CHANGES IN TEAT END CONDITION FOLLOWING INSTALLATION OF AN INDIVIDUAL QUARTER PULSATION SYSTEM

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ABSTRACT

Overmilking may increase teat end hyperkeratosis incidence. The objective of this study, conducted at the University of Kentucky Coldstream Dairy, was to examine changes in teat end hyperkeratosis in a herd transitioning from a standard pulsation system to an individual quarter pulsation milking system. Teat end hyperkeratosis was evaluated immediately after cluster removal using the classification system outlined by Mein et al. (2001) where N signifies no ring; S signifies a smooth, raised ring; R signifies a rough ring; and VR signifies a very rough ring. Scoring periods were classified for 69 cows (48 Holstein, 12 crossbred, and 9 Jersey) relative to installation (April 28, 2011) of the Milpro P4C™ (Milkline, Gariga di Podenzano, Italy) system as follows: PRE1-April 7; PRE2-April 21; POST1-May 12; POST2-May 26; POST3-June 9. The Milpro P4C™ system stops milking individual quarters using a unique individual quarter pulsation system with four pulsation channels instead of two. Hyperkeratosis classifications were converted to numerical scores as follows: N = 1; S = 2; R = 3; VR = 4. The MIXED Procedure of SAS® (Cary, NC) was used to evaluate fixed effects of age, breed, parity, teat position and all interactions on teat end hyperkeratosis classification with variables repeated by scoring with cow within breed as subject. The effects of position and scoring × breed on teat end hyperkeratosis classification were significant (P < 0.01). Hyperkeratosis scores improved for Holstein cows from PRE1 to PRE2 (1.75 ± 0.10 and 1.63 ± 0.10, respectively, P = 0.04), PRE1 to POST1 (1.75 ± 0.10 and 1.59 ± 0.10, respectively, P = 0.02), PRE1 to POST2 (1.75 ± 0.10 and 1.53 ± 0.10, respectively, P < 0.01), PRE1 to POST3 (1.75 ± 0.10 and 1.42 ± 0.10, respectively, P < 0.01), PRE2 to POST3 (1.64 ± 0.09 and 1.42 ± 0.10, respectively, P < 0.01), POST1 to POST3 (1.59 ± 0.10 and 1.41 ± 0.10, respectively, P < 0.01), and POST2 to POST3 (1.53 ± 0.10 and 1.42 ± 0.10, respectively, P < 0.05). Hyperkeratosis scores for crossbred cows did not differ among scorings (P > 0.05). Hyperkeratosis scores for right front teats were significantly higher than for right rear and left rear teats (1.58 ± 0.09, 1.37 ± 0.09, and 1.36 ± 0.09, respectively, P < 0.01) and left front hyperkeratosis scores were significantly higher than right rear and left rear teats (1.62 ± 0.09, 1.37 ± 0.09, and 1.36 ± 0.09, respectively, P<0.01). Hyperkeratosis scores for Jerseys tended to increase from PRE2 to POST3 (1.34 ± 0.21 and 1.63 ± 0.22, respectively, P = 0.05) and POST1 to POST3 (1.32 ± 0.21 and 1.63 ± 0.22, respectively, P = 0.04).

INTRODUCTION

o Maintenance of healthy teat ends is a vital part of an effective mastitis prevention program (Mein et al., 2001) because the teat end is the first line of defense in protecting the udder from the invasion of mastitis pathogens (Gleeson et al., 2004).
o Classification of bovine teat condition can be used to assess the effects of milking management, milking equipment, or environment on teat tissue and the risk of new intramammary infections (Mein et al., 2001).
o Rough teat ends are more difficult to clean during pre-milking preparation and provide a site for bacteria colonization (Zucali et al., 2008).
o Neijenhuis et al. (2001) reported a correlation between increased risk of clinical mastitis and very rough teat ends.
o Zucali et al. (2008) explained that milking duration and initial teat end hyperkeratosis scores had a larger influence on final teat end hyperkeratosis scores than liner type and liner compression. However, liner compression may contribute to the development of teat end hyperkeratosis.
o Changes in teat tissue, particularly the skin of the barrel, teat end, and teat canal, alter the risk of new mastitis infections (Neave et al., 1969).
o The pattern of milk flow has four phases of flow intensity (increase, plateau, decline, and blind/overmilking, Tančin et al., 2007).
o The Milpro P4C™ system stops milking individual quarters using an individual quarter pulsation system with four pulsation channels instead of two.
o The objective of this research was to examine changes in teat end condition in a herd transitioning from a standard single quarter pulsation system to an individual quarter pulsation milking system.

MATERIALS AND METHODS

o Teat end condition was evaluated for 69 cows immediately after cluster removal using the classification system outlined by Mein et al. (2001) where N signifies no ring; S signifies a smooth, raised ring; R signifies a rough ring; and VR signifies a very rough ring.
o Scoring periods were classified relative to installation (April 28, 2011) of the Milpro P4C™ (Milkline, Gariga di Podenzano, Italy) system as follows: PRE1-April 7; PRE2-April 21; POST1-May 12; POST2-May 26; POST3-June 9.
o Teat end hyperkeratosis classifications were converted to numerical scores progressing from most desirable to least desirable as follows: N (no ring)= 1; S (smooth, raised ring) = 2; R (rough ring) = 3; VR (very rough ring) = 4.
o When a given hyperkeratosis score differed from preceding and subsequent scores by ± 1, all scores for that teat were removed from the data set.
o Only cows (n = 69, 48 Holstein, 12 crossbred, and 9 Jersey) with scores available for the entire study period were included in the final analysis.
o Score frequencies were calculated by scoring period using the FREQ Procedure of SAS® (SAS version 9.3, SAS Institute, Inc., Cary, NC).
o The MIXED Procedure of SAS® (SAS version 9.3, SAS Institute, Inc., Cary, NC) was used to evaluate fixed effects of breed, parity, scoring, and teat position and their interactions on teat end hyperkeratosis classification with variables repeated by scoring with cow within breed as subject.

Figure 1. Teat end hyperkeratosis classification N (no ring).
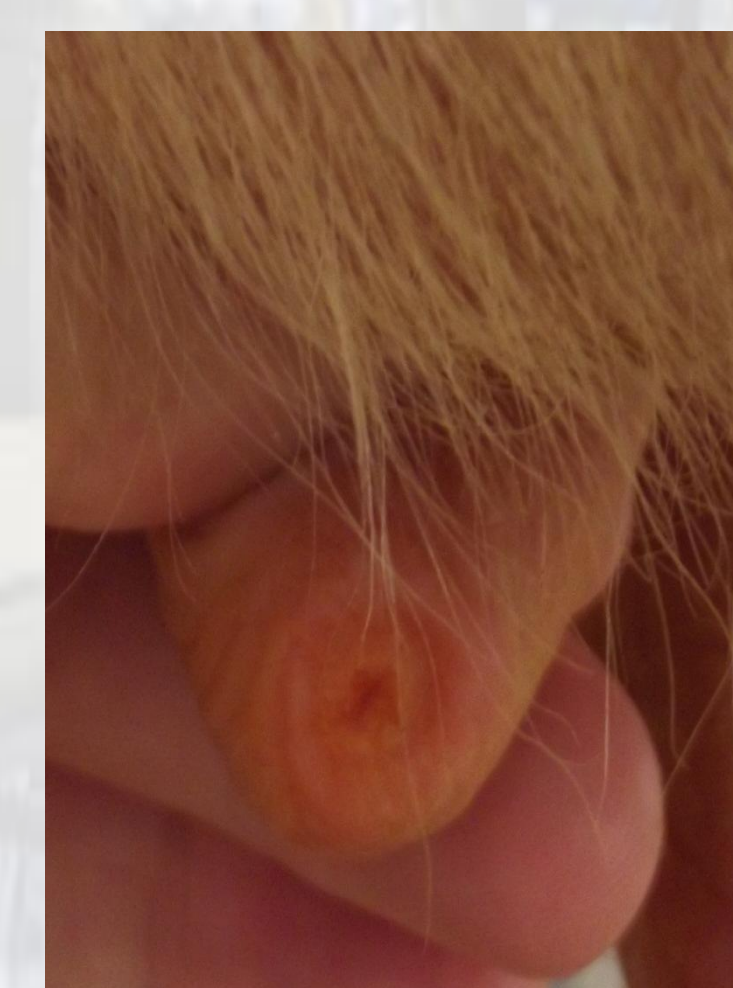

Figure 2. Teat end hyperkeratosis classification S (smooth, raised ring).

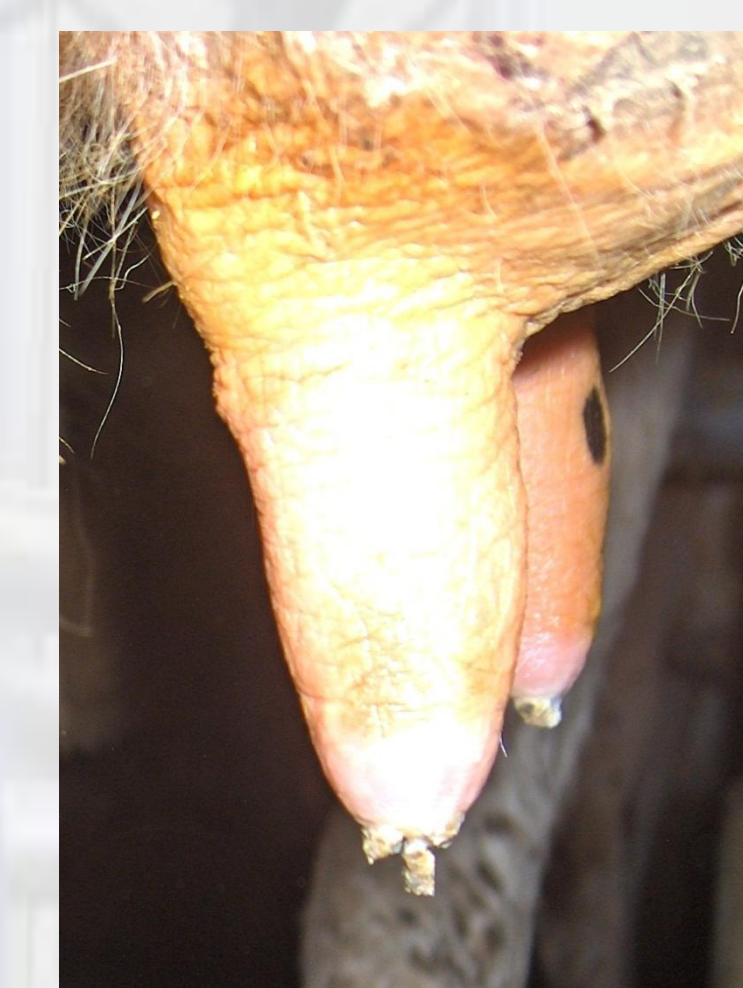Figure 3. Teat end hyperkeratosis classification R (rough ring).

Figure 4. Teat end hyperkeratosis classification VR (very rough ring).

RESULTS AND DISCUSSION

o The effects of teat position and scoring × breed on teat end hyperkeratosis classification were significant (P < 0.01).
o Holstein teat end hyperkeratosis scores improved in this study (Table 1), which may be related to decreased overmilking.
o Jersey and crossbred teat end hyperkeratosis scores did not differ among scorings (Table 1; P > 0.05).
o Teat end hyperkeratosis scores for right front teats were higher than for right rear and left rear teats (Table 2; P < 0.01) and left front hyperkeratosis scores were higher than for right rear and left rear teats (P < 0.01). Similar results are supported by Neijenhuis et al. (2000).
o The frequency of less desirable teat end hyperkeratosis scores decreased from 8 and 15 (R and VR, respectively) at the first scoring to 3 and 7 (R and VR, respectively) at the last scoring (Figure 5).
o The timing of changes in teat end hyperkeratosis observed in this study is consistent with the 2 to 8 weeks necessary for a change in teat condition described by Mein et al (2001). Changes in teat end hyperkeratosis are not immediate and should be monitored over months.
o Other factors, not explored in this study, affecting teat end hyperkeratosis include teat end shape and genetic predisposition of individual cows (Gleeson et al., 2004).
o Additional research is needed to determine if these results are applicable to varying herd conditions, to better understand the breed differences noted in this study.
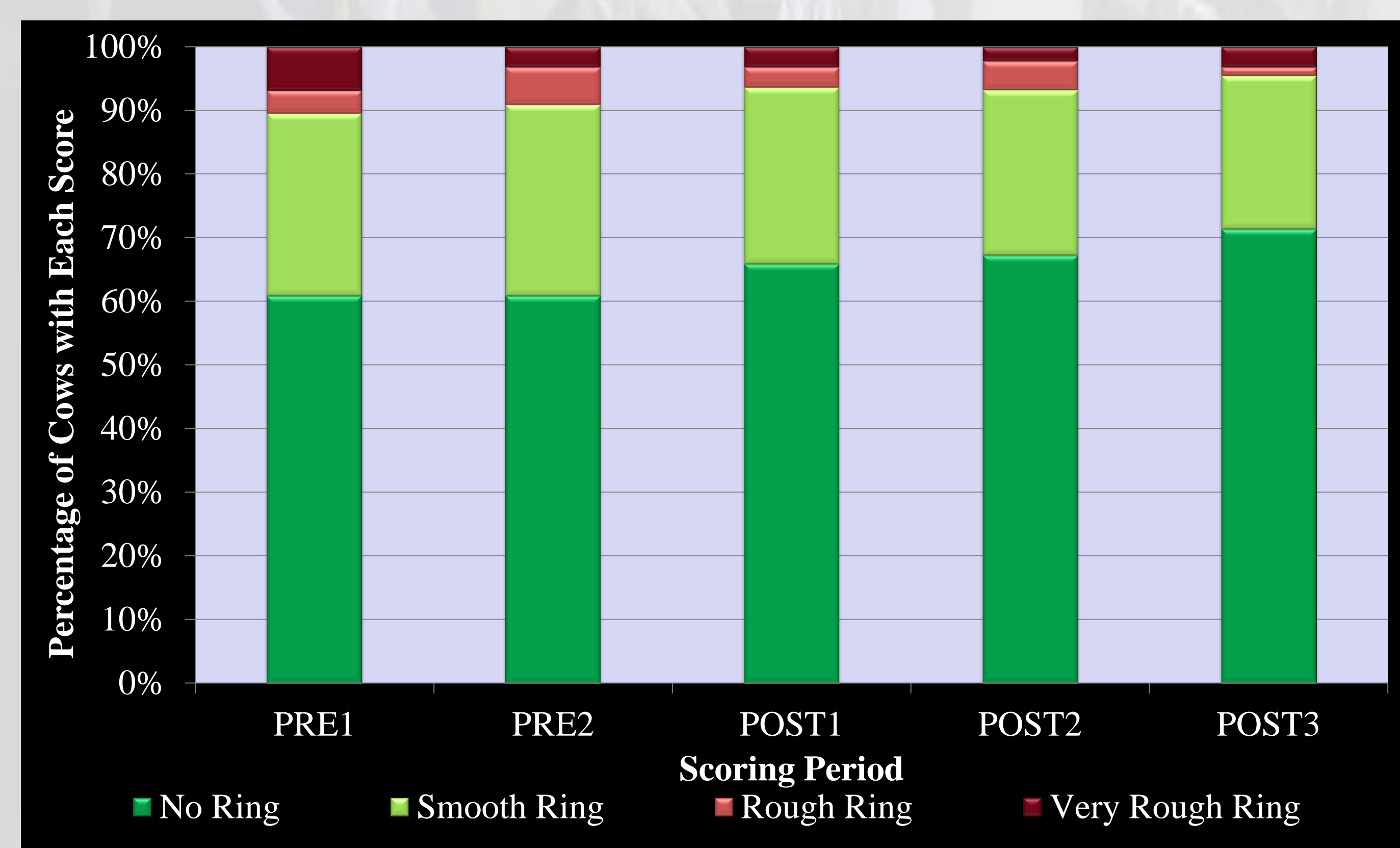
Table 2. Least squares means (± SE) teat position relative to the installation of an individual quarter pulsation milking system.[1,2]

Teat Position	Left Front	Left Rear	Right Front	Right Rear
Teat end hyperkeratosis score (± SE)	1.62 ± 0.09[a]	1.36 ± 0.09[b]	1.58 ± 0.09[a]	1.37 ± 0.09[b]

[1]Least squares means within rows with different superscripts differ (P < 0.05).
[2]1 (N) signifies no ring; 2 (S) signifies a smooth, raised ring; 3 (R) signifies a rough ring; and 4 (VR) signifies a very rough ring.

Figure 5. Percentage of cows by teat end score within teat scoring period relative to installation of an individual quarter pulsation milking system.[1,2]

Table 1. Least squares means (± SE) within teat scoring period relative to the installation of an individual quarter pulsation milking system.[1,2,3]

		Scoring Period				
		PRE1	PRE2	POST1	POST2	POST3
Breed	Holstein	1.75 ± 0.10[a]	1.63 ± 0.10[b]	1.59 ± 0.10[b]	1.53 ± 0.10[b]	1.42 ± 0.10[c]
	Jersey	1.40 ± 0.21[ab]	1.34 ± 0.21[ab]	1.32 ± 0.21[a]	1.43 ± 0.21[ab]	1.63 ± 0.22[b]
	Crossbred	1.35 ± 0.17	1.47 ± 0.17	1.40 ± 0.17	1.49 ± 0.17	1.44 ± 0.17

[1]Least squares means within rows with different superscripts differ (P < 0.05).
[2]1 (N) signifies no ring; 2 (S) signifies a smooth, raised ring; 3 (R) signifies a rough ring; and 4 (VR) signifies a very rough ring.
[3]PRE1 and PRE2 refer to teat end condition observations using a standard milking system while POST1, POST2, and POST3 refer to teat end condition observations using an individual quarter pulsation milking system.

[1]PRE1 and PRE2 refer to teat end condition observations using a standard milking system while POST1, POST2, and POST3 refer to teat end condition observations using an individual quarter pulsation milking system.
[2]The Milpro P4C™ system stops milking individual quarters using a unique individual quarter pulsation system with four pulsation channels instead of two.

CONCLUSIONS

These results demonstrate an improvement in teat end condition for Holstein cows after installation of an individual quarter pulsation milking system. The changes in teat end hyperkeratosis observed in this study may be attributed to decreased overmilking. Individual quarter pulsation systems may improve teat end condition.

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