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Effect of stocking density on social, feeding, and lying behavior of prepartum dairy animals

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ABSTRACT

The objectives of this study were to determine the effects of prepartum stocking density on social, lying, and feeding behavior of dairy animals and to investigate the relationship between social rank and stocking density. In total, 756 Jersey animals were enrolled in the study approximately 4 wk before expected calving date. This study used 8 experimental units (4 replicates × 2 pens/treatment per replicate), and at each replicate, one pen each of nulliparous and parous (primiparous and multiparous) animals per treatment was enrolled. The 2 treatments were 80% stocking density (80D, 38 animals per pen; each pen with 48 headlocks and 44 stalls) and 100% stocking density (100D, 48 animals per pen). Parous animals were housed separately from nulliparous animals. Animals at 254 ± 3 d of gestation were balanced for parity (parous vs. nulliparous) and projected 305-d mature-equivalent milk yield (only parous animals) and randomly assigned to either 80D or 100D. Displacements from the feed bunk were measured for 3 h after fresh feed delivery on d 2, 5, and 7 of each week. Feeding behavior was measured for 24-h periods (using 10-min video scan sampling) on d 2, 5, and 7 on wk 1 of every replicate and d 2 and 5 for the following 4 wk. A displacement index (proportion of successful displacements from the feed bunk relative to all displacements the animal was involved in) was calculated for each animal and used to categorize animals into ranking categories of high, middle, and low. Seventy nulliparous and 64 parous focal animals in the 80D treatment and 89 nulliparous and 74 parous focal animals in the 100D were used to describe lying behavior (measured with data loggers). Animals housed at 80D had fewer daily displacements from the feed bunk than those housed at 100D (15.2 ± 1.0 vs. 21.3 ± 1.0 per day). Daily feeding times differed between nulliparous and parous animals at the 2 stocking densities. Nulliparous 80D animals spent 12.4 ± 5.0 fewer minutes per day feeding than nulliparous 100D animals, whereas 100D parous animals tended to spend 7.6 ± 4.5 fewer minutes per day feeding than 80D parous animals. The 2 treatments were not different in the number of lying bouts or lying-bout duration; lying time was longer for 100D on d −33, −29, and −26 and shorter on d −7, −5, and 0 than 80D. The interaction between treatment, parity, and social rank was associated with lying and feeding times. In summary, animals in the 80D treatment had a lower number of displacements from the feed bunk and spent more time lying down near parturition than 100D animals, and 80D nulliparous animals had reduced daily feeding time compared with 100D nulliparous animals. Although these results showed some potential behavior benefits of a prepartum stocking density of 80% compared with 100%, observed changes were small. However, greater stocking density cannot be recommended; more research is needed to evaluate the effects of stocking densities greater than 100% and with other breeds of cattle besides Jersey.

Key words: prepartum cow, stocking density, feeding behavior, lying behavior, social behavior

INTRODUCTION

The transition dairy cow is one of the highest-risk animals for falling ill or dying on the dairy farm. Typically the transition period is described as 3 wk before and after calving (Grummer, 1995). During this period cows experience physiological, immune, and nutritional changes making the cow at risk for metabolic and infectious diseases (Goff and Horst, 1997). Up to 25% of cows are culled or die during the first 60 DIM (Godden et al., 2003), which may be attributed to an unsuccessful transition period. Concern over animal well-being and reduction on farm profitability due to morbidity and mortality losses have stimulated more research in the area of transition-cow management and behavior to improve transition-cow success.

Dry matter intake decreases 3 wk before calving (Hayirli et al., 2002), and more severe reductions in DMI may put the cow at risk for metabolic disorders such as ketosis and fatty liver. Cows will typically oc-

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cupy 80% of the feed-bunk linear space during the peak feeding time after fresh feed delivery (Huzzey et al., 2006; Nordlund et al., 2006). The current industry recommendations for prepartum freestall-housed dry cows is to provide a minimum of 0.76 m of linear bunk space per cow (or stock at 80% of 0.61-m headlocks) with at least one stall per cow for resting space (Nordlund et al., 2006). In a field study with prepartum nulliparous and parous animals housed together, it was reported that for every 10% increase in stocking density above 80% of headlocks, milk yield decreased 0.7 kg/d for first-lactation cows in that lactation (Oetzel et al., 2007). Increasing linear feeding space has been observed to reduce competition at the feed bunk (Huzzey et al., 2006) and may benefit lower-ranking animals. The number of aggressive interactions was fewer and feeding activity during the 90 min after fresh feed delivery increased when lactating dairy cattle had access to 1.0 m of feeding space per cow compared with 0.5 m per cow (DeVries et al., 2004). Krawczel et al. (2012) reported changes in social behavior of lactating cows with a linear increase in displacements from the feed bunk as stall stocking density increased from 100 to 142%, but they observed no differences in feeding or rumination time.

Two resources highly valued by cows are lying and feeding space. Lactating cows spend approximately 12 to 13 h/d lying down (Fregonesi et al., 2007) and 5 to 6 h/d feeding (Val-Laillet et al., 2008). Lying has a higher priority for cows than eating and social contact when these behaviors are restricted (Munksgaard et al., 2005). Lying time was linearly reduced when stocking density increased from 100 to 150% (Fregonesi et al., 2007). Krawczel et al. (2012) reported lying time was reduced for stocking densities of 131 and 142% compared with 100 or 113%. Late-lactation cows stocked at 100% of stalls spent less time lying down compared with cows stocked at 25% of stalls (Telezhenko et al., 2012).

The feed bunk can be an area of competition causing changes in feeding behavior. Multiparous cows in a competitive feed environment (2 cows per 1 feed bin) had a shorter feeding time and ate at a faster rate for up to 2 wk postcalving, whereas the feeding behavior of primiparous cows did not differ (Proudfoot et al., 2009). In other studies, when the number of cows to feed bin increased, the competitively fed cows did not differ in DMI or daily feeding time, but cows had fewer meals per day with the tendency of larger and longer meals (Olofsson, 1999; Hosseinkhani et al., 2008). Additionally, as competition at the feed bunk increased, idle standing time also increased (Olofsson, 1999), which has been associated with an increase in lameness prevalence (Cook et al., 2004).

Only a few studies have evaluated stocking density during the prepartum period and in conditions similar to commercial dairies. Data collected by Oetzel et al. (2007) demonstrated a decrease in milk yield for primiparous cows in a mixed pen with multiparous cows when prefresh pen stocking densities exceeded 80%. Huzzey et al. (2012) reported greater DMI, plasma nonesterified fatty acids, and glucose concentrations with a tendency for greater fecal cortisol metabolite for cows housed at a higher pen stocking density (1 stall per cow and 0.67 m of linear feed bunk space compared with 0.5 stall per cow and 0.34 m of linear feed bunk space). To our knowledge no research on stocking density during the prepartum period has been conducted with Jersey cows, and results could differ from Holstein cows.

The objectives of this study were to determine whether increasing stocking density in a commercial Jersey dairy farm from 80 to 100% would affect social, feeding, and lying behavior of prepartum nulliparous and parous dairy animals and to investigate whether behaviors varied among animals of different social rank at the 80 or 100% stocking density.

MATERIALS AND METHODS

Animals and Housing

A total of 756 nulliparous and parous (primiparous and multiparous) Jersey animals were allocated to 2 treatments from October 2012 to March 2013. The study was conducted at a large commercial dairy farm (6,400 lactating dairy cows) in south-central Minnesota. Prepartum animals were provided a TMR (balanced to meet nutrient requirements) once daily at approximately 0700 h and fed from a feed alley by headlocks. Four experimental pens housing either 38 or 48 animals each were used in each replicate period with 2 pens per treatment enrolled at each replicate. Two pens (one per each treatment) housed primiparous and multiparous cows together referred to as parous, and 2 pens (one per each treatment) housed nulliparous animals. All experimental pens had the same measurements of 31.7 × 11.0 m and had 44 deep sand bedded freestalls (229-cm length × 107-cm width × 114-cm height) with a head-to-head configuration and forty-eight 0.61-m headlocks. Sand bedding was added once weekly, and pens were scraped once daily. Two water troughs were located in the pen and measured 366 × 56 cm. One water trough was located at the end of the bank of freestalls, and a shared water trough was located between the treatment pen and an adjacent nonexperimental pen. After each replicate, treatment within parity (nulliparous or parous) was switched to the opposite pen to prevent location bias.