Short Communication: Teat Skin pH

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ABSTRACT

Changes in teat skin surface pH were studied over 12 wk in 99 lactating Holstein cows. Half the udder of each cow routinely received postmilking disinfection, and the other half served as control. Measures of pH were made on all teats at weekly intervals. Teat skin pH was affected by treatment but not week. Mean teat skin pH measures were: $7.18 (\pm 0.64)$ and $7.53 (\pm 0.46)$ for treatment and control teats. In study II, pH teat skin measures were made hourly on 16 cows, starting 2 h before milking, immediately before a milking, immediately after a milking, and for 2 h postmilking. Teat skin pH was significantly lower for treatment teats and was lower for all teats postmilking.

(**Key words:** teat skin, pH)

Abbreviation key: GLM = general linear model.

Colonization of the teat by mastitis pathogens is presumed to be a risk factor for IMI (Pankey et al., 1984). The skin's acid mantle is bacteriostatic and retards pathogen growth (Raab, 1990; Chikakane and Taa-hashi, 1995). Washing of skin will increase the surface pH (Raab, 1990) and a dairy cow's teats are subjected to several washings per day. Washing may therefore have a negative effect on the maintenance of the acid mantle and might predispose the teat to pathogen colonization. Thus, it would seem important to have an understanding of the factors that influence the dynamics of teat skin pH. The purpose of this study was to determine the changes in teat skin pH relative to the milking process.

In study 1 the effect of postmilking teat disinfection, dip, on teat skin pH, and changes in teat skin pH over time as measured weekly, was studied using 99 cows at the Washington State University for a period of 12 wk. This trial was done in conjunction with one reported by Oura et al. (2002). In this trial, the dip used contained 0.32% sodium chlorite as base, with 2.5% gly-

cerin, 0.27% sodium dodecylbenzene sulfonic acid, and 1.32% lactic acid as an included activator. The pH of the dip was 3.1. A split udder design was used where half the udder received teat dip after milking, while the other half was not dipped and served as a control. Allocation of treatment and control sides (by cow) was by systematic, random assignment. This trial was conducted during the colder months of the year: January through March.

Prior to milking, water from drop hoses were applied to all teats, and visible debris was wiped off with a single-service towel. The surface pH of the teat skin was measured weekly on each teat of each cow after premilking preparation and before milking unit attachment following the procedure described by Jenkinson and Mabon (1973). In brief, a saturated solution of NaCl was applied to the center of the surface of the teat closest to the investigator. A glass combination electrode (Corning Flat Surface Combo w/RJ, Corning, NY) using a Corning pH-45 portable meter (Corning) was applied to each teat surface with NaCl solution. The electrode was held for 20 s prior to recording the surface pH. The electrode was rinsed with distilled water between measures and it was recalibrated between cows using a commercial pH standard of 6.0.

During July, a second trial was conducted where 16 cows were randomly selected to determine the changes in teat skin pH during a 4-h period around a single milking on a single day. Teat skin measures of pH were made at hourly intervals starting at 2 h before through 2 h after milking as described. Two measures were taken at milking time, the first immediately before the milking unit was applied to the mammary gland, and a second immediately after the milking unit was retracted. Thus, 6 measures were made in this segment of the study. Again, only half the mammary gland received postmilking teat asepsis with the product used as described.

In first trial, differences in teat skin pH were assessed using the general linear model (GLM) analysis where the independent variables considered were: week of measure, cow, and treatment (dipped or control). In the second trial, the GLM model included time of measure relative to milking, cow and treatment, where mean

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Table 1. Changes in teat skin pH 2 h before and 2 h after milking.

Period ¹	Treatment	Control
1	7.1 ^a	7.2 ^a
2	7.2 ^a	7.3 ^a
3	7.3 ^a	7.2 ^a
4	6.6 ^b	6.6 ^b
5	5.2 ^c	6.6 ^b
6	5.5 ^c	6.8 ^b

^{a,b}Means within a row and column not sharing a common superscript were significantly different.

¹Measures of pH were taken hourly, 2 h before a milking (periods 1 and 2); immediately prior to the milking (period 3), immediately after the milking (Period 4), and hourly 2 h after the milking (periods 5 and 6).

pH measures by time were contrasted using Duncan's multiple range test.

The teat skin pH of cows in the first study was significantly ($P < 0.001$) affected by cow and treatment, but not by week of measure as determined by the GLM. The 12-wk mean pH of treated teat skin was 7.18 (± 0.64) and 7.53 (± 0.46) for control skin. In the second study, differences in teat skin pH were affected by time period and treatment, means are in Table 1. Teat skin pH decreased after milking, with a nadir 1 h after milking, period 5. The overall mean pH measures on control teat skin were significantly greater ($P < 0.05$) than treatment group pH measures: 7.0 (± 0.3) vs. 6.5 (± 0.9).

Postmilking teat disinfection can affect teat skin pH. In study 1, the surface pH of teat skin became more acidic as teats receiving disinfection had significantly lower pH values than controls. Presumably, the drop in teat skin pH with disinfection would have a positive affect on maintenance of the acid mantle and the bacteriostatic properties of the teat skin. It is not known whether the effects on teat skin pH with the current dip are comparable to other dips, given that there are numerous classes of teat disinfectants available for commercial use (Pankey et al., 1984). Teat skin pH was not affected by week of trial, suggesting that teat skin pH is stable over a wide range of time. Although there was no statistically significant week-to-week variation in teat skin pH as measured in study 1, daily variation in teat skin pH was not measured in either study. Thus, the repeatability of pH measures made in study 2 is unknown. However, the pH of teat skin in study 1 averaged 7.35 for all cows, very—similar to the pH of teat skin taken immediately prior to milking, period 3 of study 2, where pH averaged 7.25 for all treatments. Thus, both studies together suggest that teat skin pH for cows managed under similar conditions could be stable.

Results of study 2 indicate that teat skin pH decreased after milking and that decrease was greatest 1 h postmilking, and greater in disinfected vs. control teats. Given that the teats are washed prior to milking, and that skin pH increases after washing (Raab, 1990), it was expected that teat skin pH would become more basic rather than more acidic after milking. However, the pH of milk has been reported to be 6.65 (Cecil et al., 1965), and we hypothesize that the milk film on the skin surface after milking was associated with the decrease in surface pH of the skin of both dipped and control teats. Additionally, the pH was most acidic on the surface of teat skin that was disinfected. Residual components of the dip likely contributed to the more acidic pH of treated teat skin. Findings herein suggest that teat skin with an acidic pH is maintained within 2 h after milking, and the disinfectant tested was significantly associated with lowered teat skin pH.

Meyer and Neurand (1991) noted that information on the skin surface pH of mammals other than man was limited. They made a comparative study of skin surface pH of domesticated and laboratory mammals with a focus to determine a species that might best serve as a model for dermatological research. We are only aware of one study that examined the surface pH of teat skin of cattle. Jenkinson and Mabon (1973) made extensive measurements of skin pH of Ayrshire cows including the teat surface. Yet little information was reported regarding the timing of teat skin surface pH measure relative to milking; neither the premilking udder preparation routine nor the frequency of measures made. The results from our study indicate that the pH of the teat skin surface can be affected by disinfection, and that such affect may be consistent with maintenance of the acid mantle.

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