

Effects of Alternative Housing and Feeding Systems on the Behavior and Performance of Dairy Heifer Calves

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ABSTRACT

Most calves in the dairy industry are housed individually prior to weaning. However, this type of housing limits the calves' ability to display social behavior, which may impede development of normal social responses. Eighty-two female Holstein calves were allocated to treatments at 6 ± 3 d of age and monitored for approximately 9 wk. Treatments were as follows: individual housing fed with a bucket, individual housing fed with a bottle, paired housing fed with a bucket, or paired housing fed with a bottle. Two experimental sites were utilized. Calves were housed in hutches (non-tethered, wire pen) at Site 1 ($n=34$) and in wire-panel pens in a feed commodity shed at Site 2 ($n=48$). Calves allocated to the individual housing were placed in a single hutch at Site 1, whereas calves assigned to the paired treatment were housed by joining two adjacent hutches, with doubling of the pen size. Milk was fed via bucket or bottle twice daily (6 L/d). Calves had ad libitum access to calf-starter (same at both sites) and water. Gradual weaning commenced at wk 6 by reducing the calves' milk allowance by 2 L/wk. Calves were weaned at the beginning of wk 8. Grain consumption and body weight were monitored on a weekly basis and wither height measured at the beginning and end of the experiment. Behavior was directly observed once per week for all calves at Site 1. Total DM intake (grain and milk solids) was higher ($P = 0.04$) for calves housed in pairs compared to those housed individually (1.76 ± 0.03

versus 1.69 ± 0.03 kg/d). Average daily gain (ADG) was similar for location, housing treatment, and feeding treatment. Change in wither height was greater ($P < 0.01$) at Site 1 (13.5 ± 0.5 versus 9.5 ± 0.4 cm) than for Site 2 and for calves housed individually compared to those housed in pairs (12.2 ± 0.4 versus 10.8 ± 0.5 cm; $P = 0.03$). Calves fed with a bottle spent more time lying than calves fed with a bucket. In conclusion, housing young calves in pairs may enhance feed intake due to social facilitation.

INTRODUCTION

The way in which dairy calves are managed may significantly affect their welfare, behavior, and production performance both as calves and as mature cows. Most female dairy calves in the dairy industry are housed individually prior to weaning, with the housing methods ranging from hutches, corrals, or stalls. This type of calf housing management is used to avoid undesirable behaviors, such as cross-sucking and transmission of disease-causing bacteria. Preferences for housing calves individually may also stem from the idea that weight gain may increase under these conditions (Maatje et al., 1993). However, this type of housing limits the calves' ability to display social behavior, which may impede development of normal social responses. Individual housing is often preferred to minimize undesirable behaviors, such as cross-sucking (Chua et al., 2002). However, the bovine species under natural and semi natural conditions live in groups where complex behavioral hierarchies characterize them as social animals. Limiting their social behavior early as calves may alter their behavior and performance as mature cows. Group housing allows for social interactions, including play behaviors (Jensen et al., 1997). Group housing could also lead to calves that are less stressed with lower cortisol concentrations than calves that are housed individually (Friend et al., 1985). However, dairy producers are often

reluctant to switch to group housing because of the possible financial implications as well as an increased level of bacterial contamination, potentially leading to a deleterious effect on calf health. In this study, paired housing is used to maximize the positive effects of social interaction and limit the instance of bacterial transfer. Managing calves in pairs may allow them to develop socially as they interact with one another (Chua et al., 2002). Paired housing may serve as an attractive alternative to large group housing because it can be implemented with little or no cost to the producer, it may limit the risks of disease transmission, and reduce the competition for resources among calves.

An important consideration of paired housing is that calves have an increased chance to cross-suckle with each other. Suckling is an innate response in young calves, and if it is not satisfied through drinking, calves will begin to suckle on other items or each other (Jensen and Budde, 2006). This cross-sucking can be the main contributing factor to disease transmission because of mouth-to-mouth contact of the calves. Previous studies have indicated that if calves are fed with a bottle instead of a bucket, these undesirable behaviors may be reduced (Jensen and Budde, 2006; De Paula Vieira et al., 2010,). Therefore, allowing calves to suckle on a nipple rather than drink milk from a bucket may reduce the incident of cross-suckling, which may decrease bacterial contamination.

The aim of the present study was to compare the performance, behavior, and health of calves housed individually and calves housed in pairs, with calves either fed using a bottle or a bucket.

MATERIALS AND METHODS

This study was conducted at Twin Oak Dairy, LLC located in South Solon, Ohio, approximately 40 miles away from the Ohio State University. Eighty-two female Holstein calves were allocated to treatments at 6 ± 3 d of age and monitored for approximately 9 wk. Treatments were as follows: individual housing fed with a bucket, individual housing fed with a bottle, paired housing fed with a bucket, or paired housing fed with a bottle. Two experimental sites were utilized. Calves were housed in hutches (non-tethered, wire pen) at Site 1 (n = 34) and in wire-panel pens in a feed commodity shed at Site 2 (n = 48). Calves allocated to the individual housing were placed in a single hutch at Site 1, whereas calves assigned to the paired treatment were housed by joining two adjacent hutches with doubling of the pen size (Figure 1). Calves were separated from their dams and fed colostrum within 12 h of birth.

Feed

Pasteurized whole milk was fed via bucket or bottle, twice a day at 6 L/d. The calves were fed at approximately 700 and 1700 h. The composition of the milk on average was 3.99% fat, 3.41% protein, 914,050 somatic cell count per milliliter, 4.60% lactose, 5.49% other solids and 9.69 mg/dl of milk urea nitrogen. All calves had ad libitum access to water and a calf-starter, which averaged 95.7% dry matter and 21.1% crude protein. Gradual weaning commenced at wk 6 by reducing the calves' milk allowance by 2 L/wk and calves were weaned at the beginning of wk 8.

Performance measurements

Grain consumption was monitored on a weekly basis by weighing of refusals. Grain was saved in a separate container and weighed weekly. Calves were weighed weekly, and wither height was

measured at the beginning and end of the experiment using a wither height stick. Data was analyzed using the MIXED model procedure of SAS (2004).

Behavioral measurements

Behavior was directly observed once per week for all calves at Site 1 by direct observations using both scans and continuous sampling methods for 9 wk. Observations occurred both in the morning and in the afternoon approximately 700 and 1750 h. Scan sampling occurred first as observers walked down their designate row of calves and recorded the calves behavior for that second. Observers returned to the beginning of their group of calves and continuously watched and recorded each calf for one minute. The observer recorded a “0” if the calf was not exhibiting that behavior and a “1” if the calf was exhibiting the behavior. Behavior categories observed were: posture, interacting with objects in pen (IO), self- and allogrooming, play, starter interaction, water interaction, milk interaction, social, cross-sucking, and other. Data was analyzed using the MIXED model procedure of SAS (2004).

RESULTS AND DISCUSSION

Performance

Total DM intake (grain and milk solids) was higher ($P < 0.05$) for calves housed in pairs (1.76 ± 0.03 kg/d) compared to those housed individually (1.69 ± 0.03 kg/d; Table 1). Calves housed at Site 2 had higher ($P < 0.05$) feed intake (1.48 ± 0.03 kg/d) compared to Site 1 (1.97 ± 0.03 kg/d). Although not significant, average daily gain (ADG) was numerically higher for calves housed at Site 1 compared to those housed at Site 2 (0.71 ± 0.03 versus 0.64 ± 0.02 kg/d,

respectively). Intake and ADG of calves fed with a bottle was similar to those fed with a bucket. Change in wither height was greater at Site 1 compared to calves housed at Site 2 (at 13.5 ± 0.5 versus 9.5 ± 0.4 cm/d, respectively).

Behavior

Behavioral results revealed that calves spent significantly more time lying and less time standing and walking in the afternoon than in the morning (Table 2). For example, lying time increased ($P < 0.05$) in the afternoons ($72.9\% \pm 0.02$) compared to the mornings ($21.2\% \pm 0.02$). Also, calves that were fed with a bottle spent more ($P < 0.05$) time lying than calves fed with a bucket. For example, lying time increased to $50.2\% \pm 0.02$ in the afternoons compared to the $43.9\% \pm 0.02$ of the time was spent lying in the mornings. When fed with a bottle, calves spent more ($P < 0.05$) time engaged in play behavior than when fed with a bucket (1.40 ± 0.01 versus $0.600\% \pm 0.01$, respectively). Interacting with nonnutritive objects in the pen was decreased ($P < 0.05$) in calves housed individually ($6.60\% \pm 0.02$) compared to those calves housed in pairs ($9.80\% \pm 0.01$). No significant differences between feeding treatments were observed for cross-sucking. For instance, calves fed with a bottle spent $32.7\% \pm 0.8$ cross-sucking compared to calves fed with buckets at $67.3\% \pm 0.8$. There were no significant differences in allogrooming behavior for calves fed with buckets compared to those fed with bottles. Social behavior was similar for calves fed with a bucket versus a bottle (46.8 ± 1.0 vs. $56.2\% \pm 1.0$).

Data presented here are only from Site 1. Site 2 data are currently being compiled and may or may not alter the behavior results.

SUMMARY

Behavior results revealed that calves fed with a bottle spent more time lying than calves fed with a bucket. This may indicate that bottle-fed calves have a higher level of satiety as per the nipple on the bottle. A higher level of satiety may have been reached because the calf's natural suckling desire having been satisfied, resulting in a more content calf. However, our hypothesis was that cross-suckling may have been minimized because of an increased level of satiety, but the data revealed no significant difference in cross-suckling between the feeding treatments. There were no significant differences between feeding treatments on DMI. Performance results revealed that calves housed in pairs had higher ADG than did the calves housed individually. This indicates that housing calves in pairs may enhance feed intake due to social facilitation.

In modern production systems, dairy cattle are housed in groups, and it is because of their natural complex dominance hierarchies within groups that producers should facilitate social interactions as calves. Certain social interactions may need to take place in order for the animal to experience smooth transitions as they move through multiple housing groups in their lifetime. Early social contact has been shown to facilitate normal social responses and decrease the amount of agonistic behavior (Veissier et al., 1994, 1997; Jensen et al., 1997). These results in this study would suggest that housing young heifer calves in pairs allows for social interactions without being detrimental to their performance.

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Table 1. Mean (\pm SEM) dry matter intake (DMI), average daily gain (ADG), and change in wither height (cWH) for calves fed differently and housed at two locations.

	LOCATION		HOUSING TREATMENT		FEEDING TREATMENT	
	Site 1	Site 2	Singles	Pairs	Buckets	Bottles
Milk DMI (kg/d)	0.58 \pm 0.01 ^a	0.68 \pm 0.01 ^b	0.63 \pm 0.01	0.63 \pm 0.01	0.61 \pm 0.01 ^a	0.65 \pm 0.01 ^b
Grain DMI (kg/d)	0.86 \pm 0.03 ^a	1.46 \pm 0.02 ^b	1.10 \pm 0.03 ^a	1.22 \pm 0.03 ^b	1.14 \pm 0.03	1.18 \pm 0.03
Total DMI (kg/d)	1.48 \pm 0.03 ^a	1.97 \pm 0.03 ^b	1.69 \pm 0.03 ^a	1.76 \pm 0.03 ^b	1.70 \pm 0.03	1.75 \pm 0.03
ADG (kg/d)	0.71 \pm 0.03	0.64 \pm 0.02	0.65 \pm 0.03	0.70 \pm 0.03	0.64 \pm 0.03	0.71 \pm 0.03
cWH (cm)	13.5 \pm 0.5 ^a	9.50 \pm 0.4 ^b	12.2 \pm 0.4 ^a	10.8 \pm 0.5 ^b	11.8 \pm 0.5	11.2 \pm 0.4
^{ab} Means within a location, housing treatment, or feeding treatment are different($P < 0.05$).						

Table 2. Mean (\pm SEM) percentage of the time calves at Site 1 spent engaged in each of the behaviors measured.

	TIME OF DAY		HOUSING TREATMENT		FEEDING TREATMENT	
	AM	PM	Singles	Pairs	Bucket	Bottle
Lying	21.2 \pm 0.02 ^a	72.9 \pm 0.02 ^b	47.9 \pm 0.02	46.3 \pm 0.02	43.9 \pm 0.02 ^a	50.2 \pm 0.02 ^b
Standing	73.7 \pm 0.02 ^a	25.7 \pm 0.02 ^b	50.6 \pm 0.02	48.8 \pm 0.02	52.5 \pm 0.02	46.9 \pm 0.02
Walking	5.00 \pm 0.01 ^a	0.60 \pm 0.01 ^b	2.10 \pm 0.01	3.50 \pm 0.01	3.00 \pm 0.01	2.60 \pm 0.01
Interacting objects	10.9 \pm 0.01 ^a	6.00 \pm 0.01 ^b	9.80 \pm 0.01 ^a	6.60 \pm 0.02 ^b	8.80 \pm 0.02	7.70 \pm 0.01
Self grooming	3.70 \pm 0.01	2.50 \pm 0.01	3.90 \pm 0.01	2.20 \pm 0.01	2.90 \pm 0.01	3.20 \pm 0.01
Play behavior	1.50 \pm 0.01 ^a	0.50 \pm 0.01 ^b	1.10 \pm 0.01	0.900 \pm 0.01	0.600 \pm 0.01 ^a	1.40 \pm 0.01 ^b
Starter interaction	5.20 \pm 0.01	3.40 \pm 0.01	4.20 \pm 0.01	4.40 \pm 0.01	4.00 \pm 0.01	4.60 \pm 0.01
Water interaction	1.00 \pm 0.01	1.40 \pm 0.01	0.100 \pm 0.01	1.50 \pm 0.01	1.50 \pm 0.01	1.00 \pm 0.01
Milk interaction	–	–	5.20 \pm 0.01	5.20 \pm 0.01	4.00 \pm 0.01 ^a	6.40 \pm 0.01 ^b
Lying in same hutch	–	–	–	–	31.2 \pm 0.2	68.8 \pm 0.2
Cross-sucking	–	–	–	–	67.3 \pm 0.8	32.7 \pm 0.8
Allogrooming	–	–	–	–	43.5 \pm 0.9	56.5 \pm 0.9
Social behavior	–	–	–	–	46.8 \pm 1.0	56.21 \pm 1.0

^{ab}Means within time of day, housing treatment, or feeding treatment are different ($P < 0.05$).

Figure 1. Experimental set-up of calf hutches at Site 1. Each treatment group consisted of two individually housed calves and one set of calves housed in pair.

