Association of THI and light intensity with colostrum production in 18 New York farms

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Introduction

The optimization of colostrum quantity in dairy cows is of great concern to the dairy industry due to the importance of transfer of passive immunity to the newborn calf. Previous research has explored various prepartum environmental variables associated with colostrum production including season, temperature and humidity index (THI), and light intensity. Research shows that cows produce less colostrum during the fall and winter, leading to a decrease in farm-wide supply and greater need for careful colostrum management during colder months. In previous work investigating this problem, researchers used local weather data to determine THI and light intensity, rather than measuring these parameters directly on the farm. The objective of this study was to determine if prepartum THI and light intensity in the close-up barn are associated with observed annual changes in colostrum production.

Materials and methods

Light and THI sensors (HOBO, Onset Computer Corp) recording in 15- and 30-min intervals, respectively, were placed in the close-up dry cow pens of 18 NY Holstein dairy farms. Farm personnel recorded individual cow calving date and colostrum yield. Total area under the curve (AUC) of the THI and light intensity (lux) was calculated using trapezoidal sums (MATLAB 2022a, MathWorks, Inc) for 0 to -7, -7 to -14, -14 to -21, 0 to -14, and 0 to -21d relative to calving. THI AUC was categorized into 5 groups for an average THI per 30 min interval of ≤ 40.2, 40.3-50.1, 50.2-60.0, 60.1-69.2, and > 69.2 for groups 1, 2, 3, 4, and 5 respectively. Likewise, light intensity was categorized into 3 groups using quartiles 1 and 3, with an average lux AUC per 15-min interval of ≤ 64.0, 64.1-154.2, and > 154.2 for groups 1, 2, and 3, respectively. Univariable models were run (SAS 9.4, SAS Institute Inc.) to determine ideal representation of prepartum THI and light intensity based on the strongest association with colostrum yield (defined by lowest Akaike information criterion). Variables identified using univariable screening were then included in a separate multivariable mixed models for primiparous and multiparous cows to assess both THI and light associations with colostrum yield with herd and month of calving as random effects. Tukey's post hoc test was used to adjust for multiple comparisons and different superscripts indicate significance of pairwise comparisons at $P < 0.05$. Colostrum yield is represented as least squares means and 95% confidence interval.

Results

Sensors collected data over a range of 11.7 to 15.4 months. Records from 12,553 multiparous and 5,790 primiparous cows were included. Following univariable screening, the 0 to -7 d period for THI and 0 to -14 d period for light intensity were selected for multivariable analysis. Model results showed an effect of THI ($P = 0.0002$) and light intensity ($P = 0.042$) on colostrum yield of multiparous cows. Colostrum yield in THI groups 1-5 was 4.54 (3.98, 5.19)[a] kg, 4.66 (4.12, 5.26)[a] kg, 4.92 (4.35, 5.56)[a,b,c] kg, 5.24 (4.63, 5.94)[b,c] kg, and 5.62 (4.93, 6.40)[c] kg, respectively. In light intensity groups 1-3 multiparous colostrum production was 4.92 (4.34, 5.57)[a,b] kg, 4.88 (4.33, 5.50)[a] kg, and 5.15 (4.56, 5.83)[b] kg. In primiparous cows, colostrum yield was not associated with THI ($P = 0.22$) or light intensity ($P = 0.46$).

Significance

This observational study showed associations of light intensity and THI in the immediate prepartum period with colostrum yield, which is supported by previous work. These data suggest that colder and drier prepartum environments are associated with decreased colostrum production when controlling for the effect of month of calving and farm. Because this study was performed only in New York with a humid continental climate, future studies should investigate if these same associations hold true across wider ranges of THI and light intensity. Information provided by this study can be used to guide farmers and practitioners when preparing for anticipated periods of low colostrum yield.