Influence of season, ambient temperature, and time until feeding on bacteria counts in pasteurized milk for dairy calves

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Introduction

Pasteurization of waste milk fed to calves is increasingly common. The primary objectives of this study were to evaluate milk bacteria counts as time passed following on-farm pasteurization and identify potential differences in bacteria counts over time between seasons and the associated ambient temperatures. A secondary objective was to evaluate, by season, the time after pasteurization until milk bacteria counts became > 20,000 cfu/mL, which has been suggested as an industry-standard upper limit for feeding milk to calves.

Materials and Methods

Three commercial Colorado dairy farms pasteurized discard milk at 145°F (63°C) for 30 min. During each of the four seasons, milk was sampled prior to pasteurization, when milk cooled to 120°F (49°C) after pasteurization (0 hr), and at 1, 2, 3, 4, 5, 6, 7, 8, 10, 12, and 24 hours after pasteurization. One aliquot of each batch was incubated outdoors, and another was incubated indoors at refrigerated temperature (winter), room temperature (fall and spring), or 98°F (37°C; summer).

At each time point, milk was streaked on Petrifilm™ to determine aerobic count SPC. Dilutions of milk in Butterfield's Buffer ranging between undiluted to 10^{-10}, depending on logical expectations of SPC for elapsed time and season, were streaked on Petrifilm™; no samples had SPC results of too numerous to count.

Results

Pre-pasteurized LogSPC did not differ among farms ($P = 0.99$) or seasons ($P = 0.12$, ANOVA). LogSPC decreased significantly ($P < 0.0001$) after pasteurization. The most significant SPC decrease after pasteurization was detected in spring (1,749,167 to 1,194 cfu/mL; $P < 0.05$, Tukey's).

Mean and median indoor and outdoor temperatures, respectively, were: fall, 73°F (23°C), 73°F (23°C) 46°F (8°C), 46°F (8°C); winter, 43°F (6°C), 43°F (6°C), 46°F (8°C), 48°F (9°C); spring, 64°F (18°C), 63°F (17°C), 50°F (10°C), 48°F (9°C); summer, 99°F (37°C), 99°F (37°C), 86°F (30°C), and 82°F (28°C). Indoor temperatures differed significantly among the four seasons, and Summer had significantly (all $P < 0.0001$; ANOVA, Tukey's) higher outdoor temperatures than the outdoor temperatures for the other seasons.

The final general linear model for factors associated with LogSPC ($R^2 = 0.71$; $P < 0.0001$) revealed that time after pasteurization, summer, and time during summer (interaction) were associated with increased SPC. There was also a farm effect; 1 farm had a faster SPC increase during spring and another farm's milk SPC increased more rapidly during summer, compared with the milk SPC increase during summer for other farms.

Times until mean seasonal SPC > 20,000 cfu/mL were: fall, > 8 hr (between 7,796 then and 24 hr when reached 2,121,818 cfu/mL); winter, > 24 hr (at end of 24 hr study, 173 cfu/mL); spring, > 12 hr (between 1,904 then and 24 hr when reached 9,234,633 cfu/mL); summer, 4 hr (186,800 cfu/mL, faster than other seasons; $P < 0.0001$).

Significance

Under conditions during this study year, in the northern temperate climate, milk was safe to feed to calves (defined as SPC < 20,000 cfu/mL) for at least 8 hr after pasteurization during fall and spring, and for at least 24 hr during winter. During summer, it was important whether pasteurized milk could be stored indoors at 73°F (23°C) or cooler; if stored outside it could be safely fed for only 3 hr after pasteurization. During summer, any outdoor milk remaining after the first feeding following pasteurization should be re-pasteurized or discarded.