Housing and Management in the Dry Period

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Introduction

Traditionally, management of cows during the dry period was minimal. Approximately 60 days before calving, milking would cease and cows were treated with long lasting antibiotic in an attempt to clear up any lingering subclinical mastitis and prevent new infections. Cows were typically removed from the milking herd, given reduced feed, and often exposed to pasture and allowed to "rest" prior to parturition. In the last 10-15 years, however, this low input approach has shifted as numerous studies suggested that aggressive nutritional management during the dry period could reduce the incidence of metabolic disease and improve the transition into lactation. Improved understanding of the roles of dietary energy density, cation-anion balance, and fat metabolism have led to new nutritional recommendations for dry cows to improve subsequent lactational performance (Drackley, 1999). Similar to nutrition, there is a growing body of evidence to suggest that appropriate management of housing during the dry period can also yield dividends in the subsequent lactation, and that is the topic of this paper.

Photoperiod Management

Controlling the duration of light a cow is exposed to daily has dramatic influence on milk production during lactation (Dahl et al., 2000). Long days, light for 16 to 18 hours each day interrupted by a 6 to 8 hour period of darkness, increase milk yield 5 lbs/day at all stages of lactation. In addition, exposing growing heifers to long days accelerates lean growth and results in higher milk yields in the first lactation relative to shorter durations of light, i.e. short days (Rius et al., 2005; Rius and Dahl, 2006). However, recent studies suggest that exposure to short days during the dry period improves cow health and mammary growth before calving, eases the transition into lactation and ultimately results in greater milk production compared with cows on long days when dry (Dahl and Petitclerc, 2003).

The first study to show a response to short days in dry cows compared 60 days of short days to long days; essentially exposing cows to either photoperiod for the entire dry period (Miller et al., 2000). Subsequent studies have confirmed not only an improvement of milk yield following a dry period of short day exposure, but also evidence of more robust immune function and health (Auchtung et al., 2004, 2005). Dry cows on short days had fewer quarters infected with mastitis in early lactation and the incidence of metritis was reduced (Auchtung et al., 2004).

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Physiologically, the impact of photoperiod management is attributed to shifts in the secretion of certain hormones that are critical to lactation and health. Under short days, secretion of prolactin is lower relative to cows on long days (Dahl et al., 2000). Prolactin acts through a specific receptor that is present in many tissues, notably the mammary gland and numerous cells of the immune system including lymphocytes and neutrophils (Auchtung and Dahl, 2004). Those prolactin receptors are then responsible for transducing the signal when the hormone binds to them. In contrast to prolactin itself, the number of prolactin receptors increases under short days compared with long days, thus, the signal intensity may increase (Auchtung and Dahl, 2004). There is strong evidence then that the inverse relationship between prolactin and its receptor drives photoperiod related shifts in milk yield and health, with a reduction in prolactin being desirable during the dry period.

Cooling

In lactating cows, heat stress abatement is critical to maintain dry matter intake and milk yield during the summer months and even year round in some areas of the US (Collier et al., 2006). Because dry cows typically consume less feed and intake is limited relative to lactating cows, heat stress may have been overlooked during the dry period. However, previous reports indicate that provision of shade and other heat stress abatement improves calf health and production in the next lactation (Collier et al., 1982). More recently, Urdaz et al. (2006) showed that cooling dry cows late in the dry period improved intake and subsequent milk yield.

But heat stress effects on dry matter intake may explain only a portion of the improvements that occur when dry cows are cooled. Heat stress also produces an increase in circulating prolactin, a similar response to that of long day photoperiod exposure. This led to a test of the hypothesis that prolactin responsive gene expression in the liver was negatively affected by heat stress during the dry period, and that led to lower milk yield. The objective of the study was to evaluate the effects of heat stress prepartum under controlled photoperiod on lactation performance and hepatic metabolic gene expression of periparturient Holstein cows. Cows were dried off 46 d before expected calving date and assigned to treatments by mature equivalent milk production. The treatments were: 1) Heat stress (HT) and 2) Cooling (CL). Both treatments had a photoperiod of (14L:10D). After calving, cows were housed in a free stall barn with cooling, and milk yield was recorded daily up to 42 DIM. Daily DMI was measured from -35 to 42 d relative to calving. Liver biopsies were collected at dry off, -20, +2, and +20 d relative to calving for cows on HT and CL to measure mRNA expression of prolactin responsive genes. HT cows had greater afternoon rectal temperatures (39.2 vs. 38.8^{o}C) and decreased DMI prepartum (26.5 vs. 31.1 lbs/d) and milk yield postpartum (63.5 vs. 76.7 lbs/d) compared with CL cows. Relative to CL cows, hepatic mRNA expression of *suppressors of cytokine signaling* -2 (*SOCS2)* and *IGFBP5* was down-regulated in HT cows. Expression of *ACADVL* was up-regulated in CL cows at d +2 but down-regulated at d +20 relative to HT cows. These results suggest that heat stress abatement in the dry period improves subsequent lactation, possibly through SOCS-2 and its regulation of hepatic lipid metabolism (do Amaral et al., 2008).

Stocking Density

The preceding discussion suggests that dedicated facilities, especially those that feature controlled lighting and cooling, may be used to improve dry cow management and subsequent lactational performance. Yet for facilities to yield a maximal return on the investment of capital, they must be designed and used to maximize the efficiency of cow flows over time. Although dairy cows are not seasonal breeders, there are seasonal spikes in calving that dictate fluctuations in dry cow numbers. That means that overstocking of dry cows is likely to occur even in a dedicated facility.

Stocking density is a critical component of overall cow comfort, yet the impact of overstocking during the dry period is unknown. And, the relative contribution of limiting feed access versus stall access to stocking density effects is unknown. To determine if reduced freestall availability during the dry period had an impact on subsequent milk yield and performance, we used 40 Holstein cows dried off approximately 60 d before calving and assigned to 70% stall availability (overstocked) or 100% stall availability (control) for the entire dry period. All cows were fed individually using a Calan gate system and dry matter intake (DMI) was recorded during the dry period. Treatments ended at calving when all cows were managed in a commercial facility throughout lactation. Cows were milked three times per day; milk production was recorded until 150 d in milk. There was no difference between groups in days dry, DMI, BCS or milk production. When dry, overstocked cows consumed 33.7 lbs/d DM compared with 32.9 lbs/d for cows with full stall access. BCS did not differ between treatments and score averaged 3.2 for overstocked versus 3.1 for control cows. Milk production was 97 lbs/d for 100SA and 96 lbs/d for 70SA. These results suggest that dry cows can adapt to substantial reductions in stall availability during the dry period if adequate access to feed is maintained, and not experience a reduction in subsequent milk yield (Velasco et al., 2007).

While determining the actual incidence of disease requires a tremendous number of cows, there are certain indicators of immune function that can be used to compare immune competence and potential disease resistance. In 20 cows of the study, short-term treatment effects on neutrophil phagocytosis and chemotaxis and lymphocyte proliferation were measured 4 and 24 h after assignment to either overstocked or control conditions. Lymphocyte proliferation was measured again at 2 and 5 wk post-treatment. Locomotor scores and postpartum disease prevalence were also recorded for these 20 cows and the second cohort of 20 cows subjected to the same treatments. In the short-term, immune cell activity was enhanced among cows on the 70SA treatment compared with cows on 100SA. Lymphocyte proliferation, a measure of immune competence, increased in response to ConA and tended to increase in response to PHA, suggesting an increased responsiveness of T-cells. The percentage of neutrophils engulfing 1 or more fluorescent marker beads was greater among 70SA cows than the 100SA cows. Long-term there was a tendency for cows in the 70SA treatment to have increased LPS-induced B-cell proliferation compared to 100SA cows. Postpartum disease prevalence was similar for cows on both treatments. There were interactions between treatment and cohort and week and cohort on locomotor score. Locomotor score did not change over time for cohort 1 cows or for the 100SA cows in cohort 2, but it worsened over time for the 70SA cows in cohort 2. A moderate reduction in freestall access in dry cow facilities should not adversely affect immune function, but it may negatively impact hoof health (Gressley et al., 2007).

Summary

In addition to appropriate nutritional management during the dry period, the studies described above support the concept that housing management can affect dry cow health and production in the next lactation. Exposure to short days improves milk yield and health, as does heat stress abatement for the entire dry period. There is evidence accumulating that suggests a common linkage through effects on prolactin responsive genes. Whereas increased stocking density causes subtle changes in immune function relative to 1:1 cow to stall ratio, there was little evidence of a subsequent depression of milk yield or performance, as long as feed access was not altered. These lead to the recommendations that dry cows be housed in limited light situations, be well cooled, and have ample feedbunk space even if stall availability is limited.

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Notes