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Pair housing and enhanced milk allowance increase play behavior and improve performance in dairy calves

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ABSTRACT

To investigate the effects of social housing and milk feeding on play behavior and performance, 48 Holstein-Friesian male and female calves were either individually or pair housed in straw-bedded pens (3.0 m × 4.5 m). Half of the calves in each housing treatment were fed a standard milk allowance (5 L/d from d 3 to 42); the other calves were fed an enhanced milk allowance (9 L/d from d 3 to 28 and 5 L/d from d 29 to 42). All calves were abruptly weaned on d 43. Play behavior was recorded for 48 h beginning on d 15, 29, and 43. Variables were square root–transformed before analysis, but back-transformed values are given. On d 15 the duration of locomotor play behavior was greater among enhanced- than standard-fed calves [15.2 vs. 10.8 (±1.0) corresponding to 231 vs. 117 s/24 h]; this behavior decreased when milk allowance in the enhanced treatment was reduced on d 29. Across ages, the duration of locomotor play behavior was greater among individually housed than pair-housed calves [10.9 vs. 8.2 (±0.6) corresponding to 119 vs. 67 s/24 h], but the total duration of play did not differ between individual and pair-housed calves [130 (45–295) s/24 h; median and interquartile range]. Only pair-housed calves could perform social play behavior (play fighting), and the duration of this was greater on d 15 and 29 than on d 43 [8.3, 10.7 and 3.5 (±1.3) corresponding to 69, 115 and 12 s/24 h for d 15, 29, and 43]. Among calves on enhanced milk, pair-housed animals had a greater concentrate intake than individually housed calves (840 vs. 530 ± 110 g/d); for calves on standard milk, we detected no effect of housing [990 and 1,090 (±110) g/d]. Among calves on enhanced milk, pair-housed calves had greater body weight gain than individually housed calves [990 vs. 850 (±40) g/d]. For calves on standard milk, we observed no effect of pair versus individual housing [810 and 840 (±40) g/d]. In conclusion, greater durations of play behavior in enhanced-fed calves suggest an animal welfare benefit of this feeding method. Enhanced-fed calves consumed less concentrate, but pair housing stimulated concentrate intake in these calves, suggesting that pair housing and enhanced feeding should be used together.
Key words: welfare, group housing, milk feeding, play behavior, performance

INTRODUCTION

During the first weeks of life, dairy calves are typically kept in individual housing and fed limited quantities of milk. Recent research has begun to question these practices. For example, when calves are housed in pairs or small groups, they perform more social behaviors (Duve and Jensen, 2012) and form social bonds (Færevik et al., 2006; Raussi et al., 2010; Duve and Jensen, 2011). Socially housed calves also vocalize less than individually housed calves when they are weaned (De Paula Vieira et al., 2010) and struggle less when subjected to handling and blood sampling (Duve et al., 2012), suggesting that the presence of a peer provides a buffer during stressful management procedures.

There is also growing evidence that feeding more milk benefits calf welfare. Ad libitum whole-milk intakes of Holstein calves are 10 L/d or more (Appleby et al., 2001; Jasper and Weary, 2002). In contrast, calves offered the traditional allowance of approximately 5 L/d of whole milk (Thomas et al., 2001; De Paula Vieira et al., 2008) or replacer (Jensen and Holm, 2003; Nielsen et al., 2008) show behavioral signs of hunger such as unrewarded milk feeder visits and vocalization. Undernourishment and hunger adversely affect animal welfare and may prevent the animals from experiencing positive states (Špinka et al., 2001; Boissy et al., 2007). For instance, Krachun et al. (2010) found that the duration of locomotor play behavior in preweaned dairy calves was greater in calves fed 12 L/d of whole milk compared with calves fed 6 L/d and suggested that locomotor play behavior is a useful measure of how the welfare of calves is affected by feeding practices. Play behavior in dairy calves includes both social play and locomotor play. Locomotor play behavior consists

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of galloping with sudden change of direction, bucking, hind leg kicking, and body and head rotations and twists. The behavior includes elements of defense and flight but when performed as play, these elements are exaggerated, repeated, and more variable than during the corresponding functional behavior. Social play consists of interactions resembling those during aggressive interactions but when performed as play they do not result in flight or submission, and social play is typically interspersed with locomotor play and rotations of the head directed toward the play partner (Jensen et al., 1998). How feeding practices affect social play has not been investigated and it is unknown if both categories of play behavior are affected by energy intake and whether social housing results in more play regardless of milk allowance. The first aim of the present study was to investigate these 2 questions.

Young calves are unable to compensate for a low milk intake by increasing their concentrate intake during the first weeks of life (Khan et al., 2011) and although calves fed low quantities of milk ingest more concentrates, they have markedly lower nutrient intakes and BW daily gains compared with calves offered higher milk allowances (Jasper and Weary, 2002; Jensen, 2006; Khan et al., 2007). Eventually, all calves must make the transition from milk to solid feed, and weaning from milk causes less of a distress response and growth check if animals are well established on solid feed before the milk is withdrawn. De Paula Vieira et al. (2010) found that pair-housed calves had greater intakes of concentrates than individually housed calves before weaning, an effect likely due to social facilitation of feeding. Therefore, we might expect a larger effect of pair housing for the enhanced-fed calves. The second aim of the present study was to investigate the interactive effects of pair housing and enhanced milk feeding on concentrate intake and BW gain.

MATERIALS AND METHODS

The study took place at Aarhus University's cattle research facilities in Foulum, Denmark. Animals were cared for and treated according to a protocol approved by the Danish Animal Experiments Inspectorate, The Danish Ministry of Justice, Copenhagen, Denmark.

Animals and Treatments

Forty-eight Holstein-Friesian male and female calves were allocated to 8 blocks of 6 calves. In each block the 6 calves were allocated to 1 of 4 treatments: individually housed and fed a standard milk allowance (**IS**; 5 L/d from d 3 to 42; 1 calf/block); individually housed and fed an enhanced milk allowance (**IE**; 9 L/d from d 3 to 28 and 5 L/d from d 29 to 42; 1 calf/block); pair housed and fed the standard milk allowance (**PS**; 2 calves/block); or pair housed and fed the enhanced milk allowance (**PE**; 2 calves/block). The ratios of male to female calves in each treatment group were 6:2, 4:4, 7:9, and 7:9 for IS, IE, PS, and PE, respectively. The mean birth weight of the calves was 43.5 ± 5.7 kg (mean ± SD). The mean age difference of the calves within a block was 5 ± 2 d. To reduce disturbance in the barn, all management procedures (except colostrum feeding) were performed according to the age of the youngest calf in the block.

Housing

All calves were born in individual maternity pens in a calving facility less than 100 m from the calf barn. Individually housed calves and the youngest calves of a pair were moved to the calf barn within 6 to 8 h of birth, whereas the oldest calves of a pair (treatments PS and PE) were kept in an individual pen placed in a separate room in the calving facility until the youngest calf of the pair was born. All calves were moved to the calf barn in a cart; pair-housed calves were moved together, whereas individually housed calves were moved alone.

The straw-bedded pens (3.0 m × 4.5 m) in the calf barn had sides made of vertical metal bars. Adjacent pens were positioned 1.5 m apart, preventing physical contact between calves in different pens. Within the block, position of each treatment in the barn was randomized. All calves were fed 4 L of the dam's colostrum within 6 h of birth. Over the next 3 d, they were fed 3 L of fresh colostrum twice a day (0700 and 1500 h) from a colostrum pool, and from d 4 they were fed fresh whole milk. Calves on the standard allowance received 2.5 L of milk per feeding (i.e., 5 L/d) and calves on the enhanced allowance received 4.5 L of milk per feeding (i.e., 9 L/d) until the youngest calf in the block was 28 d old. From d 29, all calves received 2.5 L of milk per feeding until they were abruptly weaned off milk on d 43 (day of age referring to the age of youngest calf in the block). All milk feedings were offered in teat buckets (plastic buckets fitted with one teat; Peach Teat, Skellerup Industries Ltd., Christchurch, New Zealand). All buckets were individually marked and cleaned between feedings. Calves had free access to water, concentrate (18% CP, 4% fat, and 6% fiber; Gron Kalv Valset; DLG, Copenhagen, Denmark), and hay throughout the study. Fresh straw bedding was supplied on a regular basis and pens were cleaned out every 14 d. Artificial lights were on in the barn from 0600 to 2200 h and were dimmed throughout the night. The temperature and humidity fluctuated according to overall weather conditions (9.2 ± 4.6°C and 74.8 ± 7.0% relative humidity).