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Pasture Preconditioning Calves at a Higher Rate of Gain Improves Feedlot Health but Not Postweaning Profit

C. P. Mathis,*[1] PAS, S. H. Cox,† C. A. Löest,† M. K. Petersen,†[2] and J. T. Mulliniks†
*Extension Animal Sciences and Natural Resources Department, and †Department of Animal and Range Sciences, New Mexico State University, 88003

ABSTRACT

Over 2 yr, 132 calves (218 ± 12 kg initial BW) were used to compare a low- and high-input pasture preconditioning method to evaluate performance and profit during the preconditioning (weaning to 49 to 53 d) and finishing (end of preconditioning to slaughter) phases. At weaning (d 0), steers were randomly assigned to low-input or high-input treatments during preconditioning. Steers were fenceline-weaned for 7 d beginning on d 0 and were then transported to their respective pastures (d 7). The high-input steers had ad libitum access to a self-fed corn- and wheat middlings-based pellet, and low-input steers were supplemented with a 32% CP range cube delivered 3 times/wk to average 0.57 kg/d. At the end of preconditioning, high-input steers were 19 kg heavier ($P < 0.01$) and had a \$20/steer greater final value ($P < 0.01$), but feed and total costs were \$42/steer higher ($P < 0.01$). During preconditioning, low-input steers had a net income advantage of \$20.54/steer ($P < 0.01$). After preconditioning, steers were finished at a commercial feedlot. During finishing, there were no differences in ADG, final BW, or carcass characteristics ($P \geq 0.28$). Morbidity during finishing was 16.7 percentage units higher ($P = 0.01$) for low-input steers and resulted in a \$6.63/steer greater ($P = 0.05$) medicine cost than for high-input steers. There was no impact ($P = 0.49$) on finishing net income or on profit from weaning to slaughter ($P = 0.90$). In conclusion, pasture preconditioning steers at a higher rate of BW gain can improve finishing health but may not increase postweaning profitability.

Key words: preconditioning, beef calf, feedlot, profit, health

INTRODUCTION

Guidelines for adding value to calves through a defined vaccination protocol and the separation of weaning and shipping by 45 d or more [i.e., Value-Added Calf-45 (**VAC-45**); Texas AgriLIFE Extension Service, 2005] are justified by improved subsequent performance and health (Cravey, 1996; Lalman et al., 2005). Industry acceptance of such guidelines is evident in that more than 25% of the reported calves sold through the Superior Livestock video auction in 2007 were marketed as VAC-45 (King, 2007). However, management intensity and costs during preconditioning can vary. Mathis et al. (2008) demonstrated that a low-input pasture preconditioning approach can cost as much as \$52/steer less than a high-input dry-lot approach. Furthermore, Boyles et al. (2007) and Mathis et al. (2008) showed that compared with dry-lot preconditioning, pasture-based approaches can yield improved health during the finishing phase. It has been suggested that the combined stressors of dietary change and environmental change experienced by calves preconditioned in a dry lot may negatively affect subsequent health (Mathis et al., 2008).

Controlled experiments comparing pasture-based preconditioning methods on calf performance and profitability through slaughter are limited. Therefore, this study compared pasture preconditioning methods with a high level of nutritional input to a lower input approach to evaluate

[1] Corresponding author: clmathis@nmsu.edu
[2] Present address: USDA-ARS Fort Keogh Livestock and Range Research Laboratory, Miles City, MT 59301.

performance and profit from weaning through slaughter.

MATERIALS AND METHODS

Over 2 yr, 132 calves (218 ± 12 kg initial BW) were used to compare 2 preconditioning methods at the New Mexico State University, Corona Range Livestock Research Center (**CRLRC**), located 13 km east of Corona, New Mexico (avg. elevation = 2,000 m; avg. annual precipitation = 380 mm). All animal handling and experimental procedures were in accordance with guidelines established by the New Mexico State University Animal Care and Use Committee. Calves originated from the CRLRC spring-calving British cross cow herd, and were born in late February, March, or April of 2006 and 2007. Each year, bull calves were castrated at branding in early May with elastrator bands. Steer calves were weaned in mid-September.

Calfhood Vaccination Protocol

At branding, on d 1 after weaning, and at 28 d postweaning, calves were vaccinated against bovine respiratory disease complex (bovine respiratory syncytial virus, infectious bovine rhinotracheitis, bovine viral diarrhea, and parainfluenza 3) with Bovi-Shield Gold 5 (Pfizer Animal Health, Exton, PA). Calves were also administered a 7-way clostridial vaccine (Ultrabac-7, Pfizer Animal Health) at branding and on d 28, and were vaccinated against *Pasteurella* (One-Shot; Pfizer Animal Health) on d 1.

Preconditioning Phase

All preconditioning period BW were measured unshrunk between 0900 and 1100 h, and a 3% pencil shrink was applied. At weaning (d 0), calves were weighed, assigned a market price, and randomly assigned to 1 of 2 preconditioning nutrition treatments: 1) ad libitum self-fed pellets (high-input treatment) or 2) hand-fed range cubes delivered 3 times/wk to average 0.57 kg·steer^{-1}·d^{-1}; low-input treatment).

Table 1. Composition of preconditioning pellet fed to steers at a high rate of gain[1]

Item	Amount
Ingredient, % (as fed)	
Corn, ground	34.7
Wheat middlings	32.0
Soybean hulls	15.0
Cottonseed meal	5.8
Cottonseed hulls	5.0
Molasses	5.0
Calcium carbonate	1.5
Potassium chloride	0.5
Salt, vitamins, trace minerals[2]	0.5
Nutrient concentration	
CP, % of DM	15.8
NE_m, Mcal/kg DM	2.13
NE_g, Mcal/kg DM	1.41

[1]Pellet formulation was consistent across years.

[2]Includes Rumensin-80 at 0.0125% (Elanco Animal Health, Indianapolis, IN).

The low-input treatment was designed to be similar to the low-input pasture treatment evaluated in previous work (Mathis et al., 2008). In addition, the self-fed preconditioning pellet (Table 1) offered to the high-input steers was formulated identically to the pellet fed by Mathis et al. (2008) to steers preconditioned in a dry lot such that the main difference in the high-input confinement feeding approach used previously and the current high-input treatment was the environment (pasture vs. confinement). Treatments were replicated within year.

Steers were fenceline-weaned for 7 d, beginning on d 0. During the fenceline-weaning procedure, steers were unable to nurse but were able to maintain nose-to-nose contact with their dams. On d 0 to 6, alfalfa hay (1.13 kg·steer^{-1}·d^{-1}) was placed in and around self-feeders to accustom all calves to the self-feeder as a source of feed. Calves were transported to their respective treatment pastures on d 7. The same 4 native range pastures (2 pastures/treatment; minimum 4.1 ha/steer) were used each year.

Table 2. Nutrient composition of clipped forage samples collected at the beginning (September) and end (November) of the preconditioning phase

Nutrient, % of DM	September	November
CP	6.0 ± 1.28	4.6 ± 0.62
NDF	70.8 ± 2.12	69.4 ± 1.69
ADF	44.2 ± 2.58	45.6 ± 1.75

Free-choice access to water and a loose mineral mix (38% NaCl, 12% Ca, 8% P, 2% K, 2% Mg, 2,500 ppm Mn, 1,000 ppm Cu, 1,000 ppm Zn, 13 ppm Se, and 125,000 IU/kg vitamin A; Hi-Pro Feeds, Friona, TX) were provided.

Native range pastures were not grazed during the spring and summer growing season before stocking during preconditioning. Predominant grass species included blue grama [*Bouteloua gracilis* (Willd. ex Kunth) Lag. ex Griffiths], threeawn (*Aristida* spp.), and wolftail (*Lycurus phleoides* Kunth; Forbes and Allred, 2001). Average annual forage production at the study site is 1,000 kg/ha (G. B. Donart, New Mexico State University, Las Cruces, unpublished data). Forage availability exceeded cattle need each year. To estimate forage quality, grass samples were annually clipped from each pasture at the beginning and end of the preconditioning period, and were analyzed for CP, NDF, and ADF at a commercial laboratory (Table 2; SDK Laboratories Inc., Hutchinson, KS).

On d 8 to 10 after weaning, low-input calves were trained to hand-delivery of protein supplement by enticement with 1.13 kg·steer^{-1}·d^{-1} alfalfa hay (as fed), plus protein supplementation with 0.57 kg·steer^{-1}·d^{-1} of a hand-fed 32% CP range cube (as fed; Rancher Pro 32, Hi-Pro Feeds). Beginning on d 11, the frequency of protein supplement delivery was reduced to 3 times/wk, to average 0.57 kg·steer^{-1}·d^{-1} (as fed). Calves were fed between 1000 and 1200 h each day that feed was delivered.

Steers on the high-input treatment were given immediate ad libitum access to a self-fed preconditioning pellet. A single self-feeder was placed near water in each high-input pasture. The self-feeder rental charge ($1.50/d) was prorated across the number of steers in each high-input replicate and charged to steers individually. On d 7 to 9, 1.13 kg·steer^{-1}·d^{-1} alfalfa hay (as fed) was placed on top of the self-fed pellets to initiate pellet consumption. Average daily self-fed pellet intake was 4.21 ± 0.35 kg (as fed). During yr 2, three steers in one high-input treatment group escaped the treatment pasture during the preconditioning period and were removed from the experiment.

Each year, BW was measured on d 28 and at the end of the preconditioning phase (d 53 in yr 1; d 49 in yr 2). The day final preconditioning BW was measured marked the end of the preconditioning phase. All steers were then held overnight in a common drylot pen and fed 4.54 kg/steer alfalfa hay (as fed). Steers were shipped to the feedyard the following morning. Steers remained at the CRLRC for at least 49 d postweaning and conformed to guidelines for the VAC-45 weaning option (Texas AgriLIFE Extension Service, 2005).

Each year, weaning price and final preconditioning price were individually applied to each calf based on prices in the New Mexico Weekly Weighted Average Feeder Cattle Report (USDA CV LS795; USDA, 2007) for the beginning and ending week of the preconditioning phase. The price-reporting category used to best represent calves in this study was the medium to large frame score, with a muscle score of 1 to 2. Prices were reported in 23-kg weight categories. Prices for consecutive weight categories were averaged to create 11-kg price blocks and were then applied to calves based on shrunk BW. No premium for preconditioning was applied. Purchased feed prices per ton for yr 1 and 2, respectively, were $224 and $206 for the preconditioning pellets, $250 and $242 for the range cubes, and $165 and $200 for the alfalfa hay. Feed costs were applied as weight of feed consumed by steers in each pasture × unit feed cost. Labor was similar between the high-input and low-input treatments. There was no preconditioning medicine cost because no calves were treated for sickness during the preconditioning phase.

Finishing Phase

After preconditioning, steers were shipped to a commercial feedlot (yr 1, Double A Feeders, Clayton, NM; yr 2, Celebrity Feeders, Felt, OK), where their data were managed through the New Mexico Ranch to Rail Program. Final BW and price of steers from the preconditioning phase were used as the initial BW and price of steers for the finishing phase.

Steers were received at the feedlot on November 7 (yr 1) or 8 (yr 2), and were managed according to the standard procedures in place at the respective feedlot at the time of finishing. On arrival, all steers were administered a growth-promoting implant (yr 1, Synovex Choice, Fort Dodge Animal Health, Fort Dodge, IA; yr 2, Revalor I-S, Intervet/Schering-Plough Animal Health, Millsboro, DE). Additionally, feedlot managers observed steers at arrival, considered the previous health and management protocol, and subjectively decided the receiving preventive pharmaceutical protocol for all steers. In yr 1, steers received Titanium 5 (Agri Laboratories, St. Joseph, MO), Caliber 7 (Boehringer Ingelheim Vetmedica Inc., St. Joseph, MO), and Ivomec injectable (Merial Limited, Duluth, GA). During yr 2, steers were administered Vista 3 (Intervet/Schering-Plough Animal Health), Vision C & D (Intervet/Schering-Plough Animal Health), and Safeguard (Intervet/Schering-Plough Animal Health). Steers were diagnosed as morbid based on subjective visual appraisal by experienced feedlot staff. Medicine costs, which included daily hospital pen expenses, were charged to individual steers that were treated for sickness. Each year, all steers were fed in a single pen throughout the finishing period. Pens allowed more than 9.3 m^2/steer and allowed 40 cm/steer linear bunk space.

In early February, steers were processed with secondary application of growth-promoting implants (yr 1: Synovex Plus, Fort Dodge Animal Health; yr 2: Revalor S Intervet/Schering-Plough Animal Health). Steers averaged 181 d on feed in yr 1, whereas in yr 2, steers were fed for 209 d. During yr 1, steers were weighed and individually assigned to marketing groups by using the ultrasound technology and computer software of the Cattle Performance Enhancement Co. (CPEC, Oakley, KS). Once the optimal market date for each steer was estimated, steers were assigned to marketing groups that were slaughtered between March and early July. Each year, cattle were slaughtered at a commercial facility (National Packing Co., Liberal, KS). Hot carcass weight (**HCW**) was collected at slaughter, and LM area, fat thickness, calculated YG, and marbling score were evaluated by an independent data collection service (Cattle Trail LLC, Johnson, KS) after carcasses were chilled. During yr 2, steers were visually appraised by experienced feedlot staff to determine a single marketing date (June 3, 2008) to achieve optimal performance. After finishing, all steers were sold on an individual carcass basis (National Beef Grid, National Packing Company). Premiums and discounts were applied using HCW and USDA QG and YG.

Statistical Analysis

The effects of preconditioning treatment on performance, carcass, and financial data were evaluated using the MIXED procedure (SAS Inst. Inc., Cary, NC) with year as a blocking factor and pasture as the experimental unit. The model included replicate, year, and treatment. Chi-square in the FREQ procedure (SAS Inst. Inc., Cary, NC) was used to evaluate the categorical distribution of USDA QG, USDA YG, morbidity, and death

Table 3. Preconditioning performance and profit of steers preconditioned on pasture at a high or low rate of gain

	Preconditioning method			
Item	Low	High	SE	*P*-value
Head, no.	69	63		
Preconditioning performance[1]				
Weaning BW, kg	217	219	11.9	0.38
Interim BW,[2] kg	236	242	12.2	0.25
Final BW,[3] kg	242	261	7.5	<0.01
ADG, d 0 to interim, kg/d	0.69	0.78	0.05	0.22
ADG, interim to final, kg/d	0.26	0.88	0.12	<0.01
Total ADG, kg/d	0.50	0.82	0.07	<0.01
Preconditioning financial				
Weaning price, $/45.4 kg	129.13	127.73	3.51	0.14
Weaning value, $	615.66	615.51	16.94	0.98
Final price, $/45.4 kg	104.91	100.81	1.59	<0.01
Final value, $	559.12	579.98	8.66	<0.01
Feed costs, $	9.83	51.40	2.69	<0.01
Hay[4]	2.69	2.69	—	—
Dry-lot pellet	—	44.10	—	—
Range cube[5]	7.14	—	—	—
Self-feeder	—	4.61	—	—
Net income,[6] $	−66.38	−86.92	6.47	0.01

[1]A 3% pencil shrink was applied to all BW.

[2]Interim BW collected on d 28.

[3]Final BW collected on d 53 and 49 during yr 1 and 2, respectively.

[4]Hay was fed during the initial week to train steers to range cubes or the self-feeder.

[5]Range cubes (32% CP) provided to low-input steers at 0.57 kg/d; delivered 3 times/wk.

[6]Net income does not include labor charges, which were similar for high- and low-input steers.

loss. Steer was the experimental unit for categorical data analysis.

RESULTS AND DISCUSSION

Preconditioning Phase

There were no differences in weaning BW, price, or value at the beginning of the treatment period ($P \geq 0.14$; Table 3). Interim BW (d 28) and ADG from weaning to d 28 were similar ($P \geq 0.22$); however, high-input steers were 19 kg heavier ($P < 0.01$) than low-input steers at the end of preconditioning because they gained 0.32 kg/d more ($P < 0.01$) across the entire preconditioning period. The BW advantage of high-input steers occurred primarily because ADG from d 28 to the end of preconditioning was more than 3-fold higher ($P < 0.01$) for high-input than low-input steers. Treatment also yielded dissimilar patterns of ADG during preconditioning. Specifically, ADG among high-input steers was 13% greater from d 28 to the end of preconditioning than during the initial 28 d, likely resulting from increasing intake of self-fed pellets (not measured by period) during the latter portion of preconditioning. In contrast, the rate of BW gain observed among low-input steers after d 28 was 62% less than that exhibited during the first 28 d of preconditioning. This outcome is similar to previous work (Mathis et al., 2008) in which calves managed in an almost identical pasture preconditioning treatment gained 58% less during the second half of preconditioning. Mathis et al. (2008) attributed this observation to the declining quality of forage during the treatment period, which was supported by the 1.4 percentage unit average decline in forage CP content from September (6.0%) to November (4.6%) in the current study. The BW advantage of high-input steers at the end of preconditioning was reflected in a $4.10/45.4 kg lower ($P < 0.01$) final preconditioning price but a more than $20/steer greater ($P < 0.01$) final preconditioning value than for low-input steers.

By design, preconditioning feed cost was lower ($41.57/steer; $P < 0.01$) for low-input than high-input steers. Even though high-input steers generated more gross income during preconditioning, the 5-fold higher cost of the self-fed pellet feeding method relative to feeding a limited quantity of range cubes to the low-input steers resulted in a $20.54 preconditioning net income advantage ($P < 0.01$) to low-input steers. These results are in agreement with previous work (St. Louis et al., 2003; Mathis et al., 2008) demonstrating that lower cost preconditioning approaches can generate a greater net income during preconditioning.

Both treatments yielded monetary losses. The 2 main factors contributing to these losses were that 1) a price premium was not applied to preconditioned calf prices, which approximated $8/45.4 kg in 2006 and 2007 (King 2006, 2007), and 2) the local market seasonal decline in price from September to November averaged more than $18/45.4 kg during 2006 and 2007 (250-kg calf basis; USDA CV LS795; USDA, 2007), approximately 2.25 times larger than the US 5-yr average (2004 to 2008) seasonal decline of $8.15/45.4 kg from September to November (CattleFax, 2009). Nonetheless, a price premium of $12.45 and $15.12/45.4 kg at the end of preconditioning would have been required for low-input and high-input steers, respectively, to break even monetarily during the preconditioning phase.

Table 4. Feedlot performance, carcass characteristics, and profit of steers preconditioned on pasture at a high or low rate of gain

Item	Preconditioning method		SE	*P*-value
	Low	High		
Number of steers	69	63		
Feedlot performance[1]				
Final BW,[2] kg	531	540	28.2	0.38
ADG, kg/d	1.47	1.44	0.02	0.35
Treated for sickness,[3] %	24.6	7.9		0.01
Death loss,[3] %	4.4	1.6		0.36
Carcass				
Hot carcass weight, kg	338.0	343.1	17.8	0.42
Fat thickness, cm	1.50	1.47	0.15	0.69
LM area, cm²	77.5	78.6	1.3	0.58
Marbling score[4]	514	507	23.6	0.63
Feedlot financial[1]				
Medicine cost, $	11.14	4.51	3.34	0.05
Feed cost, $	414.64	418.27	59.06	0.63
Total cost, $	1017.76	1035.63	62.64	0.11
Carcass price, $/45.4 kg	147.62	147.40	0.91	0.87
Gross income, $	1054.80	1098.28	31.30	0.35
Net income, $	37.04	62.66	43.12	0.49
Net income (weaning to slaughter)[5]	−29.34	−24.26	49.07	0.90

[1]Final preconditioning BW and price = initial feedlot BW and price.

[2]Final BW is an estimate calculated as carcass weight ÷ average dressing percentage of the marketing group.

[3]Chi-square analysis.

[4]Marbling score: Small 00 = 500.

[5]Net income does not include preconditioning phase labor charges, which were similar for high- and low-input steers.

Finishing Phase

During the finishing phase, there were no differences ($P \geq 0.35$) in ADG (Table 4) or final BW, and preconditioning method had no impact ($P \geq 0.42$) on HCW, fat thickness, LM area, or marbling score. The distribution of USDA QG and YG was also similar ($P \geq 0.28$; Table 5). The lack of impact of preconditioning method on carcass attributes and performance measured across the entire finishing period agrees with previous findings (Mathis et al., 2008) comparing preconditioning approaches.

The proportion treated for sickness during finishing was 16.7 percentage units higher ($P = 0.01$) for low-input steers and resulted in a $6.63/steer greater ($P = 0.05$) medicine cost than for high-input steers. Morbidity rate of low-input steers was comparable with the 23.9% national average morbidity rate reported by the USDA-Animal and Plant Health Inspection Service (2001); however, high-input steers were lower than the USDA estimate but were equivalent to the 8% morbidity rate reported by Edwards (1996) for Midwestern feedlots. Previous work (Mathis et al., 2008) showed higher feedlot mortality (7.6 percentage units) when steers were preconditioned in a dry lot as compared with preconditioning on pasture. The higher mortality and numerically greater (14 percentage units) morbidity among dry-lot-preconditioned calves in that study were attributed to the additional stressors of greater dietary and environmental changes among the steers preconditioned in confinement on a high-grain pellet than among pasture-preconditioned calves. Although not statistically separable ($P = 0.36$), death losses in the current study for low-input and high-input steers were 4.4 and 1.6%, respectively. Across both studies, steers fed range cubes on pasture during the preconditioning phase exhibited feedlot morbidity rates of 25 and 34% (current study and Mathis et al., 2008, respectively). On the other hand, feedlot morbidity was 48% when Mathis et al. (2008) fed a preconditioning pellet in confinement, compared with only 8% when the same pellet formulation was consumed ad libitum by steers preconditioned in a pasture setting. Collectively, these studies suggest that providing a higher plain of nutrition to steers during preconditioning in a pasture environment may better precondition calves to cope with the

Table 5. Distribution of USDA QG and YG by preconditioning method

Item	Preconditioning method		*P*-value
	Low	High	
Number of steers	66	62	
USDA QG, %			0.28
Choice	59.1	46.8	—
Select	37.9	51.6	—
Dark cutter	3.0	1.6	—
USDA YG, %			0.48
1	0	3.2	—
2	21.2	17.7	—
3	62.1	59.7	—
4	16.7	19.4	—

immune challenges associated with shipping to a commercial feedlot.

Preconditioning treatment had no impact on finishing feed cost ($P = 0.63$) but caused a tendency ($P = 0.11$) for a higher total feedlot cost for high-input steers. This occurred largely because of the higher value of high-input steers at the end of preconditioning, resulting in a higher initial cost of high-input steers entering the finishing phase. Carcass price and gross income were similar ($P \geq 0.35$) between low-input and high-input steers. The numerical 2.8-percentage-unit difference in death loss between treatments made the greatest contribution to the $43.42 numerical difference in gross income between low-input and high-input steers. Overall, preconditioning treatment had no effect ($P = 0.49$) on finishing phase net income.

Although the differences in net income during the finishing phase were not statistically separable, the numerical advantage in profitability among high-input steers during finishing compensated for the net income advantage of low-input steers during the preconditioning phase. As a result, overall net income from weaning to slaughter was similar ($P = 0.90$) for low-input and high-input steers.

IMPLICATIONS

Beef calves can be preconditioned on pasture with divergent levels of nutritional input and programmed BW gain. The cost of nutritional inputs has a substantial influence on the profitability of a preconditioning program. Grazing calves on native rangelands at a higher rate of BW gain can better prepare calves to remain healthy after shipping. However, the increased feed input costs often required to achieve a higher rate of BW gain on pasture may not be cost effective relative to a lower cost approach if calves are sold after preconditioning or retained through slaughter.

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LITERATURE CITED

Boyles, S. L., S. C. Loerch, and G. D. Lowe. 2007. Effects of weaning management strategies on performance and health of calves during feedlot receiving. Prof. Anim. Sci. 23:637.

CattleFax. 2009. US Average 550-lb Steer Price. http://www.cattlefax.com Accessed Feb. 24, 2009.

Cravey, M. 1996. Preconditioning effect on feedlot performance. p. 33 in Proc. Southwest Nutr. Manage. Conf. University of Arizona, Tucson.

Edwards, A. J. 1996. Respiratory disease of feedlot cattle in the central USA. Bovine Pract. 30:5.

Forbes, A. C., and K. W. Allred. 2001. A field guide to the flora of New Mexico State University's Corona Range and Livestock Research Center. Agric. Exp. Sta. Res. Rep. 745. New Mexico State Univ., Las Cruces.

King, M. E. 2006. The effect of value added health programs, the owner certified natural program and age and source verification on the price of beef calves sold through seven Superior Livestock video auctions in 2006. Final Report. Pfizer Animal Health, Exton, PA.

King, M. E. 2007. The effect of value added health programs, the owner certified natural program and age and source verification on the price of beef calves sold through seven Superior Livestock video auctions in 2007. Final Report. Pfizer Animal Health, Exton, PA.

Lalman, D., S. Hutson, W. Shearhart, C. Ward, and S. McKinley. 2005. Preconditioning reduces sickness and death loss in weaned calves. J. Anim. Sci. 83(Suppl. 2):21. (Abstr.)

Mathis, C. P., S. H. Cox, C. A. Löest, M. K. Petersen, R. L. Endecott, A. M. Encinias, and J. C. Wenzel. 2008. Comparison of low-input pasture to high-input drylot backgrounding on performance and profitability of beef calves through harvest. Prof. Anim. Sci. 24:169.

St. Louis, D. G., T. J. Engelken, R. D. Little, and N. C. Edwards. 2003. Case study: Systems to reduce the cost of preconditioning calves. Prof. Anim. Sci. 19:357.

Texas AgriLIFE Extension Service. 2005. Value Added Calf (VAC)-Vaccination Program. ASWeb I20. Texas AgriLIFE Extension Service. http://animalscience.tamu.edu/images/pdf/beef/beef-vac-mgmt.pdf Accessed Feb. 24, 2009.

USDA. 2007. New Mexico Weekly Weighted Average Feeder Cattle Report. USDA CV LS795. http://www.ams.usda.gov/mnreports/CV_LS795.txt Accessed Nov. 12, 2007.

USDA-Animal and Plant Health Inspection Service. 2001. Treatment of respiratory disease in U.S. feedlots. Rep. N347-1001. USDA-Anim. Plant Health Inspection Serv., Fort Collins, CO.