Effect of a trainer cow on health, behavior, and performance of newly weaned beef calves[1,2]

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ABSTRACT: Experiments were conducted to investigate the effects of the presence of a trainer cow on behavior, performance, health, and feeding patterns of newly weaned beef calves. In Exp. 1, 252 weaned calves (270 ± 18 kg) were allocated to 22 pens (11 to 15 calves per pen). A trainer cow was randomly assigned to each of 11 pens. Calves were weighed prior to feeding on d 0, 3, 7, 14, 21, and 28. Rectal temperatures were taken on each of these days (except d 28) and blood samples were collected on d 0, 3, and 7 and subsequently analyzed for serum haptoglobin and leukotoxin antibody titers. Instantaneous scan observations of calf behavior were made at 10-min intervals between 0730 and 1730 on d 1, 2, 4, 5, and 6. A similar protocol was used in Exp. 2, in which 297 calves (258 ± 17 kg) were allocated to 24 pens. Blood analyses included haptoglobin, white blood cell counts (WBC), and neutrophil:lymphocyte (NL) ratios. In Exp. 3, the above protocol was followed and patterns of feed bunk attendance of individual calves were also monitored using radio frequency identification by passive transponder ear tags. Trainer cows did not influence ($P > .10$) calf rectal temperatures, requirements for antibiotic therapy, WBC, NL ratios, or leukotoxin antibody titers. Pooled across treatments, NL ratios were lower ($P < .01$) on d 0 (.31) than on d 3 (.36) or d 7 (.39). Although differences in weight gain were detected in some periods within the three experiments, there were no differences ($P > .10$) overall (d 0 to 28). Trainer cows did not affect ($P > .05$) frequency or duration of bunk visits by the calves. Averaged across treatments, frequency and duration of bunk visits increased ($P < .001$) from 9.6 visits/d and 56.7 min/d between d 0 and 3 to 12.3 visits/d and 108.9 min/d between d 15 and 21. The number of calves observed eating during scan sampling observations also increased from 16.4% on d 1 to 25% on d 4 ($P < .10$) and 29% on d 5 and 6 ($P < .05$). More ($P < .05$) calves were observed lying on d 1 (41.7%) and d 2 (45.3%) than on d 4 (37.5%), d 5 (34.8%), or d 6 (36.2%). With a trainer cow present, fewer (36.7% vs 41.5%; $P < .001$) calves were observed lying and more (11.7% vs 10.2%; $P = .08$) were observed walking than when no cow was present. Trainer cows did not improve calf health, time spent at the feed bunk, or performance of newly weaned calves.

Key Words: Beef, Feeding Behavior, Feedlots, Health, Performance

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Introduction

In recently weaned and transported calves, low feed intake is common and may persist for up to 2 wk (Cole and Hutcheson, 1988; Fluharty et al., 1994). This low feed intake is due in part to the calves' unfamiliarity with feed and water location as well as apprehension associated with the novelty of relocation. In addition, stress-induced immunosuppression (Kelley, 1980; Griffin, 1989) has been implicated as a primary factor in respiratory disease of feedlot cattle following weaning, mixing, and transport (Andrews, 1976; Ribble et al., 1994).

Feeding behavior is strongly influenced by social facilitation and learning from conspecifics (Ralphs and Provenza, 1999). Prior to weaning, calves are in continual contact with their dams, who provide protection and lead them to forage and water (Fraser and Broom, 1990). However, when newly weaned calves are

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grouped together in a feedlot, they are placed in a novel environment where both the location of feed and water are foreign and contact with an adult leader no longer exists. By modeling feeding techniques, a mature cow accustomed to the feedlot pen may facilitate newly weaned calves' finding the feed and water and reduce apprehensions associated with novel sources of feed and water. Previous studies have indicated that the presence of an adult improves performance and well-being of newly weaned elk (Pollard et al., 1992; Haigh et al., 1996) and cattle (Loerch and Fluharty, 2000).

The objective of the present experiments was to determine the impact of a "trainer" cow on the performance, health, feed intake, and behavior of recently weaned feedlot calves.

Materials and Methods

Experiment 1

Animals, Diet, and Feeding. In late October 1996, 252 Charolais-cross and Hereford steer calves (270 ± 18 kg) were obtained from a local auction market and transported to the Beef Research Unit of the University of Saskatchewan at Saskatoon. The steers arrived at the feedlot in four discrete groups over a 1-wk period. Date of arrival at the feedlot was considered as d 0 for each group.

Upon arrival (d 0), calves were ear-tagged and injected with modified-live IBR-PI_3 vaccine (SmithKline Beecham, Mississauga, ON), a killed *Clostridium* vaccine (Tasvax 8, Mallinckrodt Veterinary, Ajax, ON), and 30 mL of ivermectin (Ivomec, Merck Agvet, Kirkland, QC). Calves were blocked by breed and randomly allotted to one of two treatments: 1) housed with a pregnant "trainer" cow (**Trainer**; 126 calves), or 2) housed with no cow in the pen (**Control**; 126 calves). Within each treatment, calves were randomly assigned to 11 pens, so that each pen housed 11 to 15 animals. Straw bedding was provided in all pens prior to arrival of calves. Pen and bunk design allowed 322 m^2 and 7.4 m of pen space and linear bunk space, respectively, per pen. The trainer cows were placed in the feedlot approximately 7 d prior to the start of the experiment to allow them to adapt to the feedlot pen and silage-based diet, but they had no contact with the calves prior to the experiment. The Trainer pens were not visible to calves in the Control pens. Cows were removed from the pens on d 14.

Cattle were fed once a day at approximately 0900. On the day of arrival, cattle had ad libitum access to unprocessed crested wheat grass hay. On d 2, cattle were again given ad libitum access to unprocessed crested wheat grass hay and a starter ration (4.54 kg/animal). The starter ration consisted of 33.6% barley-based concentrate, 32.6% processed crested wheat grass hay, and 33.8% barley silage (DM basis). The barley-based concentrate consisted of 85% rolled barley, 9.5% canola meal, 2% tallow, and 3.5% mineral/vitamin supplement. On d 3, the starter ration was increased to 6.8 kg/animal. On d 4, the wheat grass hay was removed and cattle were given ad libitum access to the starter ration from d 4 through 14. The diet was formulated to provide 1.44 Mcal NE_m/kg, 13% CP, and minimum recommended levels (NRC, 1996) of minerals and vitamins. A diet comprising 37.6% barley-based concentrate, 18.4% chopped barley straw, and 44.1% barley silage (DM basis) was fed from d 15 to 28, also in quantities to meet ad libitum consumption. This diet was formulated to provide 1.49 Mcal NE_m/kg, 12.5% CP, and minimum recommended levels (NRC, 1996) of minerals and vitamins. Dry matter contents of diet ingredients were determined by oven drying for 24 h at 55°C prior to the trial.

Weight Gain, Rectal Temperature, and Antibiotic Treatment Rates. Steers were weighed individually (prior to feed delivery) on d 0, 3, 7, 14, 21, and 28. Rectal temperatures were taken with a digital thermometer (Model M216, GLA Agricultural Electronics, San Luis Obispo, CA) on all weigh days except d 28. Steers with rectal temperature ≥ 40.5°C on weigh days or appearing to be ill were treated with antibiotics. Febrile animals were treated initially with a subcutaneous injection of Micotil (1.5 mL per 45.5 kg BW; Provel - Eli Lilly, London, ON). If after 24 h rectal temperature was ≤ 40.5°C, treatment was discontinued; otherwise, Trivetrin (3.0 mL per 45.5 kg BW; Mallinckrodt Veterinary) was administered i.m. If rectal temperature remained elevated beyond 40.5°C on the 3rd d, calves were given an i.m. injection of Liquamycin LA (4.5 mL per 45.5 kg BW; Rogar/STB, Calgary, AB). If rectal temperature was ≤ 40.5°C, treatment was discontinued.

Blood samples were collected via jugular venipuncture from all calves on d 0, 3, 7, and 21. Serum leukotoxin antibody titers were determined by ELISA (Harland et al., 1992) in samples collected on d 0 and d 21. Serum haptoglobin concentrations were determined in samples collected on d 0, 3, and 7 with a monoclonal-antibody-based capture immunoassay (Godson et al., 1996).

Behavior. An instantaneous scan sampling technique (Lehner, 1979) was used to record calf behavior. Observations were made at 10-min intervals from 0730 to 1730 on d 1, 2, 4, 5, and 6. Behavior of each calf was classified as walking, lying, standing, or feeding, and percentages of calves engaging in each of these behaviors were calculated.

Experiment 2

Animals, Diet, Feeding, and Behavior. In early October 1997, 297 Charolais-cross, Hereford, and Angus steer calves (258 ± 17 kg) were purchased, processed, vaccinated, fed, and bedded in a manner similar to that described for calves in Exp. 1. Calves were delivered in four separate groups over a 1-wk period to the same feedlot as was used in Exp. 1 and were randomly allocated to 24 separate pens (11 to 14 steers per pen) designated Trainer (148 calves, n = 12) or Control (149 calves, n = 12). Calves were fed once daily, commencing at 0900. On the day of arrival (d 0), cattle had ad libitum access to a starter ration consisting of 27% barley-based concentrate, 35.1% brome grass hay, and 37.9% barley silage (DM basis). The barley-based concentrate consisted of 60% rolled barley, 34% canola meal, 2% tallow, and 4% mineral/vitamin supplement. This diet was formulated to provide 1.44 Mcal NE_m and 13% CP and was provided for ad libitum consumption throughout the experiment.

As in Exp. 1, trainer cows were placed in the Trainer pens 1 wk prior to the start of the experiment to allow adaptation to surroundings and diet. Calf behavior was monitored using instantaneous scan sampling as described for Exp. 1.

Weight Gain, Rectal Temperature, and Antibiotic Treatment Rates. Body weights and rectal temperatures were recorded and blood samples were collected as described in Exp. 1. The same protocol for antibiotic therapy was also followed. White blood cell counts were determined using a Coulter S + 4 automated counter (Hialeah, FL). Neutrophil:lymphocyte ratios were determined by light microscopy and differential count. Serum haptoglobin concentrations were quantified as described by Godson et al. (1996).

Feed Intake. Feed intake was determined for each pen for each interval between weigh days (d 0, 3, 7, 14, 21, and 28) based on total feed delivered less the orts measured before feeding on each weigh day. Diet DM content was determined as described in Exp. 1. For DMI calculations, orts were assumed to have the same DM content as delivered feed. Feed intake by cows in the Trainer pens was not included in values calculated for the calves. The cows were fed individually for 14 d following their removal from the calf pens. Their ad libitum intake of the experimental diet was recorded for the last 7 d, and their average DMI was subtracted from the total feed consumed in the Trainer calf pens.

Experiment 3

Animals, Diet, and Feeding. Sixty recently weaned Charolais and Simmental-cross steer calves (269 ± 17 kg) were purchased from a local auction barn and fed for 28 d in four pens at the Agriculture and Agri-Food Canada Research Center at Lethbridge, AB. Straw bedding was provided in all pens prior to arrival of calves. Mature, nonpregnant cows (one per pen) were placed in two of the pens (Trainer), which were visually separated by a plywood partition from the two neighboring Control pens. On d 0, the calves were branded, dehorned as required, and vaccinated using modified-live IBR-PI_3 (SmithKline Beecham) and *Haemophilus somnus* (Resvac 2/Somnubac, Pfizer Animal Health, London, ON), as well as a killed *Clostridium* vaccine (Tasvax 8, Mallinckrodt). They were ear-tagged with two tags, one for visible identification and one (Allflex USA, Dallas-Ft. Worth, TX) bearing a passive transponder for electronic identification. The steers were sorted to ensure that approximately equal weights and numbers of dehorned calves were allotted to Trainer (15 calves/pen) and Control (15 calves/pen) treatments. Body weight was measured on d 0, 3, 7, 14, 21, and 28 and blood samples collected on d 0, 3, and 7 for white blood cell counts and blood differentials as described for Exp. 2.

Calves were initially fed a diet consisting of (on a DM basis) 53.9% steam-rolled barley, 25.2% alfalfa hay, 15.0% barley silage, and 5.9% mineral/vitamin supplement that contained 500 mg of rumensin/kg of supplement. As intake increased over the first 11 d of the experiment, the barley, hay, and supplement were incrementally reduced over three rations and replaced with barley silage, yielding a growing diet containing 45% barley, 50% silage, and 5% supplement. The diet was formulated to provide 1.74 Mcal NE_m/kg and 12.2% CP. Feed was provided at quantities to minimize, but not eliminate, orts. Diet ingredients sampled on d 0, 10, 20, and 28 were dried to constant weight at 55°C for determination of DM content. Orts were also weighed on d 10, 20, and 28 for calculation of average feed intake during three periods: d 0 to 10, d 11 to 20, and d 21 to 28. As in Exp. 2, DM content of orts was considered to be equal that of delivered feed. Feed intake by the cows was not determined separately for subtraction from pen intake; thus, average intakes for Trainer pens include intake by cows. Pen space and linear bunk space were 15.2 m^2 and 82 cm per animal, respectively.

Feed bunk attendance patterns of calves in all four pens were monitored using radio frequency technology (GrowSafe Systems Ltd., Airdrie, AB) as described by Gibb et al. (1998) and Schwartzkopf-Genswein et al. (1999).

Statistical Analysis

All statistical analyses were conducted using the SAS (1990) program. Nonsignificant variables ($P > .10$) were removed from statistical models when statistical sensitivity was increased by doing so. Dependent variables of interest are presented for each experiment. However, where trial × treatment interactions were not significant, pooled values are also presented and discussion is limited to treatment effects.

Rectal temperatures, white blood cell counts, neutrophil:lymphocyte ratios, haptoglobin levels, antibody titers, ADG, feed intake, and antibiotic treatment rates were analyzed by pen with the residual error used as the error term. The GLM procedure was used to evaluate the effects of treatment, experiment, breed type (Exp. 1 and 2), group in which the calves arrived at the feedlot (Exp. 1 and 2), and the interactions between these variables. Blood measurements (white blood cell counts, neutrophil:lymphocyte ratios) and rectal temperature were analyzed as a split plot in time because sphericity tests (SAS, 1990) were not significant ($P > .05$).

Table 1. Average daily gain (kg/d ± SE) of feedlot calves housed with or without a mature cow

Period of calculation	Experiment 1 (11 pens per treatment)		Experiment 2 (12 pens per treatment)		Experiment 3 (2 pens per treatment)		Pooled across experiments (25 pens per treatment)	
	Control	Trainer cow present	Control	Trainer cow present	Control	Trainer cow present	Control	Trainer cow present
Days 0 to 3	1.94 ± .28[b]	.89 ± .28[a]	.92 ± .34	.21 ± .34	.85 ± .96[a]	–1.91 ± .96[b]	1.23 ± .35[a]	–.27 ± .35[b]
Days 0 to 7	.93 ± .18	.99 ± .18	1.24 ± .22	1.34 ± .22	.27 ± .61	–.56 ± .61	.81 ± .22	.59 ± .22
Days 0 to 14	1.04 ± .12[b]	1.36 ± .12[a]	1.20 ± .14	1.52 ± .14	1.19 ± .39	1.28 ± .39	1.14 ± .14	1.39 ± .14
Days 0 to 21	1.22 ± .08	1.40 ± .08	1.36 ± .09	1.41 ± .09	1.17 ± .26	1.01 ± .26	1.26 ± .09	1.28 ± .09
Days 0 to 28	1.21 ± .06	1.30 ± .06	1.31 ± .08	1.45 ± .08	1.00 ± .21	.93 ± .21	1.17 ± .08	1.22 ± .08

[a,b]Within an experiment and row, means with different superscripts differ ($P < .05$).

Percentages of calves observed standing, walking, lying, and feeding were averaged by day for each pen. Pen averages were analyzed using the GLM procedure with the residual error used to test effects due to treatment, experiment, day, and their interactions.

Frequency and duration of bunk visits monitored in Exp. 3 were averaged by calf across days for each period between weigh days and through the whole experiment. Average values were analyzed using calf as the experimental unit with animal × pen × treatment used as the error term to test treatment effects. The effects of treatment, period, animal, and their interactions were evaluated using the GLM procedure. The number of whole-day bunk absences (calves not detected at the feed bunk for 24 h) were totaled over each period and compared between treatments using chi-square analysis.

Results and Discussion

Weight Gain

Interactive effects of experiment and treatment on weight gain (Table 1) were not observed ($P > .20$); thus, discussion will be limited to pooled results. Average daily gain over the first 3 d in the feedlot was negatively influenced by the presence of a trainer cow (–.27 kg/d vs 1.23 kg/d; $P < .001$). Differences in apparent gain over this short time period are strongly influenced by fill (Cole et al., 1982; Phillips et al., 1986). Thus, these data may indicate that Trainer calves were consuming less feed during the first 3 d of the experiment. Although treatment did not affect intake in any period measured in Exp. 2 (Table 2), it should be noted that the intakes reported are calculated estimates based on pen consumption minus the average daily intake of the respective cows fed individually following their removal from the pen. It is possible that the cows' intake during individual feeding may have differed from their intake in the interval immediately following introduction of the calves to the Trainer pens. Other researchers have reported both increased intake associated with group feeding (Coppock et al., 1972; Phipps et al., 1983) and decreased gains (and likely intake) by cows upon introduction of calves (Loerch and Fluharty, 2000). Due to the influence of fill over this short time period, gain by calves likely gives a better indication of intake than the value estimated using the cows' individual intakes. Consistently lower gains by Trainer calves at d 3 in all three experiments suggests that intakes were likely lower for Trainer calves than for Controls immediately following introduction to the feedlot. In the Trainer pens, the cows' maturity, size, and familiarity with the environment would have promoted a natural establishment of their dominance among their penmates (Sambraus, 1969); thus it is possible that their presence may actually have negatively affected intake and performance of calves until they were adapted to the new surroundings. Reduced performance of beef (Wagnon, 1965) and dairy (Krohn and Konggaard, 1979) heifers when fed with mature cows has been reported.

The increased ($P < .01$) weight gains for Trainer calves at d 14 in Exp. 1 1ikely reflects the compensation in intakes (Meyer and Clawson, 1964; Fox et al., 1972) that probably occurred following the first 3 d of the experiments. There were no other differences in ADG due to treatment found on any other weigh days.

Feed Intake

Comparing feed intake by Trainer and Control calves was difficult due to the presence of the mature cows in Trainer pens. Over the 28 d of Exp. 2, in which intake by calves was corrected for estimated intake by cows, no differences ($P = .48$) in average DMI between treatments were observed (6.4 vs 6.5 kg·calf^{-1}·d^{-1}; Table 2). In Exp. 3, DMI values included intake by cows, and still average intake by the Trainer group was numerically lower than DMI by the Control group (5.5 vs 5.1 kg·calf^{-1}·d^{-1}).

Pooled across treatments, DMI by calves in Exp. 2 increased from 1.1% of BW during the first 3 d to 2.6% of BW during the 4th wk. Most of this increase occurred between d 4 and 7, during which time intake averaged 6.2 kg·calf^{-1}·d^{-1}. Over the 28 d, intake was comparable to that observed in other research (Hutcheson and Cole, 1986; Phillips et al., 1987), but consumption by the calves in Exp. 2 increased more rapidly than has been reported previously for transit-stressed calves (Phillips et al., 1987). After documenting stress responses following weaning and subsequent shipping for 22 h, Phillips et al. (1986) proposed that stress arising from transit may be more severe than the stress of weaning. The calves used in the present experiment were purchased from auction markets located 1 to 5 h from the research facility, and thus the transit stress they experienced may have been relatively less severe, which could explain their more rapid increase in feed intake. Also, calves originating within the local area may have been exposed to feeds similar to those used in the experiments, which would help explain their rapid adaptation to the new diets.

Immune Function

To evaluate the effect of trainer cows on immune function and health, aspects of both the innate (antigen-nonspecific) and adaptive (antigen-specific) immune responses were monitored. It was expected that vaccination would induce some degree of innate response due to injection site reaction, as well as initiating an antigen-specific antibody response. Our objective was to determine whether the presence of the trainer cow, by affecting the level of stress experienced by the calves, would affect the magnitude of these responses.

Haptoglobin is an acute-phase protein in cattle; it is produced by the liver and increases in concentration in blood as part of the acute-phase response to injury or infection (Eckersall and Conner, 1988) but levels remain low in the absence of an immune challenge (Godson et al., 1996; Wittum et al., 1996). Haptoglobin levels increased ($P < .05$) on d 3 and 7 relative to d-0 levels. Because haptoglobin does not respond to stress alone (Alsemgeest et al., 1995), elevated levels on d 3 and 7 likely reflect the response to vaccination and other treatments at processing (Conner and Eckersall, 1988; Stokka et al., 1994). White blood cell counts were within normal ranges for beef cattle (Merck & Co., Inc., 1991; Table 3) and were unaffected by cow presence or the day blood was drawn. Variation attributed to the group within experiment variable was nonsignificant when analyzing white blood cell counts and neutrophil:lymphocyte ratios and was therefore removed from the statistical model. Treatment (cow presence) also did not affect neutrophil:lymphocyte ratios, but they tended ($P = .10$) to be higher on d 3 (.36) than on d 0 (.31) and were significantly higher ($P < .05$) on d 7 (.39) than on d 0. An increased neutrophil:lymphocyte ratio is characteristic of a mild inflammatory response. Granulopoiesis of stem cells can increase neutrophil numbers within 2 to 3 d following the stimulus, with a further increase due to increased stem cell output within 4 to 5 d (Duncan and Prasse, 1977). Alternatively, stress can also increase neutrophil:lymphocyte ratios; increased plasma cortisol levels following a stressful event can reduce neutrophil adhesion to blood vessel epithelial cells (Phillips et al., 1989), thereby increasing blood neutrophil concentrations and neutrophil:lymphocyte ratios.

Most of the changes that occurred in blood profiles on d 3 and d 7 can be explained by the vaccinations received on d 0. In addition, the antibody response to vaccination was not different between groups (Table 4), indicating that the presence of the trainer cow did not affect the innate or adaptive immune function of newly weaned calves.

Rectal temperatures and prevalence of treatment of fever were also used as indicators of the level of infectious disease, a potential outcome of impaired immune function. Breed within experiment did not significantly affect variability of rectal temperature and was therefore removed from the statistical model. There was no treatment effect in any single experiment or when pooled across experiments. There was no correlation (*P*

Table 2. Average dry matter intake (kg/d) by feedlot calves housed with or without a trainer cow

Item	Control (no trainer cow)	Trainer cow present
Experiment 2[a] (12 pens per treatment)		
Days 0 to 3	2.9[g]	3.2[f]
Days 4 to 7	6.4[e]	6.0[e]
Days 8 to 14	5.7[f]	6.2[e]
Days 15 to 21	7.0[d]	7.1[d]
Days 22 to 28	7.8[c]	7.8[c]
Overall (d 0 to 28)	6.4[e]	6.5[e]
SEM	.22	.22
Experiment 3[b] (2 pens per treatment)		
Days 0 to 10	3.5[e]	4.1[d]
Days 11 to 20	6.3[cdx]	4.8[dy]
Days 21 to 28	7.2[c]	6.5[c]
Overall (d 0 to 28)	5.5[d]	5.1[d]
SEM	.37	.37

[a]Average intake by trainer cows is excluded from calculations.
[b]Calculations include intake by trainer cows.
[c,d,e,f,g]Within an experiment and column (period effect), means with different superscripts differ ($P < .01$).
[x,y]Within a row (treatment effect), means with different superscripts differ ($P = .05$).

Table 3. White blood cell counts and neutrophil:lymphocyte ratios of feedlot calves housed with or without a trainer cow (TC)

	Day 0		Day 3		Day 7		
Item	Control	TC	Control	TC	Control	TC	SEM
White blood cell count							
Exp. 2 (n = 12)	9.4	9.2	10.0	9.8	9.2	9.3	.27
Exp. 3 (n = 2)	10.4	10.1	10.1	10.3	10.6	10.6	.67
Pooled values (n = 28)	9.8		10.1		9.9		.27
Neutrophil:lymphocyte ratio							
Exp. 2 (n = 12)	.34^{b}	.33^{ab}	.38^{ab}	.37^{ab}	.40^{ab}	.43^{a}	.03
Exp. 3 (n = 2)	.28	.21	.31	.31	.29	.34	.07
Pooled values (n = 28)	.31^{c}		.36^{b}		.39^{a}		.02

^{a,b,c}Within a row (period effect), means with different superscripts differ (P < .05).

= .21) between haptoglobin levels and rectal temperature detected in the present study, or in the study conducted by Wittum et al. (1996), but the highest average rectal temperature was also recorded on d 3 (39.6°; Table 4), possibly as a result of vaccinations on d 0. Elevated rectal temperature in calves during the week following feedlot arrival and vaccination has been observed by others (K. S. Schwartzkopf-Genswein, personal communication) and has been found to be correlated to haptoglobin levels (D. L. Godson, personal communication).

The lack of treatment effect on prevalence of antibiotic therapy (Table 5) or immune function profiles clearly indicates that under the conditions of the present experiment, a trainer cow does not improve the health of newly weaned calves.

Behavior

Observed calf behaviors were consistent by day within each treatment. Therefore, the treatment × day interaction was removed from the statistical model for testing treatment effects. Pooled across experiments, the percentages of calves observed standing or eating were similar between treatments (Table 6). An experiment × treatment interaction was observed for the percentage of calves recorded walking. This interaction is the result of more (P < .001) Trainer than Control calves observed walking in Exp. 2 than in Exp. 1 and 3.

Table 4. Haptoglobin concentrations, rectal temperatures, and leukotoxin antibody titers of feedlot calves housed with or without a trainer cow

	Day measured					
Item	0	3	7	14	21	SEM
Haptoglobin, mg/dL						
Exp. 1 (n = 11)						
Control	1.01^{c}	17.03^{a}	11.56^{b}	NM	NM	1.34
Trainer cow	.94^{c}	14.86^{a}	10.24^{b}	NM	NM	1.34
Exp. 2 (n = 12)						
Control	2.03^{c}	15.66^{a}	10.27^{b}	NM	NM	1.28
Trainer cow	1.28^{c}	14.75^{a}	7.80^{b}	NM	NM	1.28
Pooled values (n = 46)	1.3^{c}	15.6^{a}	9.9^{b}	NM	NM	.65
Rectal temperatures, °C						
Exp. 1 (n = 11)						
Control	39.3^{b}	39.5^{a}	39.2^{b}	38.7^{c}	38.7^{c}	.08
Trainer cow	39.2^{a}	39.5^{a}	39.3^{a}	38.6^{b}	38.6^{b}	.08
Exp. 2 (n = 12)						
Control	39.2^{b}	39.9^{a}	39.4^{ab}	39.3^{ab}	38.9^{c}	.08
Trainer cow	39.3^{b}	39.8^{a}	39.3^{b}	39.2^{b}	38.9^{c}	.08
Exp. 3 (n = 2)						
Control	38.4^{b}	38.9^{ab}	38.7^{ab}	39.0^{a}	39.1^{a}	.18
Trainer cow	38.5^{b}	38.6^{b}	39.0^{ab}	39.3^{a}	38.9^{ab}	.18
Pooled values (n = 50)	39.2^{b}	39.6^{a}	39.3^{b}	39.0^{c}	38.8^{c}	.05
Antibody titers, log^{4}						
Exp. 1 (n = 11)						
Control	4.72 ± .24^{b}	NM^{z}	NM	NM	8.26 ± .10^{a}	—
Trainer cow	4.89 ± .24^{b}	NM	NM	NM	8.11 ± .10^{a}	—

^{a,b,c}Within a row, means bearing unlike superscripts differ (P < .05). Significant treatment effects were not observed.

^{z}Not measured.

Table 5. Incidence (% of total population) of antibiotic treatment[a] among feedlot calves housed with or without a trainer cow

	Experiment 1 (11 pens per treatment)		Experiment 2 (12 pens per treatment)		Experiment 3 (2 pens per treatment)		Pooled across experiments (25 pens per treatment)	
Period	Control	Trainer cow present	Control	Trainer cow present	Control	Trainer cow present	Control	Trainer cow present
Day 0	5.9	4.5	5.7	7.6	0	0	3.9	4.1
Days 1 to 3	12.6	8.5	26.2	22.1	0	0	12.9	10.2
Days 4 to 7	16.4	21.7	9.5	6.2	3.3	0	9.7	9.3
Days 8 to 14	3.7	3.5	5.9	5.5	6.7	16.7	5.4	8.5
Days 15 to 21	0	.7	0	1.3	3.3	0	11.1	.7
Days 22 to 28	0	.7	0	0	0	0	0	.2
Days 0 to 28	36.5	35.8	42.1	39.4	13.3	16.7	30.7	30.6
SEM	2.7	2.7	2.6	2.6	6.3	6.3	2.4	2.4

[a]Calves were treated when rectal temperatures exceeded 40.5°C.

Fewer Trainer calves than Controls were observed lying (36.7% vs 41.5%; $P < .05$). Increased lying has been used as an indication of reduced stress in weaned animals (Haigh et al., 1996). It seems that Trainer calves may have exhibited more stress associated with the new environment than the Control calves. Whether or not increased hunger resulting from lower intakes contributed to the unsettled behavior of Trainer calves is unknown. Reduced time spent lying indicates increased activity, which would increase maintenance energy requirements. Hicks et al. (1989) reported that ADG increased by approximately 100 g/d for each 1% increase in time spent lying. The reduced ($P < .01$) weight gain for Trainer calves observed the first 3 d may reflect an increased energy expenditure and reduced intakes associated with unsettled behavior. Loss of weight in mature trainer animals during the 1st wk of calf introduction (Loerch and Fluharty, 2000) may also result from disrupted eating patterns.

Loerch and Fluharty (2000) monitored feeding behavior of newly weaned calves for up to 60 min following feed delivery. In that trial, calves with trainer cows were observed eating more frequently on d 1 and 2 and had numerically higher gains during the 1st wk of the experiment than control calves. Observations of increased feeding following feed delivery, along with improved performance, suggest that calves with trainer cows likely had higher intakes. In the current experiment, there was a trend toward a higher percentage of Trainer than of Control calves observed eating on d 1 and 2, but a numeric advantage in weight gain did not occur for Trainer calves until d 14. Elk calves allowed fence-line contact with dams after weaning were also observed to eat more often and had numerically greater weight gains (Haigh et al., 1996). These elk calves may have been more settled, as indicated by reduced pacing, running, and standing and increased lying. The positive effects of a mature animal on newly weaned calves may be more pronounced when the mature animal is a previous herdmate or even a dam separated from the calf by a fence.

The number of calves observed eating increased ($P < .01$) from an average of 17.4% on the first 2 d in the feedlot to an average of 27.6% on d 4, 5, and 6 (data not reported). The reduced lying ($P < .001$) observed on d 4, 5, and 6, when values were pooled across treatments (data not reported), is likely a reflection of the increased

Table 6. Standing, walking, and eating behaviors[a] of calves housed with or without a trainer cow

	Standing		Walking		Lying		Eating	
Day	Control	Trainer cow	Control	Trainer cow	Control	Trainer cow	Control	Trainer cow
1	29.6[c]	29.7[c]	11.3	12.5	43.7[c]	39.7	14.8[d]	18.0
2	24.4[d]	24.8[d]	10.9	10.7	46.9[c]	43.7	16.5[d]	20.4
4	24.9[d]	28.3[cd]	9.7	10.9	40.4[cy]	34.6[z]	23.9[cd]	26.2
5	26.7[cd]	28.9[c]	8.9[z]	12.6[y]	37.7[dy]	31.8[z]	33.8[c]	24.2
6	23.0[d]	24.1[d]	10.2	11.7	38.7[c]	33.8	27.1[cd]	30.3
SEM	1.4	1.4	1.2	1.2	2.0	2.1	4.7	4.7
Pooled[b]	25.7 ± .7	27.1 ± .7	10.2 ± .6	11.7 ± .6	41.5 ± 1.0[y]	36.7 ± 1.0[z]	23.2 ± 2.3	23.8 ± 2.3

[a]Expressed as the percentage of calves exhibiting the behavior at the time of observation. Values presented are least squares means of pen observations (n = 25) made at 10-min intervals from 0730 to 1700 on d 1, 2, 4, 5, and 6.
[b]Average values pooled across days.
[c,d]Within a column (day effect), means with different superscripts differ ($P < .05$).
[y,z]Within a row and behavior type (treatment effect), means with different superscripts differ ($P < .05$).

Table 7. Frequency and duration of feed bunk visits by newly weaned feedlot calves[a] housed with and without a trainer cow (Exp. 3)

	Frequency (visits/d)			Duration (min/d)		
Item	Control (no cow)	Trainer cow present	Pooled values[b]	Control (no cow)	Trainer cow present	Pooled values[b]
Days 0 to 3	9.1[d]	10.1[d]	9.6[d]	53.5[e]	59.9[f]	56.7[e]
Days 4 to 7	9.9[d]	9.1[d]	9.5[d]	97.1[d]	93.9[de]	95.5[d]
Days 8 to 14	12.2[c]	12.0[c]	12.1[c]	116.1[c]	115.8[c]	115.9[c]
Days 15 to 21	11.6[c]	13.0[c]	12.3[c]	109.1[cd]	108.7[cd]	108.9[c]
Days 22 to 28	9.9[d]	10.3[d]	10.1[d]	94.5[d]	80.5[e]	87.5[d]
SEM	.51	.53	.37	6.34	6.56	4.57

[a]n = 30.
[b]Pooled across treatment (n = 60).
[c,d,e,f]Within a column (period effect), means with different superscripts differ ($P < .05$).

eating observations and not an indication of stress status.

Natural weaning occurs as milk supply declines and as consumption of solid food by the calf increases with its age, and during this time agonistic encounters between calf and dam also increase (Matthews and Kilgour, 1980). Similar rebuttals of newly weaned calves by an unfamiliar cow would be expected. Agonistic behaviors between the cow and at least one Trainer calf were associated with 5.5%, 2.5%, and 8.3% of the observations in Exp. 1, 2, and 3, respectively. Also, calves mounting and grouping around cows were documented, which suggests that cow estrus may have been a source of distraction to the calves. The suppression of estrus in the cows used by Loerch and Fluharty (2000) should be considered when drawing comparisons between that study and the present experiment. It is unlikely that the effects of a trainer cow on adapting newly weaned calves to a novel environment are all positive.

In Exp. 3, the number of visits (frequency) to and time spent (duration) at the feed bunk were not influenced ($P > .3$) by the presence of a mature cow. Both frequency and duration differed ($P < .001$) between each of the weighing periods (Table 7). Frequency of bunk visits increased ($P < .001$) from 9.6 and 9.5 visits/d during d 0 to 3 and 4 to 7 to a high of 12.1 and 12.3 visits/d during the 2nd and 3rd wk, respectively. Duration of bunk visits followed a similar trend, increasing from 56.7 min/d during d 0 to 3 to a high of 115.9 min/d during d 8 to 14. Time spent at the bunk during d 4 to 7 (95.5 min/d) was similar ($P > .20$) to the time spent during the 4th wk of the experiment (87.5 min/d). Increased bunk attendance following the first 3 d in the feedlot is consistent with the trend of increased eating detected with visual observations.

Interpreting changes in bunk attendance over time is complicated by changes in ration composition. Calves were initially fed a 59.8% concentrate ration that contained 25.2% dry chopped hay in order to decrease the silage content and provide a feed that calves would find more palatable. Levels of hay in the diet were reduced to 20.3, 10.7, and 0% on d 3, 10, and 11, respectively, in response to increasing intakes. Reduced fibrousness (Balch, 1971), including reduced forage content (Putnam et al., 1964; Gill and Kaushal, 1987; Gibb et al., 1998), or replacement of hay with silage (Suzuki et al., 1969) can increase eating rates. The replacement of dry chopped hay with silage as intakes increased may explain the reduced time spent at the bunk during the last half of the experiment.

Twenty-four feed bunk absences (calf not coming to the bunk for a 24-h period) were observed during this study, all of which occurred during the first 10 d of arrival at the feedlot. All but two calves (both Controls) visited the feed bunk on d 0, and one of these visited the bunk on d 2. Absences were fewer ($P = .06$) among Trainer calves, but this difference was due to one calf in the Control group that did not come to the bunk until d 11 of the experiment. This calf did not appear sick, nor did its rectal temperature exceed 40.5°C on any of the weigh days. It is unlikely that this calf did not locate the feed bunk for 10 d, considering that all 14 penmates visited the bunk every day. However, the weight loss recorded on d 3, 7, and 14 with consistent daily visits recorded after d 10 suggests the absences are accurate. This calf lost 8 kg over the 28-d experiment. The only other weight loss recorded was for a Trainer calf that lost < 1 kg over 28 d.

One Trainer calf had four bunk absences between d 4 and 8. This animal appeared ill on d 8 and its rectal temperature was 40.8°C; thus, it was treated with antibiotics. One other Control calf was absent twice within the first 3 d. The remaining 10 absences were all attributed to different calves. Absences of up to 4 d for transport-stressed calves (Hutcheson and Cole, 1986) and 2 d for bulls feeding from pinpointer feeding systems (Universal Identification Systems, Cookeville, TN; Stricklin, 1987) have been observed, but we are unaware of cattle not feeding for periods as long as those observed in this study.

Apprehension over novel feeds, or feeds to which an aversion has been formed, can greatly reduce intake. Even during periods of drought and low food availability, sheep can decline eating an unfamiliar supplement to the point of causing undernutrition or even death (Chapple and Lynch, 1986). Feed aversions arising from

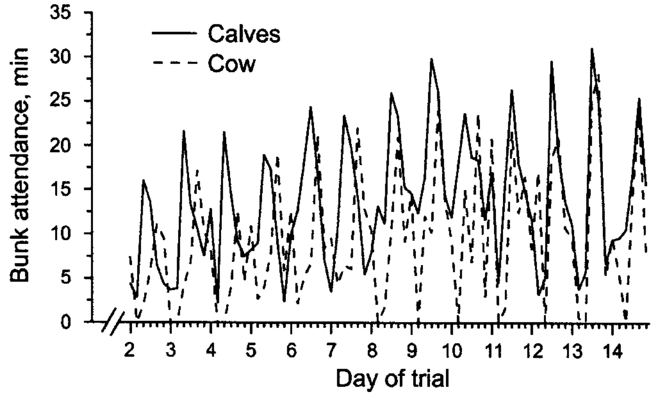

Figure 1. Average bunk attendance by 15 recently weaned calves penned with one trainer cow, from d 2 to d 14 (Exp. 3). Data are grouped in 4-h periods.

negative postingestive feedback (Provenza, 1995) result in reduced intake of the feed under study, and the reduction can be accentuated in an unfamiliar environment (Lubow et al., 1976). It is not known whether apprehension or feed aversion might explain the 10-d absence from the feed bunk exhibited by the steer in the present study. By coincidence, the 1st d that this steer came to the bunk was also the 1st d hay was not included in the diet. During the 10 d of non-attendance, the only feed to which the calf had access was the straw bedding that was provided the day before arrival. Low feed intake by recently weaned feedlot calves apparently arises not only from days of particularly low intake, but also from days of no intake by some calves.

Bunk attendance by 15 Trainer calves and their cow is grouped by 4-h intervals in Figure 1. Feeding patterns from d 1 were not included because calves were weighed, branded, and vaccinated during the first part of that day. Timing of bunk attendance initially differed considerably between the cow and the calves. Cattle offered ad libitum access to feed generally have biphasic feeding patterns, with primary bouts occurring in early to mid-morning and again in the late afternoon (Stricklin, 1987; Gibb et al., 1998). Although this pattern was demonstrated early in Exp. 3, the calves effected the majority of the morning feeding activity, and the cow the majority of the afternoon feeding activity. Gradually, calves and cows adopted similar feeding schedules, and by d 12 to 14 there was close synchrony in bunk attendance between calves and the cow. It seems that the calves may have avoided the cow at the feed bunk early in the experiment. This pattern further supports the theory that an unfamiliar trainer cow may represent an additional source of novelty (and potential stress) to which calves would have to adapt upon arrival in the feedlot.

Implications

The use of trainer cows in feedlots offered little advantage for improving health and performance of newly weaned calves. In this experiment, calves penned with a mature cow were observed lying less frequently and appeared initially to avoid the cow at the feed bunk. These patterns, along with reduced gain during the first 3 d in the feedlot, indicate that under some conditions a foreign cow may even be detrimental to getting calves settled in the new environment. Differences in social interactions resulting from differing pen sizes, stocking rates, and animal management strategies may in part explain differences in responses observed by different research teams, but they also caution against drawing widespread conclusions from individual studies.

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