Extension Education: Current Topics in Dairy Management—Transition Cows

659 Manipulating the transition udder: Where dairy management meets mammary gland biology. T. B. McFadden*, *University of Vermont*, *Burlington*.

The fundamental unit responsible for milk synthesis and secretion is the mammary alveolus, a hollow, spherical structure comprised of individual mammary secretory epithelial cells. These cells function by taking up nutrients from the bloodstream, synthesizing them into milk components, packaging them, and ultimately secreting them into the alveolar lumen. Thus, it follows that the key points of regulation of milk production involve mammary development, to establish the population of secretory cells; lactogenesis, to stimulate these cells to produce milk; and galactopoiesis, or maintenance/enhancement of their activity. Each of these processes depends on hormones and nutrients provided via the mammary blood supply. During the transition period, all of these functions play a key role, hence management strategies must effectively target one or more of them. Novel management approaches for the transition cow include manipulation of photoperiod during the dry period, frequent milking during early lactation, and reducing the length of the dry period. Recent evidence suggests that all of these strategies work through effects on the number or activity of secretory cells in the udder. The purpose of this paper is to review the regulation of mammary function and explore the biological basis for improving function through management. Through better understanding of the underlying factors, it may be possible to optimize current protocols and develop new approaches to managing the transition cow to enhance milk production efficiency.

Key Words: Transition Cow, Management, Mammary Gland Biology

660 Effects of modified dry periods on milk yield, milk composition and mammary development in dairy cows. E. L. Annen* and R. J. Collier, *University of Arizona*, *Tuscon*.

Recent research reports equal milk yield in bST-supplemented, continuously milked (CM) and 60-d dry (CTL) multiparous (MULTI) cows, but lower milk yield in CM cows not treated with bST and primiparous (PRIMI) cows treated with bST. In PRIMI cows, mammary development requirements demand a dry period longer than 30 days. We evaluated effects of CM and hormonal treatments on mammary epithelial cell (MEC) turnover during late gestation (LG) and early lactation (EL) and milk yield in CM, PRIMI cows. MEC growth is decreased in CM glands during most of LG. Assessment of MEC turnover in involuting CTL glands and lactating CM glands revealed a marked reduction in the MEC turnover process that occurs in the early dry period. When compared to CM tissue, MEC apoptosis in CTL tissue was increased 5-fold at 3 d of milk stasis and MEC growth was increased 3-fold at d 7 of milk stasis. In the last 20 d of gestation, MEC growth remained reduced in CM glands. By the last week of gestation, MEC growth was 50% less in CM tissue vs. CTL tissue. MEC apoptosis was unaffected by CM during the last 20 d of gestation, but a premature decrease in EL apoptosis occurred in CM glands at 7 d postpartum. Since CM and CTL glands contain equal MEC numbers, this decrease in apoptosis may allow CM glands to maintain MEC numbers following reduced prepartum MEC growth. In CTL glands, EL apoptosis likely sheds old and dormant MEC while permitting newer cells generated during LG to differentiate. Ultrastructure of CM tissue revealed large populations of resting or involuting alveoli by d 20 postpartum, whereas CTL glands had a homogenous population of secretory alveoli. Collectively, these data suggest that a 40-53% reduction in milk yield in CM glands is caused by reductions in MEC renewal and reduced secretory capacity. Treatments (bST, increased milking frequency, prostaglandin E_2) to stimulate milk synthesis or MEC growth in CM PRIMI glands have been unsuccessful. In conclusion, PRIMI cows continue to require a 60-d dry period, but MULTI cows are good candidates for short dry periods, and potentially no dry period.

Key Words: Modified Dry Period

661 Photoperiodic effects on the transition dairy cow. G. E. Dahl*, H. M. Crawford, and E. D. Reid, *University of Illinois*, *Urbana*.

Whereas photoperiodic effects on lactating cows are well characterized, the impact of light exposure on cows as they move through the transition from the dry period into lactation has been the subject of recent studies. In contrast to lactating cows, dry cows and pregnant heifers exposed to a reduced photoperiod (PP), that is short days (8L:16D; SDPP) have greater milk yield in the subsequent lactation relative to cows exposed to long days (16L:8D; LDPP), and that is associated with greater mammary growth. Dry cows on SDPP have higher DMI relative to LDPP. Relative to LDPP, exposure to SDPP improves immune measures in dry cows as they transition into lactation. Mammary and immune responses appear to be mediated through changes in prolactin (PRL) sensitivity, with SDPP causing a decrease in circulating PRL yet increased PRL-receptor mRNA expression compared with LDPP. Because reduced PRL concentrations in dry cows are associated with higher subsequent milk yield, other stressors that may elevate PRL should be limited. Responses to SDPP are consistent with 60 d of treatment, but shorter duration exposure is more variable, perhaps due to seasonal shifts in photoperiod under ambient conditions. With regard to application, any enclosed facility that is well ventilated is appropriate for housing. Cows can be exposed to natural light but that should be limited to 8 hrs/d. Observation can be facilitated, especially as parturition approaches, by the use of dim red lighting during periods of darkness. Following parturition, cows returning to ambient photoperiodic conditions from SDPP respond with higher milk yields than those on LDPP when dry. In summary, photoperiod manipulation of dry cows offers a non-invasive, easily implemented management approach to improve performance and health during the transition into lactation.

Key Words: Short Days, Milk Yield, Health

662 Impact of increased milking frequency during early lactation. M. VanBaale*, D. Ledwith, J. Thompson, R. Collier, and L. Baumgard, *University of Arizona*, *Tucson*.

Multiparous cows (n=300) were assigned to one of 2 increased milking frequency (IMF) treatments (trts) at parturition to investigate IMF (6X vs. 3X) effects during early lactation and subsequent lactation persistency with or without rbST. Treatments were 6X milking for 0 (control; milked 3X) or the first 7, 14 or 21 DIM (all 4 trts initiated rbST at 63 DIM), or 6X for the first 21 DIM (no rbST administration during the entire lactation and all cows returned to 3X milking after their respective trt ended). Cows milked 3X tended to produce more milk 43.2 vs. 41.5 and 41.0 kg/d during the first nine wks of lactation compared to cows milked 6X for 7 or 21 DIM, respectively. Milk yield did not differ among IMF trts (38.3 kg/d) after wk 9. Percentages of milk fat (3.80) and protein (2.90) did not differ between trts during the first nine wks after calving. Plasma NEFA concentration from a subset of cows assigned to the 3X and 6X 21 DIM trts were similar (477 μeq/L). Cows administered rbST and milked 6X for 21 DIM produced more milk (38.1 vs. 34.6 kg/d) compared to cows milked 6X for 21 DIM and not provided rbST. Percentages of milk fat and protein were not effected by rbST, however yields of fat (1.37 vs. 1.26 kg/d) and protein (1.12 vs. 1.00 kg/d) were higher for cows administered rbST and milked 6X for 21 DIM compared to cows not receiving rbST. Milk somatic cells (528 vs. 252 x 10^3 cell/ml) increased and BCS decreased (3.53 vs. 3.56) with rbST administration. The percentage of cows pregnant (37%) within 65 d of the voluntary waiting period, average DIM at pregnancy (126) and average service per conception (2.28) did not differ between treatments (X^2 = 0. 96). The number of cows that were sent to the hospital during the 305 d trial for mastitis (60), digestive disorders (9), respiratory issues (5), lameness (14), and/or retained placenta (10), were not affected by treatments (X^2 = 0.49). IMF (6x vs. 3X) in early lactation did not increase milk synthesis or improve lactation persistency.

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Key Words: Milking Frequency, Early Lactation, Somatotropin