Dynamics of body condition score, ultrasound measured backfat, and body weight during the transition period of dairy cows and their association with milk production in herds with automatic milking systems

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Introduction

Dairy cows undergo a state of negative energy balance (NEB) after parturition and use energy from fat reserves to overcome the NEB and maintain milk production. Body condition score (BCS) is used to determine the cow's body fat reserve, and its association with milk production has been studied. Backfat thickness (BFT) is associated with BCS, and it is a more objective measurement. Sequential body weight (BW) measurements may be a good way to monitor energy reserve use, yet the association between daily BW measurements and milk production has not been examined. Also, there has been little description of the related dynamics of BCS, BFT, and BW. The objectives of this study were to describe the dynamics of BCS, BFT, and BW during the first 50 days-in-milk (DIM), and to evaluate the association between these potential explanatory variables and milk production (MP) in the herds with automatic milking systems (AMS).

Materials and Methods

In a longitudinal prospective study in 3 herds that use AMS in central New York, data were collected from 105 cows beginning 1 week prior to their expected calving date and continued through the first 50 DIM. BCS was determined 1 week prior to the expected calving date and weekly between the second and seventh week of lactation. Ultrasound measurement of the subcutaneous fat in the thurl area was performed simultaneously. Daily BW data were obtained from existing scales in the AMS. A repeated measures model with Tukey's adjustment for multiple comparisons in SAS was used for the descriptive analysis of BCS, BFT, and BW of cows during the first 50 DIM. The Mixed Procedure with repeated measures and random effect of herd was used to determine the potential explanatory variables related to MP. Those variables were then used in the SAS PROC REG to explain its association with total MP during the first 50 DIM.

Results

Both primiparous and multiparous cows lost BCS, BFT, and BW during early lactation. The mean BW of primiparous cows at 9 DIM differed significantly ($P<0.01$) from that at 1 DIM (1265 lb; 575 kg), and reached a nadir of 1216.3 lb (552.7 kg) at 20 DIM. The mean BW of multiparous cows at 5 DIM was significantly ($P=0.02$) less than that at 1 DIM (1567.5 lb; 712.5 kg), and reached a nadir of 1469.6 lb (668 kg) at 33 DIM. The BCS of primiparous cows at the second week of lactation (3.4) was significantly ($P<0.01$) less than that in the dry period (3.8), but stayed relatively constant for the remaining 50 DIM. The mean BCS of multiparous cows during the dry period was 3.7, and was significantly ($P<0.01$) higher than that at week 2 of lactation (3.4), which in turn was significantly ($P<0.01$) higher than that at week 3 of lactation; however, after the third week of lactation the mean BCS remained relatively stable for the remainder of the observation period. The mean BFT measurements in the dry period (primiparous cows, 28 mm; multiparous cows, 27 mm) differed significantly ($P<0.01$) from those measurements at week 2 of lactation for both parity groups. The lowest mean BFT for primiparous cows (21 mm) was measured during week 5 of lactation, whereas the lowest mean BFT for multiparous cows (19.7 mm) was also measured during week 5 of lactation.

For primiparous cows, after controlling for disease events, BW explained the most variability in total MP during the first 50 DIM ($r^2 = 0.38$), followed by BFT ($r^2 = 0.12$) and BCS ($r^2 = 0.04$). A 1-unit decrease in BW daily was associated with a milk loss of 388 lb (176 kg), whereas a 1-unit decrease in BFT or BCS during the first 50 DIM was associated with a milk loss of 105.6 and 1355.2 lb (48 kg and 616 kg), respectively.

For multiparous cows, total MP was most affected by the occurrence of disease events during the first 30 DIM. After accounting for disease, BCS ($r^2 = 0.07$), BW ($r^2 = 0.04$), and BFT ($r^2 = 0.04$) did not explain a significant portion of the variability in milk production.

Significance

The BCS, BFT, and BW dynamics during early lactation differ between primiparous and multiparous cows.