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Social housing influences the behavior and feed intake of dairy calves during weaning

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ABSTRACT

We investigated the effect of social housing on the behavioral, intake, and physiological changes that occur at weaning for dairy calves fed milk ad libitum. These changes were evaluated during the weaning (d 40 to 48 of age) and postweaning (d 49 to 56 of age) stages. Twenty male Holstein calves were fed milk replacer ad libitum and weaned gradually by dilution over 9 d starting at d 40 of age. Calves were housed in pairs (10 calves) or individually (10 calves) from birth until the beginning of the postweaning phase, when all calves were paired. Feed and water intake were monitored daily. Feeding time was video-recorded, and blood β-hydroxybutyrate concentration was measured on alternate days beginning on d 40 and ending on d 56 of age. Electronic accelerometers continuously recorded standing and lying behavior for the 17-d study. Solid feed consumption increased by more than 5-fold over the weaning phase in all calves; during this phase pair-housed calves consumed more than twice (0.96 vs. 0.50 kg/d on d 48) that of the individually housed calves. Postweaning all calves rapidly increased their solid feed intake, and to a greater extent for previously individually housed calves, such that intake was similar between treatments by d 56. Free water intake was stable during weaning; however, a decrease (of 6.6 L) occurred in the constituent milk replacer water intake across this phase. As result, total water intake (free water + milk replacer water content) decreased (by 6.0 L) over the weaning phase between d 40 (14.9 L/d) and d 48 (8.9 L/d). On the first day postweaning (d 49), total water intake for all calves increased sharply (to 19.0 L/d) and then returned to a lower baseline (13.2 L/d) the next day (d 50), and slowly increased over the following week. During the weaning phase, feeding time and feeding rate increased with time for all calves, whereas pair-housed calves had greater feeding rates than individually housed calves (13.4 vs. 6.6 g of DM/min). After weaning, calves previously housed individually spent more time feeding in the early hours of the day than calves housed in pairs. Lying time and lying bout frequency decreased with calf age during the weaning period across treatments, and pair-housed calves tended to spend less time lying than individually housed calves (1,015 vs. 1,039 min/d) during this time period. Blood β-hydroxybutyrate increased across treatments over the weaning period, with the largest increase occurring between d 48 (0.05 mmol/L) and d 50 (0.2 mmol/L). These results show that calves alter their behavioral patterns during weaning and that housing calves in pairs may ease the transition from milk to solid feed.
Key words: dairy calf, behavioral pattern, weaning

INTRODUCTION

Increasing milk allowance improves the well-being of young dairy calves by decreasing behavioral signs of hunger (De Paula Vieira et al., 2008), encouraging natural feeding patterns (Appleby et al., 2001), and increasing growth rates (Jasper and Weary, 2002; Miller-Cushon et al., 2013a; Rosenberger et al., 2017). Increased growth rates in early life, through higher milk allowance and other management strategies, may also improve long-term performance when the calf enters the milking herd (Soberon et al., 2012; Soberon and Van Amburgh, 2013; Gelsinger et al., 2016). However, providing greater quantities of milk creates a challenge at weaning because calves consume less solid feed before weaning when provided with more milk (Terré et al., 2007; Miller-Cushon et al., 2013a) and may have reduced weight gain during the weaning transition (Sweeney et al., 2010). Improvements to current weaning programs may help eliminate these setbacks. For example, increasing the duration of the weaning period (Sweeney et al., 2010), utilizing different methods of weaning (e.g., step down weaning; Khan et al., 2007), offering different types of solid feeds, such as forages (Castells et al., 2012), or providing access to herdmates (Chua et al., 2002; Costa et al., 2016; Bolt et al.,

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2017) may improve the transition to solid feed over the weaning period.

Evidence indicates that social housing improves feed intake during the weaning period (De Paula Vieira et al., 2010; Miller-Cushon and DeVries, 2016); these data suggest that social facilitation or social learning of feeding may benefit calf intake and, thus, growth preweaning, during weaning, and postweaning (Costa et al., 2016). Effects of early social housing and early exposure to competition may have longer-term effects on calves, as there is evidence that calves previously housed in groups have greater competitive success immediately after weaning (Duve et al., 2012) and calves exposed to early competition exhibit increased competitive behavior for access to feed 6 wk after weaning (Miller-Cushon et al., 2014). Early social housing may also influence behavioral (Duve et al., 2012) and cognitive development (Gaillard et al., 2014; Meagher et al., 2015), and improve resilience to stress (Bolt et al., 2017) and competitive interactions (Miller-Cushon et al., 2014) postweaning.

Despite the importance of facilitating a smooth transition at weaning, especially in calves provided greater milk allowances, the day-to-day behavioral, intake, and physiological changes that occur during the weaning process have not been well characterized. The primary objective of this study was to investigate the behavioral and intake changes that occur during weaning for dairy calves fed milk ad libitum. Further, due to the influences of social housing on intake before and during weaning (De Paula Vieira et al., 2010; Miller-Cushon and DeVries, 2016), we also aimed to determine the effect of social housing on behavioral and intake changes that occur at weaning. We predicted that calves raised individually would show less synchronicity in their feeding behavior after being paired following weaning. During times of stress (i.e., social mixing) cows have been reported to decrease lying time temporarily (von Keyserlingk et al., 2008), thus it was hypothesized that calves would alter their normal lying behavior by standing for longer periods of time per day during a high-stress period such as weaning.

As reviewed by Khan et al. (2016), ruminal fermentation begins early in life, and VFA concentrations increase with greater solid feed intake. Butyrate, the most bioactive VFA, is absorbed by the rumen epithelium and oxidized into ketones (Baldwin et al., 2004; Khan et al., 2016). One of these ketones, BHB, is expected to increase with calf age due to higher feed intakes and absorption of short-chain fatty acids from the rumen (Swanson and Harris, 1958; Quigley et al., 1991, 1992; Deelen et al., 2016). Although researchers have positively associated blood BHB with starter intake in early life of the calf, with weekly samples (Deelen et al., 2016; Suarez-Mena et al., 2017), a comprehensive study of how blood BHB evolves over the weaning period with increasing starter consumption has not been done. Thus, another aim of this study was to investigate how blood BHB changes over the weaning period.

MATERIALS AND METHODS

This study was part of a larger study aimed at evaluating how social housing affects development of feeding behavior and social feeding habits of dairy calves. As such, detailed descriptions of the methodology of the study are presented in Miller-Cushon and DeVries (2016). To address the current objectives, this study focused on the time period around weaning (9 d of weaning, and the following 8 d postweaning), and investigated daily changes in behavior across this period.

Animals and Housing

Twenty male Holstein calves were used in this study. Calves were purchased from local dairy farms (Eastern Ontario, Canada) and transported to the University of Guelph Kemptville Campus Dairy Education and Research Centre (Kemptville, ON, Canada). Prior to transport, it was confirmed that calves received a minimum of 1 feeding of colostrum (minimum 4 L within the first 12 h of life) and were tagged with a National Livestock Identification for Dairy tag before removal from the farm. Calves were assessed by study technicians at the farm of origin and only calves deemed healthy and alert were purchased. All calves arrived at the research facility within 24 h of birth. On arrival and enrollment in the study, calves received injections of 1 mL of selenium (Dystosel, Pfizer Animal Health, Kirkland, QC, Canada) and 1 mL of tulathromycin (Draxxin, Pfizer Animal Health), as a preventive measure to reduce incidence of illness (Stanton et al., 2013). Body weight of calves on arrival was 43.3 ± 5.5 kg. At the research farm, calves were managed under the standard operating procedures of the research center, in accordance with the guidelines set by the Canadian Council on Animal Care (CCAC, 2009) and as approved by the University of Guelph Animal Care Committee (AUP# 1913). The day of arrival at the research farm marked d 0 of the study. Each new day of the trial began when fresh milk was delivered (0900 h).

Calves were randomly assigned to a treatment group upon arrival at the research farm: 10 calves were housed in pairs, whereas the other 10 calves were housed individually until after milk weaning (d 50), at which time they were switched to pair housing. Calves in each pair arrived at the farm on the same day and were paired, at random (if more than 2 calves arrived at the same