Clinical trial to assess the impact of acclimation and low-stress cattle handling on bovine respiratory disease and performance during the feedyard finishing phase

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Abstract

Acclimation and low-stress cattle handling techniques (ALSCH) are promoted to improve cattle welfare. The purpose of this clinical trial was to evaluate the impact of ALSCH in relation to conventional handling (CON) on bovine respiratory disease (BRD) and performance of cattle during the feedlot phase of production. Abruptly weaned calves (n=136; 6 to 9 months of age) were transported to a research feedyard, and randomly enrolled into 4 pens—2 replicates of CON and 2 replicates of ALSCH. Conventionally handled calves were processed through a tub and curved alleyway facility without being acclimated. ALSCH calves were systematically acclimated to the feedyard environment and an open-sided "Bud-box" design working facility prior to processing. There were no differences in respiratory morbidity between treatment groups (P=0.34). From day 19 to day 95, ADG of CON calves was 2.70 lb (1.23 kg)/day versus 2.92 lb (1.33 kg)/day for ALSCH (P=0.01). Calves in CON pens tended to have a lighter mean hot carcass weight that was approximately 29 lb (13.2 kg) lighter than calves in the ALSCH pens (P=0.07). This clinical trial provides preliminary evidence that ALSCH may result in short-term performance benefits when applied to abruptly weaned calves in a feedyard setting, and provides background information for further scientific investigation.

Key words: welfare, low-stress handling, acclimation, BRD, performance, bovine

Résumé

L'acclimatation et des techniques de manipulation du bétail peu stressantes (AMBPS) sont mises de l'avant pour améliorer le bien-être du bétail. Le but de cet essai clinique était d'évaluer l'impact de l'AMBPS par rapport aux méthodes de manipulation traditionnelles (CON) sur le complexe respiratoire bovin (CRB) et la performance du bétail durant la phase de production dans le parc d'engraissement. Des veaux sevrés abruptement (n=136; 6 à 9 mois d'âge) ont été transportés dans un parc d'engraissement de recherche et distribués aléatoirement dans quatre enclos incluant deux enclos de type CON et deux enclos de type AMBPS. Les veaux manipulés traditionnellement passaient dans une installation avec un bac et une allée recourbée sans acclimatation. Les veaux AMBPS étaient tous acclimatés à l'environnement du parc et à une installation à ouverture latérale de type 'Bud-box' avant le traitement. Il n'y avait pas de différence entre les deux groupes pour la morbidité respiratoire (p=0.34). Entre les jours 19 et 95, le gain moyen quotidien des veaux du groupe CON était de 2.70 lb (1.23 kg)/jour par rapport à 2.92 lb (1.33 kg)/jour pour les veaux du groupe AMBPS (p=0.01). Il y avait une mince différence de 29 lb (13.2 kg) au niveau du poids de carcasse à chaud des veaux des enclos CON comparé à celui des veaux des enclos AMBPS (p = 0.07). Cet essai clinique établit de façon préliminaire que l'AMBPS peut causer des bénéfices au niveau de la performance à court terme lorsque le protocole est appliqué à des veaux

sevrés abruptement et placés dans un parc d'engraissement et fournit de l'information de base pour d'autres recherches scientifiques.

Introduction

Transitioning from the weaning phase to the feedyard to complete the finishing phase can be a particularly stressful time for beef calves. The stress imposed by changes in management, social groups, and environment at the feedyard may increase the calf's susceptibility to disease by decreasing innate immunity.[1] This transition period results in increased morbidity, particularly bovine respiratory disease (BRD).[9,10] Bovine respiratory disease is a multifactorial disease and is the primary cause of morbidity during the finishing phase of production.[17,24] Estimates of BRD in the feedyard allocate approximately 50 to 80% of all feedlot morbidity and 40 to 75% of death loss.[2,24] Treatment of feedlot calves for BRD has been reported to negatively impact ADG and carcass characteristics.[23]

Specific cattle-human interactions may play a role in this stress response during the transition period. Providing an introduction to the feedyard environment prior to placement may be helpful.[11,21] Negative handling experiences may contribute to increased stress and reduced productivity, and have been shown to decrease the rate of gain in backgrounded cattle.[20,21] Additionally, stress that calves experience when transitioning to the feedyard to complete the finishing phase of production has been attributed to novelty and resultant fearfulness.[3,8] Positive handling experiences with humans outside of typical husbandry practices during the post-weaning phase (vaccination, ear tagging, and treatment for disease) may be particularly beneficial to subsequent human-cattle interactions, when cattle become less reactive to the presence of humans.[4,5] Similarly, young cattle that experienced frequent gentle human interactions displayed lower stress responses and improved temperament, demonstrating the importance of good cattle-human interactions.[6,13]

Beef industry stakeholders have encouraged refinements in animal care to reduce animal stress, such as modifications to facility design, recommendations for backgrounding techniques, and standardized handling protocols. Low-stress cattle handling techniques were introduced and popularized in the United States by the late cattleman, Mr. Bud Williams,[25] and have been promoted in laymen journals, seminars, and presentations as a way to enhance the caregiving of cattle. These techniques, sometimes referred to as "Acclimation and Low-Stress Cattle Handling" (ALSCH) are described as "caregiver activities aimed at the management of relocating cattle or reducing stress during a change of cattle address." Caregivers can use handler position, working distance, angles, and "stimulus-release" movement to create voluntary cattle motion as a herd."[18] The ALSCH technique is described in detail in the literature as well as through a series of modules, and specifically focuses on handling techniques meant to decrease distress behaviors experienced by cattle during human-cattle interactions.[18,19] Compared to conventionally handled cattle, cattle handled using ALSCH methods are expected to exhibit less disorganized, unpredictable herd movement, to rest in all areas of the home pen, and to readily use novel water and feed resources.

Increasingly, ALSCH is anecdotally reported to be introduced and implemented into commercial feedyards. ALSCH-associated reductions in stress are expected to result in improved performance and decreased morbidity; however, validation of these techniques have not been reported in the scientific literature and are necessary to determine the significance of this cattle-handling practice. Hence, the objective of our clinical trial was to evaluate and quantify the impact of ALSCH on BRD and performance of beef cattle during the finishing phase of production. The null hypothesis was that there would be no difference between ALSCH and control treatment groups in terms of health and performance.

Materials and Methods

This randomized clinical trial was designed as a 2-arm parallel trial. The treatment groups were ALSCH or conventional handling (CON) during the feedlot-finishing phase. Approval for the study was obtained from the Iowa State University Institutional Animal Care and Use Committee.

Animals and Housing

The study was conducted from September 2011 to January 2012. Calves were sourced from a privately owned ranch in western Nebraska, and were abruptly weaned, then shipped on the same day to deliberately produce highly stressed animals at risk of BRD and impaired performance. All calves had black haircoats, were steers, had predominantly Angus genetics, and were 6 to 9 months of age on the day of placement. Approximately 6 weeks prior to shipping, all calves received pre-weaning vaccinations for infectious bovine rhinotracheitis (IBR); bovine viral diarrhea virus (BVDV) types 1 and 2; parainfluenza-3 virus (PI3), bovine respiratory syncytial virus (BRSV); and clostridial organisms and then reunited with their dams.

Calves were housed on a research feedyard facility, the Iowa State University Armstrong Research and Demonstration Farm near Lewis, Iowa. All enrolled calves were housed in 1 of 4 outdoor, dirt floor pens. The pen dimensions, number of waterers, and feeding space was consistent for all 4 pens. Each pen was approximately 40 ft (12.2 m) wide and 165 ft (50 m) long. Concrete feed bunks were positioned along the north side of the lot for the entire width of the pen on a concrete apron covered by an open-front barn. Calves had *ad libitum* access to an automatic waterer and were fed twice daily. Calves were fed long-stem hay for 5 days upon placement into the feedyard, and then stepped through a 5-ration plan as detailed in Table 1.

Table 1. Percent ration components and timeline (days fed) for rations 1-5 fed to both treatment groups from arrival (day -1) to harvest (day 193).

Nutrition component	Ration 1 (days -1 to 16)	Ration 2 (days 17 to 50)	Ration 3 (days 51 to 100)	Ration 4 (days 101 to 123)	Ration 5 (days 124 to 193)
Hay %	34.9	22.8	21.8	17.1	13.0
Modified distillers grain %	38.9	39.9	42.4	44.5	45.7
Supplement %	4.0	4.0	3.2	2.4	2.4
Corn %	22.2	27.3	32.6	36.0	38.9

Sample Size

Based on the risk category of the calves (abruptly weaned, mid-range time transport of approximately 10 hours), the investigators estimated 15 to 20% rate of BRD during the first 60 days-on-feed. However, BRD magnitude and variation can be influenced by multiple variables including distance transported, having mixed gender groups, commingling of calves originating from multiple sources, as well as other factors.[22] The sample size was constrained by availability of pen space at the research feedyard. Thus, a sample size calculation was not completed prior to onset of study.

Enrollment of Cattle

A timeline describing enrollment and handling of cattle is shown in Table 2. Calves traveled approximately 10 hours from ranch to feedyard via a contracted professional cattle hauler. Calves arrived at the feedyard on 14 September 2011 (day -1) in 2 loads, each carrying approximately 68 calves. Upon arrival on day (d) -1, calves were unloaded and observed for clinical signs of clinical abnormalities, such as lameness or BRD. Specifically, calves were observed for expression of visual signs of morbidity, such as lethargy, decreased rumen fill (anorexia), bloat, droopy ears, ocular discharge, coughing, head tilt, lameness, nasal discharge, in-creased respiratory effort or dyspnea. Any calf that exhibited any of these clinical signs was not enrolled in the study. To prevent allocation bias, the researcher responsible for treatment group allocation (co-author GAD) did not participate in pre-enrollment observational exams.

Treatment Group Description and Allocation

On d -1 (arrival of calves to feedyard), 136 eligible calves were randomly allocated to 1 of 4 pens by drafting blocks of 4 calves at a time from the group and allocating 1 steer out of the draft to each pen according to the randomization schedule generated by an online application (www.random. org). Two pens were allocated to each treatment group. The cattle handling treatment groups were Treatment 1) ALSCH and Treatment 2) CON.

Cattle Handling Treatments

After sorting into assigned study pens, CON calves were sent to their pens with no acclimation or further human in-pen interactions post penning. Normal pen placement procedures at the feedyard were followed for this group, and no intentional human-calf interactions were initiated within the CON pens. CON calves were processed on d 1 through a 30 ft (9.1 m) solid-sided sweep tub with a catwalk and 25

Table 2. Timeline describing acclimation and low-stress cattle handling (ALSCH) and conventional (CON) group enrollment and procedures.

Day of study	Study event
Day -1	Randomization to ALSCH and CON groups
Day 0	ALSCH groups handled
Day 1	CON groups processed and individual weights obtained; ALSCH groups handled
Day 2	ALSCH groups handled; processed; individual weights obtained
Days 3 to 10	ALSCH groups handled
Day 12	ALSCH groups handled
Day 14	ALSCH groups handled
Day 16	ALSCH groups handled
Day 19	Individual weights obtained from ALSCH and CON calves
Days 20 to 94	ALSCH groups handled 1x weekly
Day 95	Individual weights obtained from ALSCH and CON calves
Day 193	Individual weights obtained from ALSCH and CON calves
Day 195	ALSCH and CON calves slaughtered

ft (7.6 m) solid-sided alleyway (3 ft [1 m] wide) system. A hydraulic squeeze chute[a] was utilized to process CON calves. Calves in the CON group were not acclimated to the drover's alley (estimated 200 ft [61 m]), or the handling system prior to processing. During processing, calves were individually identified with ear tags, vaccinated with a modified live 5-way viral vaccine (infectious bovine rhinotracheitis [IBR], bovine viral diarrhea virus [BVDV] types 1 and 2, parainfluenza-3 virus [PI3], bovine respiratory syncytial virus [BRSV]), treated for external and internal parasites using a pour-on parasiticide, and implanted with a growth promotant.

After sorting into assigned study pens, ALSCH calves were not further handled on d -1. Handling to acclimate calves began on d 0 (14 hours after arrival), and continued on d 1, 2, 3, 4, 5, 6, 7, 8, 10, 12, 14, and 16. Following d 16, ALSCH calves were handled once weekly through d 95. Personnel handling cattle were trained by a recognized expert in ALSCH (co-author THN) during d 0 through d 3.

Initial acclimation handling procedures on d 0 through 3 were focused on desensitizing calves to the presence of 1 to 2 humans in close proximity. Handlers subjectively identified calf distress behaviors, such as aimless wandering, excessive walking (typically repetitive fenceline pacing), milling or pacing, failure to ambulate in a cohesive group, and bawling. To modify these behaviors, all calves in the pen were encouraged to walk as a cohesive group, were directed to walk as a group in an intentional and calm manner into all corners of the pen, and were walked by the feed bunk and water resources. The handler posture and movements were adjusted to remain at the edge of the calves' flight zones, with a straightforward motion by calves the intended outcome. When a cohesive group of cattle was not present, handlers walked purposefully towards the center of the pen to encourage cattle to re-establish a cohesive group at the periphery of the pen. Then the cattle were encouraged into a straightforward motion, and once established as a coordinated group the cattle were directed to walk past the feed bunk, water tank, and/or an alternate corner of the pen. Acclimation handling sessions were performed once daily and typically 10 to 15 minutes in duration. Sessions were conducted at various times of the day during daylight hours, and no handling sessions occurred during scheduled feeding times. Session duration was dependent on cattle behavior, and was determined by the lead handler. The handling session was ended when cattle formed a cohesive group and moved away from handlers in a calm, straightforward normal walking pace.

On d 0 and 1, calves were acclimated to the processing facilities. In contrast to the CON processing area, the ALSCH facility did not include solid-sided alleyway, a catwalk, or a sweep-tub. The ALSCH processing facility included a "Bud-box" that was constructed of portable panels and was approximately 13.1 ft (4 m) wide and 20 ft (6 m) long (Figure 1). Gates were designed to open flat against the panel sides. The crowd alley was constructed of portable livestock panels, was approximately 3 ft (1 m) wide, 25 ft (7.6 m)
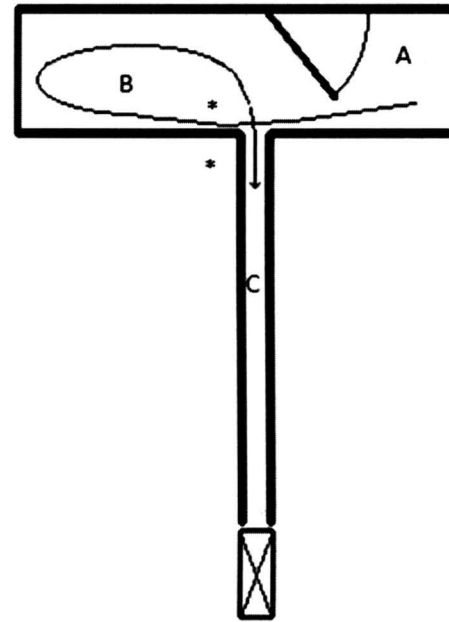

Figure 1. Bud box design, depicting placement of fences, panels or gates (heavy black lines), squeeze chute (box with X in it), cattle flow (curved line with arrow) and handler position to direct cattle into alley (* either inside or outside of Bud box).
Legend: A, drovers alley; B, Bud box; C, alley.

long, and was oriented toward a hydraulic squeeze chute.[a] During acclimation sessions, calves were directed through the drover's alley (estimated 200 ft [61 m]), Bud box, crowd alley, and chute. Calves in the ALSCH group were processed on d 2 using procedures described for the CON calves. Type of vaccine, parasiticide, and implant was consistent between treatment groups.

On d 2, handling sessions were expanded to acclimate cattle to the drover's alley only. Cattle were directed to leave the home pen and to travel down the length of the drover's alley, then stop and return to the home pen. This exercise took approximately 5 min, and was performed once during weekly handling sessions from d 2 to 95. During acclimation sessions to the drover's alley, cattle commonly displayed exploratory, play, and running behaviors and handlers permitted these activities during this component of the handling session.

Outcomes: Measures of Performance

Bovine respiratory disease and performance data were collected and included individual body weights, average daily gain (ADG), morbidity, and mortality. Individual body weights were measured on d 1 (CON group only), 2 (ALSCH group only), 19, and 95. Live weights were not measured in this study after d 95 due to limitations at the feedlot. Individual body weights were obtained using a chute mounted on load cells.[b] Calves were checked at least once daily for signs of morbidity using criteria previously described for enrollment. Calves observed in the pen as likely to have BRD were removed from the pen for further evaluation in

the treatment area. Calves that were removed from the pen because they demonstrated potential signs of BRD were individually evaluated, and if necessary, treated according to the feedyard's standard BRD identification and treatment protocol. Following identification, respiratory morbidity events were recorded electronically and included calf ID and date of diagnosis. If treatment was administered, the drug, dose, route of administration, and withdrawal period were recorded. Mortality events were recorded according to the feedyard's standard protocol and included calf ID, pen of origin, diagnosis, and results of any laboratory tests submitted. Feedlot personnel responsible for daily health checks, diagnosis, and treatment of cattle were not informed of the experimental design and were not involved in handling treatments. However, these feedlot personnel, though not involved with administration of the handling protocol, could have potentially surmised pen treatment allocations based on their casual observations. Cattle were diagnosed and treated for BRD according to standardized feedlot protocols, and had no reason for obvious bias in terms of the study outcomes.

Cattle were transported and slaughtered at a commercial plant located in western Iowa on d 193. Following slaughter, carcass parameters were collected and recorded by experienced personnel trained and employed by Tri-County Steer Carcass Futurity (TCSCF). Individual post-harvest performance parameters evaluated by TCSCF personnel included marbling score (MS) and rib eye area (REA). Marbling score was evaluated according to standard protocol: Practically devoid, 100 to 199; Traces, 200 to 299; Slight, 300 to 399; Small, 400 to 499; Modest, 500 to 599; Moderate, 600 to 699; Slightly abundant, 700 to 799; and Moderately abundant, 800 to 899. The same person (co-author WDB) supervised all data collection in the plant and was blinded to the treatment groups. The packing plant personnel recorded individual hot carcass weights (HCW), and were also blinded to treatment groups.

Statistical Analysis

Our aim was to describe the magnitude and variation of the health, performance, and carcass characteristic measurements, and to assess the associations with ALSCH. The a priori assumption was that ALSCH would result in increased performance, improved health, and better carcass characteristics as determined by the outcome measures when compared to the CON. All data were analyzed using SAS® software;[c] Proc MIXED was used for normal variables while Proc GLIMMIX was used for binary variables. Statistical significance was considered to occur when $P \leq 0.05$. A statistical trend was noted when $P > 0.05$, but ≤ 0.1. Reported measures included the adjusted mean, standard error, 95% confidence interval, point estimate (PE), and *P*-value.

Performance Analysis

Data were analyzed using pen as the experimental unit with calf within pen as the observational unit (unit of measurement). Continuous quantitative variables analyzed included ADG, HCW, and REA. The statistical model included ALSCH treatment as a fixed effect, initial calf weight at enrollment as a covariate, and calf within pen as a random effect.

Respiratory morbidity data were coded as present (1) or absent (0), and were analyzed as binary (yes/no). Descriptive data including means, minimum, and maximum values, and standard deviations of the unadjusted pre- and post-harvest data were calculated for ALSCH and CON groups.

To test the alternative hypothesis that the ALSCH and CON groups would differ in performance parameters (ADG, HCW, REA, and marbling) a comparison of quantitative variables among pens was done using analysis of variance. Morbidity related to BRD, a binary outcome, was analyzed using a mixed effect logistic regression model. Initial weight was used as a covariate to account for variation in incoming weights and adjust for potential effects. The ALSCH treatment group was used as a fixed effect and calf was the random effect in the models. The Kenward-Roger degrees of freedom adjustment was applied when testing difference between the groups. When considering ADG, data from ALSCH and CON groups were compared for time-period (TP) 1 (from initial weight to d 19), TP 2 (d 19 to d 95), and TP 3 (enrollment weight to d 95).

Results

All potential study calves met the previously described health criteria, and 136 calves (CON=69, ALSCH=67) from 4 pens with records for all data categories were included in the analyses. Any missing data were assumed to be missing at random. One d 19 data point for a calf in the ALSCH group was determined to be missing. Seven calves in the CON group and 4 calves in the ALSCH group were missing data for HCW, REA, and marbling score. At enrollment, individual weights varied from 430 to 750 lb (195 to 340 kg). Descriptive statistics (mean, standard deviation, median, min, max) for individual weights at enrollment, d 19, and d 95 are outlined in Table 3.

Despite randomization, calves in the CON pens weighed less than calves in the ALSCH pens upon enrollment (CON: d 1 = 606 lb [275 kg], SD = 47.4 lb [21.5 kg]; ALSCH: d 2 = 627 lb [284 kg], SD = 62.2 lb [28.2 kg]; *P*=0.03). There was no treatment effect on ADG from initial weight to d 19 (Table 4; *P*=0.59). Calves in CON pens (2.70 lb [1.23 kg]; SE=0.06 lb [0.03 kg]) had a lower ADG when compared to ALSCH pens (2.92 lb [1.33 kg], SE=0.06 lb [0.03 kg]) between d 19 to 95 (*P*=0.01; Table 4). This difference in ADG resulted in CON calves gaining approximately 0.22 lb (0.09 kg)/d less than ALSCH calves. Furthermore, there was a trend for improved ADG in ALSCH calves when evaluated over the 95-day feeding period (CON = 2.71 lb [1.23 kg]/d; ALSCH = 2.84 lb [1.29 kg]/d; [PE= -0.13]), resulting in a gain difference of 0.13 lb (0.06 kg)/d (*P*=0.10).

There was no difference in BRD morbidity between treatment groups (PE: 0.71 [SE:1.05]; ALSCH OR: 0.492; 95%

Table 3. Descriptive statistics (mean ± SD, range [min, and max]) for bodyweights (lb) by time-period (Initial, day 19, and day 95) for treatment groups.

Time period	Treatment Group			
	Acclimation and Low Stress Handling (ALSCH; n=67)		Conventional Handling (CON; n=69)	
	Mean	*Range (min - max)*	*Mean*	*Range (min - max)*
Initial	627 ± 47 lb	510 – 745 lb	606 ± 62 lb	430 – 750 lb
Day 19	668 ± 51 lb	535 – 780 lb	656 ± 64 lb	480 – 785 lb
Day 95	891 ± 66 lb	770 – 1055 lb	860 ± 79 lb	650 – 1015 lb

Table 4. Adjusted mean ± SE, (95% CI), Point Estimate (PE) and *P*-value of average daily gain (ADG) for ALSCH and CON group over different time intervals.

Time period	Treatment Group		PE	P-value
	Acclimation and Low Stress Handling (ALSCH; n=67)	Conventional Handling (CON; n=69)		
	ADG	ADG		
Initial weight to day 19	2.43 ± 0.32 lb (1.80, 3.07)	2.73 ± 0.32 lb (2.10, 3.36)	0.29 lb	0.59
Day 19 to 95	2.92 ± 0.06 lb (2.81, 3.04)	2.70 ± 0.06 lb (2.59, 2.82)	-0.22 lb	0.01
Initial weight to day 95	2.84 ± 0.05 lb (2.73, 2.95)	2.71 ± 0.05 lb (2.60, 2.81)	-0.13 lb	0.1

CI: 0.01 – 26.06; *P*=0.34). Thirteen (13/69; 18.8%) of the CON calves were treated for respiratory disease compared to 5 (5/67; 7.4%) of the ALSCH calves. Respiratory morbidity was observed primarily in 1 control pen (10/34), whereas the other control pen (3/35) and the 2 treatment pens (2/33 and 3/34) had similar morbidity. No mortality events occurred in this study.

Descriptive statistics for post-harvest performance parameters are described in Table 5. Adjusted means for post-harvest performance parameters are described in Table 6. Calves in CON pens tended have lighter HCW; mean HCW was 28.8 lb (13.1 kg) lighter than calves in the ALSCH pens (CON = 728 lb [330 kg]; ALSCH = 757 lb [343 kg]; *P*=0.07). Rib eye area was not different between calves in CON pens

and ALSCH pens (*P*=0.13). Similarly, marbling score was not different between CON and ALSCH pens (*P*=0.99).

Discussion

Acclimation refers to the practice of structured introductions of cattle to new environments or stimuli, such as pen resources, alleyways and working facilities prior to processing in order to decrease stress. The use of ALSCH requires caregivers to understand cattle sensory systems, particularly their vision and hearing, and to anticipate cattle innate responses to stimuli in the environment. The use of ALSCH techniques in feedyard receiving management promotes handler interactions that are thought to desensitize and calm newly

Table 5. Descriptive statistics (mean ± SD, range (min, and max)) for hot carcass weight (lb), rib eye area (in²), and marbling score by treatment group.

	Treatment Group			
	Acclimation and Low Stress Handling (ALSCH; n=67)		Conventional Handling (CON; n=69)	
	Mean	*Range (min - max)*	*Mean*	*Range (min - max)*
Hot carcass weight	757 ± 51 lb	628 - 863 lb	728 ± 70 lb	523 - 861 lb
Rib eye area	12.4 ± 0.78 in²	10.6 - 14.5 in²	12.1 ± 0.85 in²	10 - 14.7 in²
Marbling score	339.2 ± 44.1	260 -430	336.4 ± 45.4	260 - 440

Table 6. Adjusted mean ± SE, (95% CI), Point Estimate (PE) and *P*-value of ADG for ALSCH and CON group for hot carcass weight (lb), rib eye area (in²), and marbling score by treatment group.

	Treatment Group		PE	*P*-value
	Acclimation and Low Stress Handling (ALSCH; n=67)	**Conventional Handling (CON; n=69)**		
Hot carcass weight	757 ± 7.47 lb (742.36, 771.64)	728 ± 7.36 lb (713.57, 742.43)	-16.64 lb	0.07
Rib eye area	12.4 ± 0.1 in² (12.20, 12.60)	12.1 ± 0.1 in² (11.90, 12.30)	-0.22 lb	0.13
Marbling score	339.2 ± 9.3 (320.97, 357.43)	336.4 ± 9.33 (318.11, 354.69)	-0.12	0.99

arrived calves. The use of ALSCH is also thought to result in less stress when humans are in close proximity. For example, calves learn that they can pass by a handler without harm in the home pen and drover alley. The use of ALSCH techniques are promoted to encourage recently arrived cattle to travel in a cohesive and relaxed fashion around the pen in response to handler activity. By incorporating ALSCH techniques, cattle are expected to leave the home pen and are willing to flow through a simple processing facility before returning to their home pen. The use of ALSCH techniques for acclimating newly arrived cattle to processing facilities and training them to file through a processing facility is thought to build cattle confidence, and facilitate processing activities.

The absence of evaluated methods and outcomes for assessing the effect of ALSCH presents significant challenges for designing studies to assess stress mitigation strategies for beef calves completing the finishing phase. In this study, we sought to address this absence of information by investigating the effect of a potential technique for decreasing stress while improving health and performance in newly received feedlot cattle. The objective of this study was to 1) describe the magnitude and variation of measures of BRD and performance in cattle handled using ALSCH and 2) evaluate the effect of ALSCH on carcass characteristics. Information obtained in this clinical trial may facilitate appropriate design of studies for further assessing the potential effect of ALSCH strategies. First, conditional on the *a priori* assumption that transportation and disposition to a feedyard is stressful then, ALSCH is a candidate technique for improving health and performance in newly received feedlot cattle. This conclusion is based on the observation that measurements associated with ALSCH demonstrated a trend toward positive improvement in health and performance.

Several reports suggest that stress is related to morbidity and mortality in feedlot cattle.[1,9,10] Despite the continued use of metaphylactic treatments as well as the introduction and advancement of numerous antibiotics labeled for BRD treatment, BRD remains a significant health and welfare issue and continues to be the major cause of morbidity and mortality in confined feeding operations.[2,23] According to NAHMS 2011 data,[16] 92.6% of US feedyards metaphylactically treat calves on arrival that are less than 700 lb (318 kg).[17] This results in about 40.9% of all lightweight (high-risk) calves being treated with antibiotics on arrival to the feedyard.[17] It is estimated that BRD costs the US beef industry $1 billion annually due to treatment costs, reduced performance and death loss.[7,15] Management approaches that may result in decreased BRD as well as reduction in identification of other less common types of morbidity in fed cattle are important strategies to consider. We predicted that cattle in the ALSCH group would have less morbidity attributed to BRD than cattle in the CON group. Although the CON group had numerically more than twice as much respiratory morbidity compared to the ALSCH group (18.8% compared to 7.4%), the difference was not statistically significant, likely due to the small sample size (4 pens). Respiratory morbidity was primarily clustered in 1 control pen. With only 4 pens in study, this heavily influenced the mean but also increased the variability, decreasing the ability to detect a statistical difference. Clustering of disease within a pen is a common problem with field studies, and could be due to increased transmission of pathogens, decreased herd immunity or other environmental factors. However, given that all animals hailed from the same ranch, this was not expected. Further research with a larger sample size is warranted to determine if this difference in respiratory, as well as other types of morbidity, is consistently demonstrated. It is worth noting that blinding of stockmen could not be absolutely assured in this study, since there were occasions when stock people may have been aware of activities or had opportunities to observe the ALSCH sessions. This challenge for experimental design will be difficult to control for future studies if completed in typical production settings, and it is possible that this could result in a bias regarding pull rates among treatment pens. This bias could be mitigated and potential differences in BRD could be more objectively and accurately determined by assessing lung scores with an ultrasound pre-harvest, or by evaluating lungs in the packinghouse post-harvest.

Despite the small sample size, this study did show significant differences between treatment groups. However,

it was surprising that ADG did not differ between CON and ALSCH calves during the first 19 days-on-feed. This result was not what we initially expected since we had hypothesized that the ALSCH group would demonstrate a difference in ADG earlier, rather than later, in the feeding period. Potentially, the difference in initial ADG was due to the intensive handling experienced by the ALSCH group compared to the CON group. By d 19, the ALSCH group was handled 12 times compared to only 2 times for the CON group. Additionally, differences in enrollment weight at initial processing is potentially confounding this short period between weigh days because the ALSCH and CON groups were weighed on different days of the study. Since CON calves were weighed a day earlier than ALSCH calves and weighed less, their initial weight may have reflected that the CON calves had not regained as much weight lost (shrink) from weaning and transportation as the ALSCH calves did when they were weighed the following day. This would have positively impacted the ADG for the CON calves. In contrast, the ALSCH calves had an extra day to regain this weight before they were weighed, which lowers their ADG over the first 19 days. Our research results cannot clarify whether the CON calves experienced compensatory gains, and thus the potential benefits of ALSCH were not realized until later. It is possible that, had the treatment groups been balanced for weight and day of initial enrollment, the overall effect on ADG may have been even greater for the ALSCH group. Further research is needed to better clarify the effect of ALSCH procedures on short-term ADG.

We noted a trend for overall benefit of ALSCH in ADG throughout the measured growth period, particularly notable after d 19, when ALSCH procedures ceased. Between d 19 (when ALSCH procedures ceased) and d 95, ALSCH calves gained 0.22 lb more (0.10 kg)/d than CON calves. The performance trend, with a point estimate of an added 0.13 lb (0.06 kg)/d for ADG in the ALSCH group, was seen from initial weight through d 95 on feed (2.71 lb/d [1.23 kg] CON vs 2.84 lb/d [1.29 kg] ALSCH P=0.10). Holroyd et al[11] reported that calves which had been acclimated to a feedyard environment prior to entering the finishing phase had better short term average daily gain (from 5 to 55 days), but no treatment effect was observed after 55 days. Further research to better clarify potential differences in ADG over the entire feeding period is needed to fully explain this aspect of our study.

It is important to note that there was 20 lb (9 kg) difference in initial weights between the 2 treatment groups. However, this difference was controlled for in the analyses. All but 2 calves weighed at least 500 lb (227 kg) at enrollment. The 2 lightweight calves weighed only 430 and 435 lb (195 and 198 kg); both were enrolled in the CON group. With initial weights almost 200 lb (91 kg) less than the mean (606 lb; 270 kg) and median (610 lb; 275 kg), the random enrollment of both calves affected the CON group by decreasing the mean weight, increasing the standard deviation, and widening the gap between the median and the mean. Nevertheless, given

that ALSCH calves were heavier from the outset, superior ADG could be associated with the thriftiness of calf rather than the calf responses to handling treatments. As discussed earlier, differences in initial weights could also reflect the differences in procedures since CON calves were weighed on d 1, whereas ALSCH calves were weighed on d 2. Hence, this difference in starting weight may be an artifact of increased water and dry matter intake from d 0 through d 2). One of the hypothesized benefits of utilizing ALSCH is that calves are inclined to eat and drink more than CON calves because they are less stressed and less likely to engage in stress-related behaviors such as pacing and milling, bawling, and have been "shown" where feed and water resources are during the initial handling session. Hutcheson and Cole[12] found that highly stressed calves consumed 0.5 to 1.5% of body weight in dry matter daily during the first 7 days-on-feed, whereas less stressed calves were expected to consume 1.5 to 2.5% of body weight during the same time period.[14] Thus, based on mean weights at enrollment, calves in the ALSCH group may have consumed as much as 24 lb (10.9 kg) more of feed on days 1 and 2 than the CON calves prior to being enrolled. This could potentially account for some of the difference noted in initial weights.

Post-harvest performance parameters reflected a trend for improved carcass traits among calves in the ALSCH group. Hot carcass weights tended to be different between the 2 handling groups (PE = 16.64 lb [7.55 kg]; 728 lb [330 kg] CON vs 757 lb [343 kg] ALSCH P=0.07). The 29 lb (13.1 kg) HCW difference is likely attributed to the higher enrollment weights and increased ADG for the ALSCH calves, resulting in an increased HCW. For example, if 1 considers an average dressing percent of 63, then approximately 12.6 lb (5.7 kg) of the 29 lb (13.1 kg) difference in HCW may be accounted for. This is further supported when considering the PE of 16.64 lb (7.55 kg), and assuming a 55% carcass weight at enrollment; there was a 17 lb (7.7 kg) actual difference between the acclimated (412 lb; 187 kg) and control (395 lb; 179 kg), as reflected in the point estimate when enrollment weight was controlled for in the analysis. Although increased REA parameters are associated with increased HCW and ADG, there was no trend for increased REA for ALSCH calves compared to the CON treatment group (12.1 in^2 [78.1 cm^2] CON vs 12.4 in^2 [80.0 cm^2] P=0.13; PE= 0.22). Since calves hailed from the same ranch and had similar genetics, it was not surprising that marbling score did not differ between groups (336.4 CON vs 339.2 ALSCH P=0.99, PE= 0.12).

Ideally, calves could have been blocked on weight to ensure initial weights would have been more consistent between treatment groups. However, this was not possible in the current study protocol since calves in the ALSCH required handling sessions prior to processing. Hence, calves were randomized immediately after unloading and were not processed until 2 or 3 days following arrival at the yard. A possible solution for future studies is for calves to be individually weighed and identified at purchase, prior to arrival

at the study facility, to facilitate randomization and blocking for this outcome. Additionally, the establishment of defined weight range for enrollment in the clinical trial would have benefited the study by reducing variability.

The study design may also have benefited from including an assessment of potential differences between treatment groups in handling time during processing, and behaviors such as chute scores, presence or absence of vocalization, exit speed, or measurement of physiologic variables associated with stress. Addition of these variables in future studies would augment recent research by Woiwode et al which described a positive correlation among feedlot calves between chute behavior and ADG following the use of either higher or lower-stress handling practices when moving calves from their pens to the processing facility.[26]

When compared to conventional handling, the use of ALSCH was not consistently associated with an increase in pre- or post-harvest health or performance parameters. Besides the lack of power associated with this small study size, additional limitations of this study include lack of blinding and the potential confounding factor of initial weight. However, the validity and accuracy of the greater frequency of pulls for BRD in the CON groups is supported by the comparative reductions in ADG, HCW, and REA. Additionally, since all the pens were in close proximity to each other and not separated by visual barriers, social facilitation of behavioral responses to handling could potentially have occurred between pens regardless of treatment. This effect would be expected to dilute the differences between the treatment pens, and yet we detected some pen differences in this study despite the limitations of design and small sample size. Future studies would benefit from visual and auditory separation of study pens.

This study describes important first steps in identifying and quantifying the effect of ALSCH in feedyard cattle, and results can be used to calculate sample sizes needed for statistical power for additional studies. Techniques involving ALSCH require changes from traditional handling protocols and increased initial investments of labor and time by stock people. The benefits and potential returns on labor investments are important considerations and have not been fully explored or reported.

Conclusion

Management practices that may decrease stress, such as ALSCH, have the potential to improve cattle welfare, health and performance. This study suggests that ALSCH may contribute to short-term performance benefits for ADG for abruptly weaned calves. There was a trend for increases in ADG and carcass weights among calves that were acclimated to the feedyard and handled using ALSCH procedures. To further validate and improve the potential practicality of ALSCH, additional larger-scale research and refinement is required. An economic (partial budget) analysis of ALSCH interventions would also be useful.

Endnotes

Acknowledgements

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