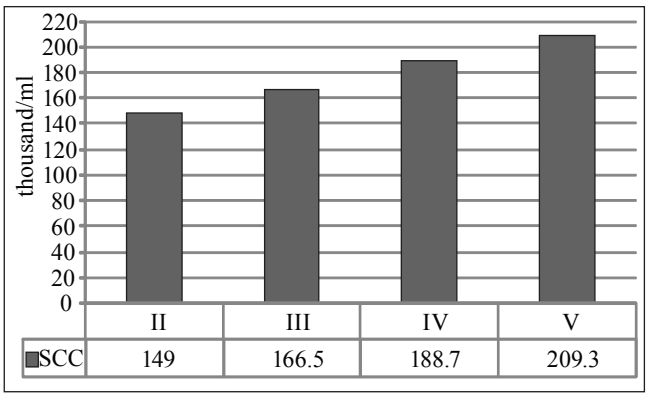

Fig. 5. LS-means of somatic cell counts (SCC) of milk by parity

teats with teat end hyperkeratosis scores 3 and 4 (Neijenhuis et al., 2000a; Breen et al., 2009). These scores are related to higher somatic cell counts – about and over 199 thousand/ml.

The detection of >199 thousand/ml somatic cell counts in milk is thought to be a predictor of bacterial infection, with reliability between 74.5 and 83.4% (Schepers et al., 1997; Breen et al., 2009).

The cause for the relatively higher proportion of rear teats with scores 3 and 4 was probably due to the enhanced influence of milking equipment on rear teats, especially for udders with various slopes. This disadvantage unfortunately is commonly seen in Bulgarian Black and White cows and becomes more frequent with age. Together with the prolonged influence of milking, it explains the higher proportion of teats with hyperkeratosis scores 3 and 4 in older, fourth to fifth-lactation cows.

Hyperkeratosis scores 3 and 4 pose higher risk for occurrence of mastitis consequently to the higher chance of infection due to damaged teat sphincter. With advancing of parity number, the share of teats with THS 3 and 4 and higher milk SCC, respectively could be seen. This happens because of the more prolonged effect of milking (more lactation) and occurring teat end changes, predisposing to teat bacterial infection.

Neijenhuis et al. (2000a) also reported an influence of the parity number on the extent of keratinization and formation of a rough ring around the teat orifice.

Other researchers demonstrated higher milk SCC in cows parallel to parity number increase (Juozaitiene et al., 2008; Sheldrake et al., 1983).

The results from this study allowed out recommending the scoring of teat end hyperkeratosis with regard to evaluation of mastitis risk and milking equipment and management quality in dairy farms.

Conclusions

The parity number and the position of teats (front or rear) had a significant effect on teat end hyperkeratosis score and somatic cell counts in milk ($P<0.001$).

The presence of keratin deposits and alterations of teat ends in cows with score 3 and 4 were related to higher somatic cell counts, 195.7 thousand/ml and 235.4 thousand/ml, respectively, which is at and over the threshold indicating a bacterial infections.

Rear teats exhibited a higher proportion of teat end hyperkeratosis score 3 (41.2 vs 28.8%) and score 4 (1.2% vs 0%), and higher somatic cell counts than front ones.

Cows at their 4th and 5th lactation demonstrated higher percentage of teats with hyperkeratosis scores 3 and 4 and respectively, higher somatic cell counts, compared to second and third lactation cows.

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