ROUNDUP 1998

Agricultural Research Center—Hays

Report of Progress 808

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ROUNDUP 1998

KAES Report of Progress 808

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Statement of Purpose

Roundup is the major beef cattle educational event sponsored by the Agricultural Research Center–Hays. The 1998 program is the 85th staging of Roundup. The purpose is to communicate timely research information to producers and extension personnel.

The research program of the Agricultural Research Center–Hays is dedicated to serving the people of Kansas by developing new knowledge and technology to stabilize and sustain long-term production of food and fiber in a manner consistent with conservation of natural resources, protection of the environment, and assurance of food safety. Primary emphasis is on production efficiency through optimization of inputs in order to increase profit margins for producers in the long term.

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KAES Contribution No. 98-340-S

Evaluating Calves with Ultrasound at Weaning for Future Carcass Potential

John R. Brethour

Beef Cattle Scientist

Summary

Results from a study with 796 calves indicated potential to estimate carcass quality grade (Choice or Select) from ultrasound estimates of marbling at weaning. Assignment of calves to Select or Choice categories at weaning was 71% accurate. A strong mathematical relationship existed between weaning marbling score and future quality grade and would be useful to set criterion levels to obtain a desired proportion of Choice. Although a relationship also existed between ultrasound-estimated backfat at weaning and future cutability grade, it may be too small for most applications. Other research has shown that carcass backfat can be controlled by measuring cattle midway in the feeding period and sorting into outcome groups.

Introduction

Ultrasound has been a useful technology for evaluating feedlot and purebred cattle. In the feedlot, ultrasound estimates made as much as 100 days prior to slaughter have effectively predicted future quality and cutability grades.

A technology that evaluates calves at weaning and projects carcass potential would have considerable value. Calves could be sorted for marketing programs that emphasize either quality or lean. The technology might enable selecting superior candidates for retained-ownership feeding programs.

An opportunity to conduct a study with a large number of calves was provided by the J. B. Grierson Ranch at Hysham, Montana. This ranch assisted in maintaining individual animal identification, assuring equivalent management of the different sets from weaning to slaughter, and sponsoring carcass data collection.

Methods

Backfat thickness and marbling estimates were made on over 2000 9-month-old calves at the J. B. Grierson Ranch in Montana in November, 1995. The evaluations were conducted within 3 weeks after weaning when calves averaged about 525 lbs. A wide spectrum of breeds existed among the calves but did not include Brahman or dairy. Calves then were kept in a backgrounding lot on the ranch until moved to Kansas or Nebraska feedlots for finishing.

At evaluation time, calves were sorted into two groups, Choice or Select, based on expected quality grade predicted from ultrasound marbling estimates. Marbling threshholds were established to attempt to obtain 80% Choice in that group. Those thresholds were elevated slightly for heavier calves that would be marketed at a younger age.

Full carcass data were not obtained because tag transfer enabled recovering only final USDA grades from the packing house kill sheets. In order to avoid contaminating data, cattle that lost tags and carcasses that were railed out at the packing plant were excluded. Only those sets of calves in the Choice and Select groups for which management was identical were used in the analysis. Data are reported on 796 calves that met the criteria for inclusion.

Results

The results are summarized in Table 1 and Figure 1. The first group (heavy steers) averaged 630 lbs at weaning, were moved to the feedlot on March 12, and were slaughtered after 85 days on feed. The short feeding period may account for the fact that only 71% Choice was obtained among those predicted to grade Choice.

The second group (Medium steers and heifers) was placed on feed on May 9 and marketed on August 8. Among those cattle, the Hereford and also had the longest interval from evaluation to slaughter. However, the accuracy of the sort was 70%.

Figure 3 shows a plot of the likelihood of grading Choice and the ultrasound marbling score obtained at weaning from the 506 cattle in group 2. It indicates that a criterion level of about 3.6 was correct to identify calves that would have an 80% probability of grading Choice after feeding. The R-squared value of this sigmoid model (Percent probability of Choice = 100/(1 + 168113.4 x marbling score $^{-9.97122}$) was 0.88.

objective of 80% Choice was achieved. However, that allowed a considerable number of calves to be assigned to the Select group that graded Choice. Lowering the critical marbling level for the assignment decision would have increased the overall accuracy but reduced the proportion of Choice in that group.

The third group (Certified Hereford - Figure 2) was sent to the feedlot on June 12 and marketed on September 3. This group poised the greatest challenge because they represented cattle with 50% or more

Cutability Grade Predictions

The correlation of weaning backfat level to eventual cutability grade was low (R squared = .07), although this statistic was highly significant because of the large number of animals in the analysis. That relationship is shown better in Figure 4, which indicates that calves with less than 2 mm backfat at weaning had a 60% probability of grading Yield Grade 2 or better, whereas those with 4 or more mm backfat had only an 18% probability of a yield grade that desirable. However, the latter class included only 11 calves.

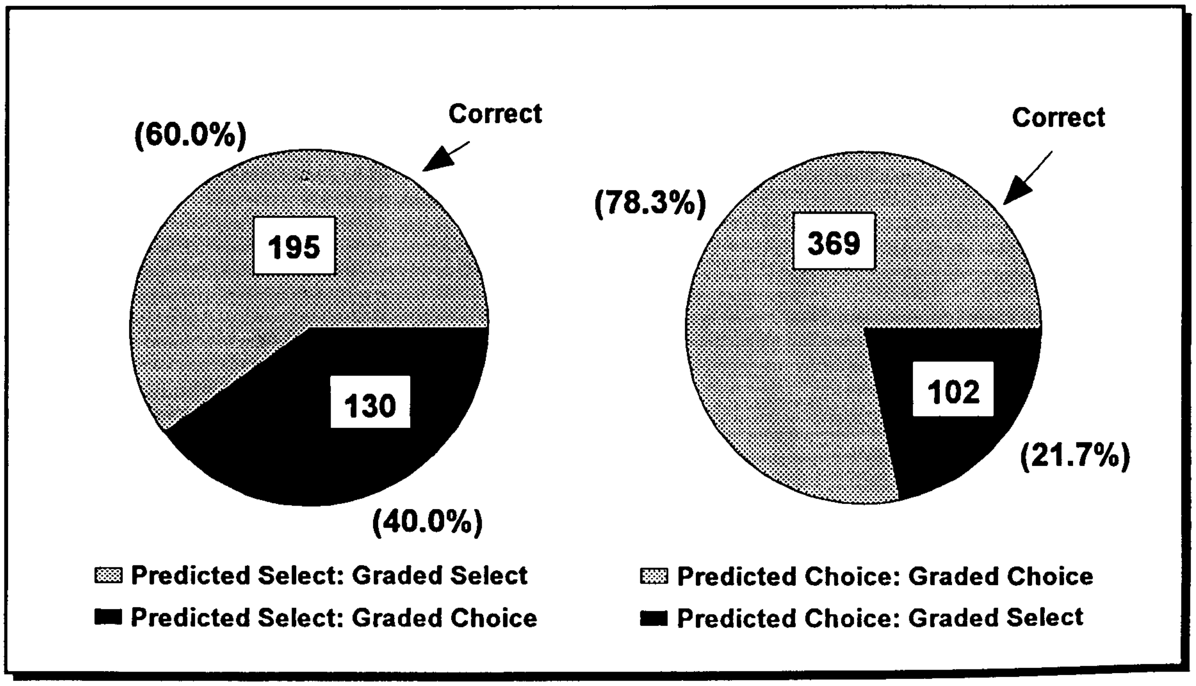

Figure 1. Projecting future quality grade from ultrasound marbling scores at weaning. 796 calves; average 247 days from evaluation to slaughter

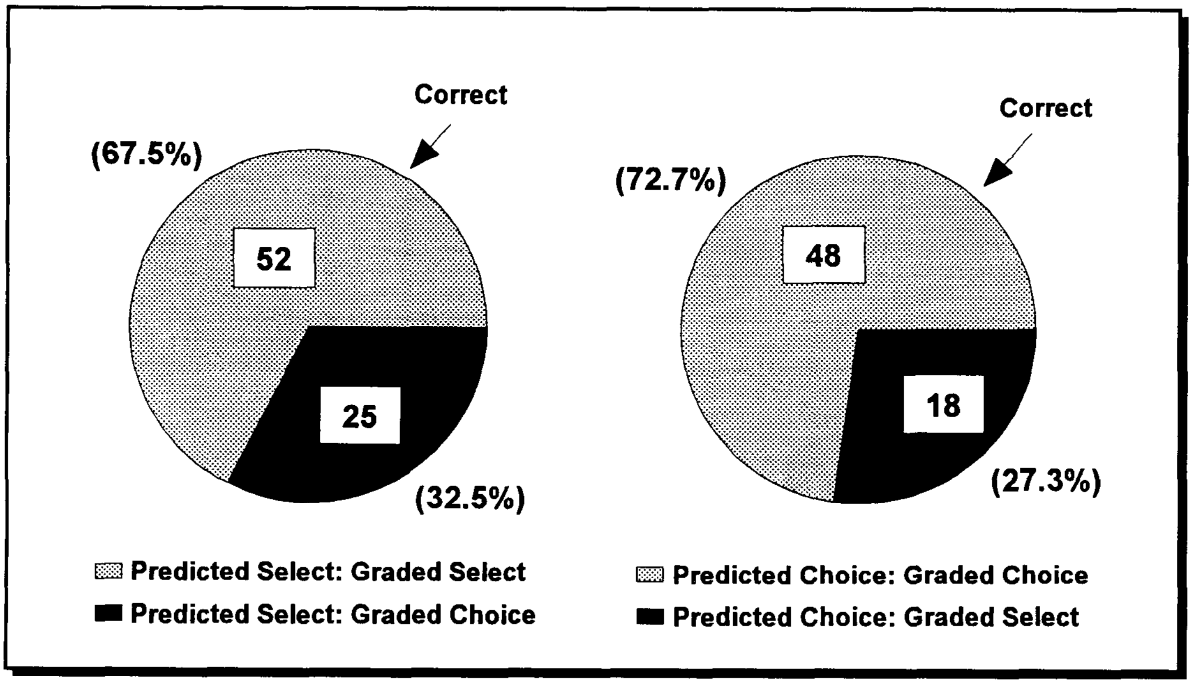

Figure 2. Projecting future quality grade from ultrasound marbling scores at weaning. 143 Hereford calves; 280 days from evaluation to slaughter

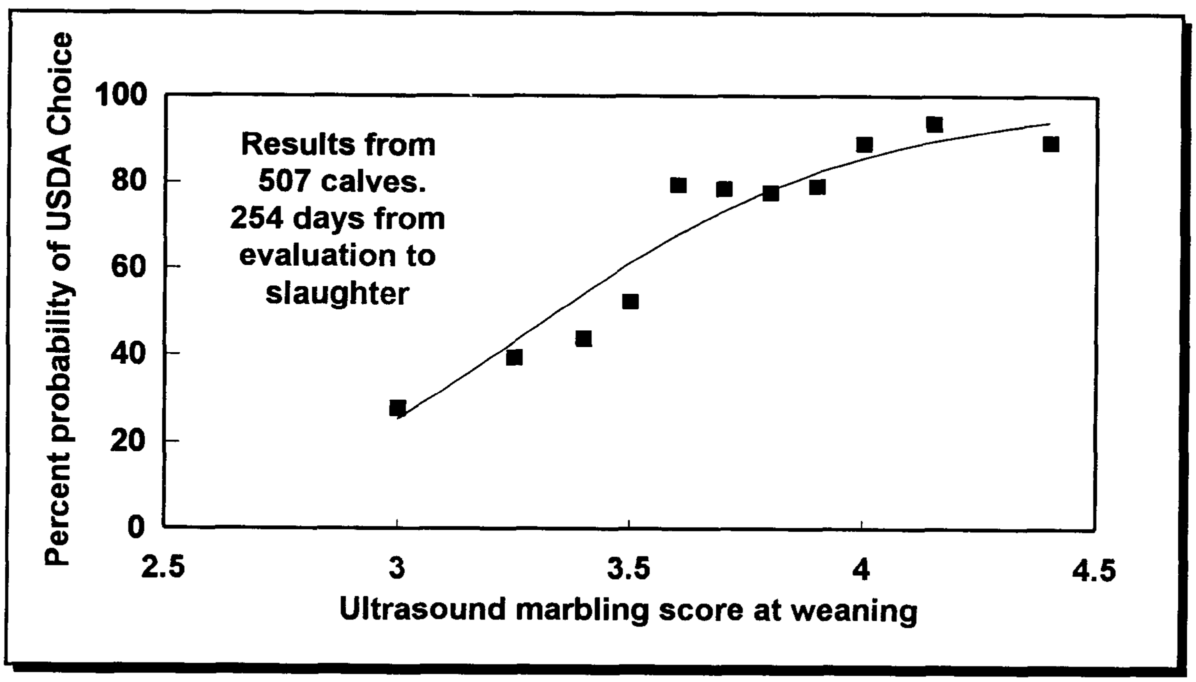

Figure 3. Relationship of ultrasound marbling score at weaning and probability of grading Choice when slaughtered 254 days later.

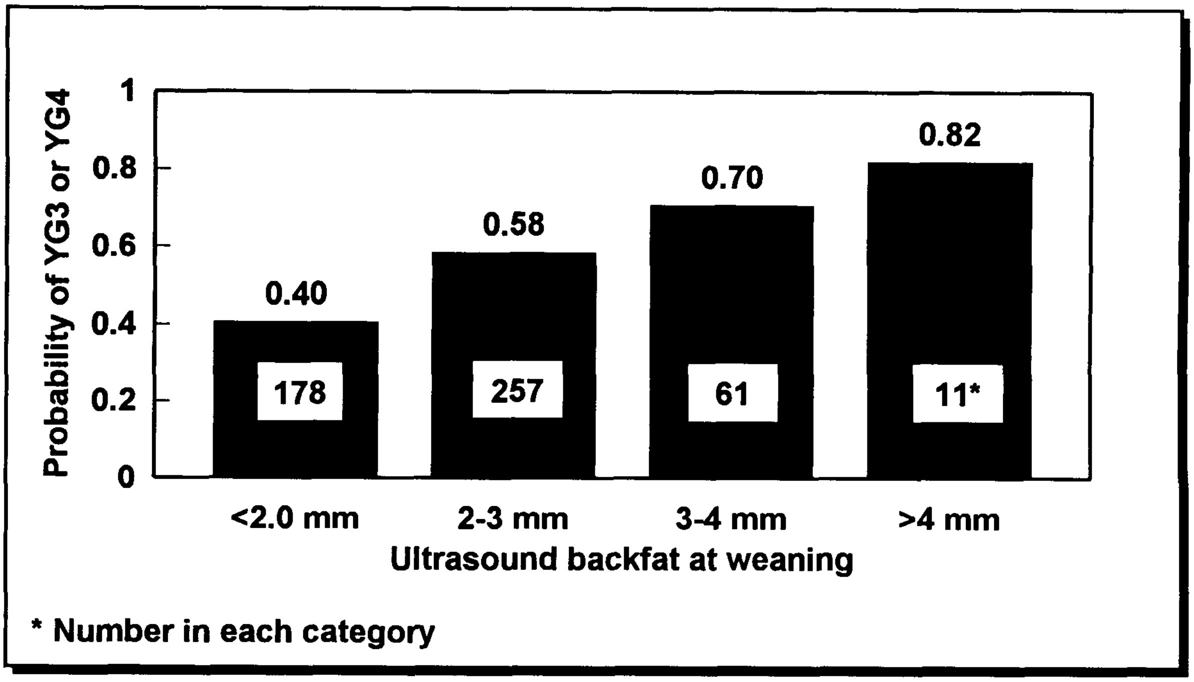

Figure 4. Relationship of ultrasound backfat thickness at weaning and probability of grading Yield Grade 3 or 4 254 days later.

Table 1. Quality grade outcomes of 796 calves evaluated at weaning.

Cattle Group	Days from Evaluation to Slaughter	Predicted Select: Graded Select	Predicted Select: Graded Choice	Predicted Choice: Graded Choice	Predicted Choice: Graded Select
Heavy steers	190	50	12	60	25
accuracy		80.65%		70.59%	
Medium steers	254	59	60	154	40
accuracy		49.58%		79.38%	
Medium heifers	254	34	33	107	19
accuracy		50.75%		84.92%	
Certified Hereford	280	52	25	48	18
accuracy		67.53%		72.73%	
Total		195	130	369	102
accuracy		60.00%		78.34%	

Accuracy of Projecting Carcass Grades with Ultrasound at Different Intervals between Evaluation and Slaughter

John R. Brethour

Beef Cattle Scientist

Summary

Two groups of steers were evaluated for backfat thickness and marbling at arrival at the feedlot and periodically throughout the feeding period to determine the improvement in accuracy for predicting future carcass merit as the interval to slaughter shortened. Satisfactory prediction of the number of days to reach 0.4 inch backfat was difficult when thin steers that averaged only 0.07 inch backfat were measured at arrival. Prediction accuracy improved as the interval between evaluation and slaughter shortened but was satisfactory after cattle exceed 0.10 inch backfat. Likewise, carcass marbling predictions were more accurate when the evaluations neared slaughter. But marbling evaluations made at arrival seemed useful in identifying contingents with either low or high probabilities of grading Choice.

Introduction

Previous research has shown that ultrasound can predict carcass merit when used at reimplanting time midway in the feeding period and about 70 to 100 days before slaughter. There is an interest in using this technology for sorting cattle into outcome groups when they arrive at the feedlot. Consequently, a study was conducted to measure the relative accuracy of evaluations made when cattle started on feed and periodically throughout the feeding period.

Methods

Two sets of cattle were used in this study. The first group contained primarily mixed breeds including many continental breed crossbreds. They were evaluated with ultrasound four times, at arrival and at days 37, 76, and 123. Their average time on feed was 167 days.

The second group included 292 yearling Angus and Angus X Hereford steers. Backfat thickness and marbling estimates were made with ultrasound soon after they arrived and again after they had been on feed for 81 days (average of 59 days before slaughter).

Cattle within each group were not slaughtered at the same time, but marketed in 4 outcome sets when they approached 0.4 inch (10 mm) backfat. This made simple correlations of ultrasound-measured backfat and carcass backfat useless as measures of accuracy. Consequently, the number of days to reach 10 mm projected from the ultrasound measures was compared to the number of days needed for each animal to reach 10 mm backfat from extrapolation of the carcass measures. Both the projections and extrapolations were from the model $Y = A \times e^{(k*t)}$, where Y = projected backfat, A is the present backfat thickness, k = the rate of increase (which was between .0097 and .0124 among these cattle), and t = time in days. Iteration was used to determine the rate coefficients that provided the best least squares fit for each scanning session. For extrapolation, the equation for adjusting days from actual day of slaughter is Y = (ln(10) - ln(x))/k, where x is the carcass backfat thickness at slaughter.

Slaughtering cattle at different times may have caused a bias in carcass marbling scores because of differences in grading. That bias was removed with a simple regression model that considered slaughter dates as categorical variables and included the ultrasound marbling estimates. Then actual carcass marbling scores were adjusted for the effects of those categorical variables, and partial correlations with ultrasound estimates were obtained.

Predicting Days to Reach .4 Inch Backfat

Results are presented in Figures 1 and 2. Both the R-squared values and average errors measure the accuracy at each scanning date, but the latter is probably more effective in evaluating the relative merit for sorting cattle into outcome groups. The accuracy in predicting days on feed to reach .4 inch backfat was poor in group 1 when cattle were evaluated at arrival, but improved with successive measurements (Figure 1). In group 1, 87% of the animals had 2 mm or less backfat when the first measurements were made, and the 138 head averaged only 1.78 mm (standard deviation - std = 0.51) at that time. That appeared to be an insufficient backfat level to effectively project future carcass backfat. (Projecting carcass backfat is an essential component for clustering cattle in outcome groups.) By 37 days on feed, average backfat and the std had increased to 2.21 mm and 1.32 mm, respectively. That improved the prediction accuracy considerably. The reason that some days are negative in Figure 1 C and 1 D is that a few cattle exceeded .4 inch backfat when those evaluations were made.

Group 2 cattle were fatter when they arrived at the feedlot; backfat averaged 3.35 mm, and the std was 1.10 mm. Consequently, projections on these cattle made at arrival and 140 days before slaughter were usable (Figure 2 A). However, accuracy was improved greatly when cattle were evaluated 81 days later (Figure 2 B).

Predicting Carcass Marbling Score (Quality Grade)

The R-squared value is a measure of the percent total variation in carcass marbling score predicted from the ultrasound estimates and is a suitable statistic to compare the relative accuracy among the different sessions. In both groups (Figures 3 and 4), prediction accuracy improved as the interval between evaluation and slaughter shortened (with an unexplained exception at the third evaluation of group 1 - Figure 3 C).

An ultrasound evaluation at arrival may be useful in identifying contingents with either low or high probabilities of grading Choice. For example, in group 1, the quartile with the lowest ultrasound marbling scores graded 11% Choice, whereas the quartile with the highest scores graded 62% Choice (the entire group 1 graded only 34% Choice). In group 2, the equivalent values for the lowest, and highest-scoring quartiles of the arrival scans were 60 and 96% Choice, and the overall total was 79% Choice.

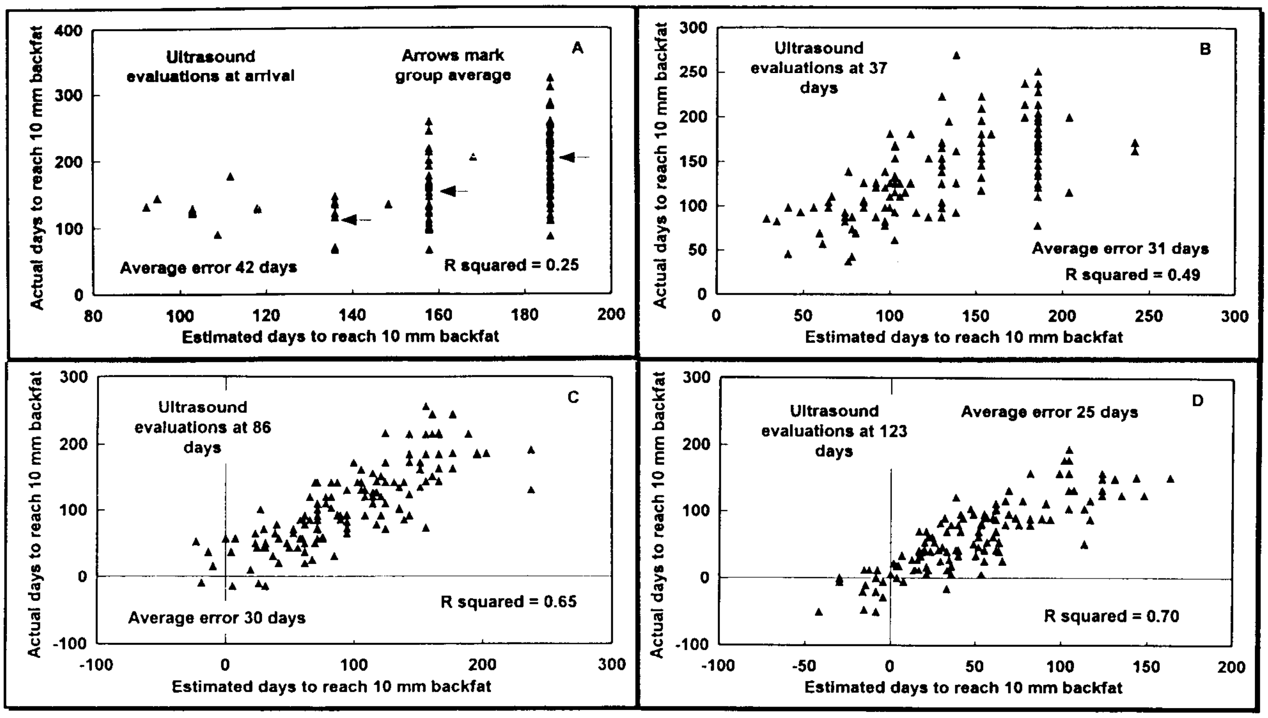

Figure 1. Estimating days to reach .4 inch backfat from ultrasound evaluations made periodically throughout the feeding period. Group 1.

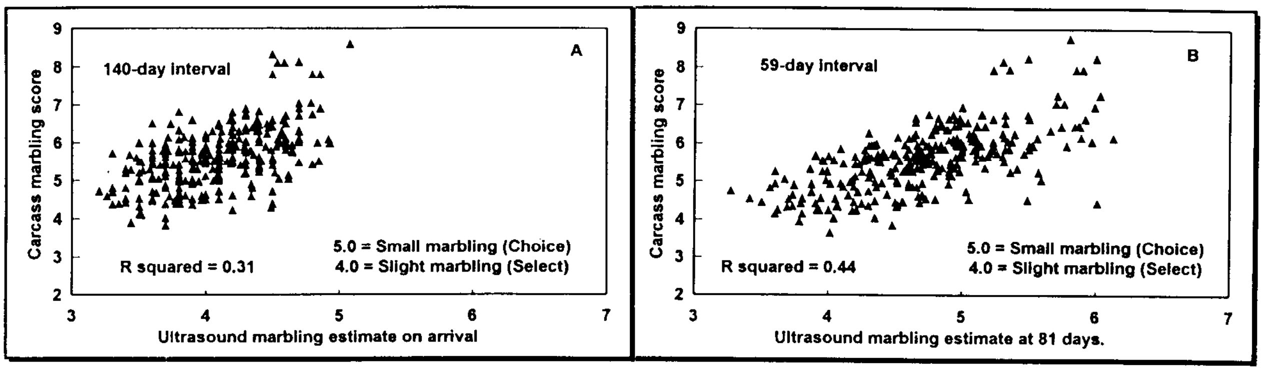

Figure 2. Estimating days to reach .4 inch backfat from ultrasound evaluations made periodically throughout the feeding period. Group 2.

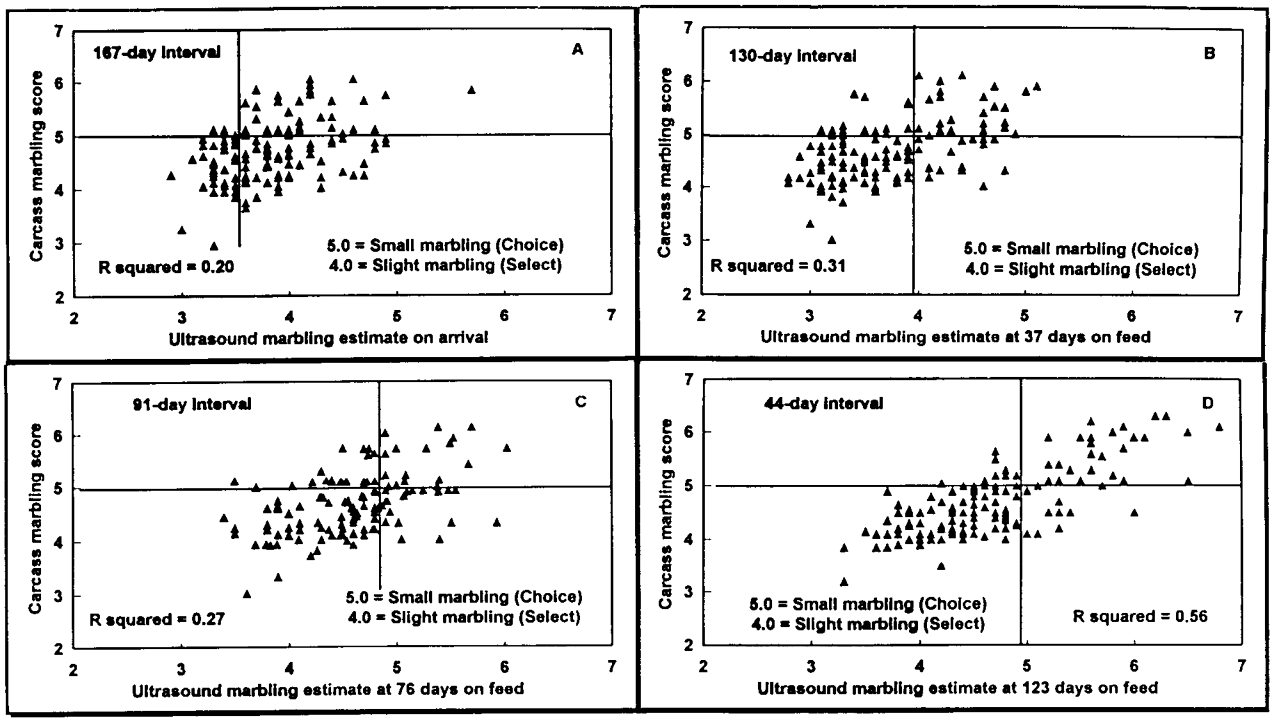

Figure 3. Estimating carcass marbling from ultrasound evaluations made periodically throughout the feeding period. Group 1

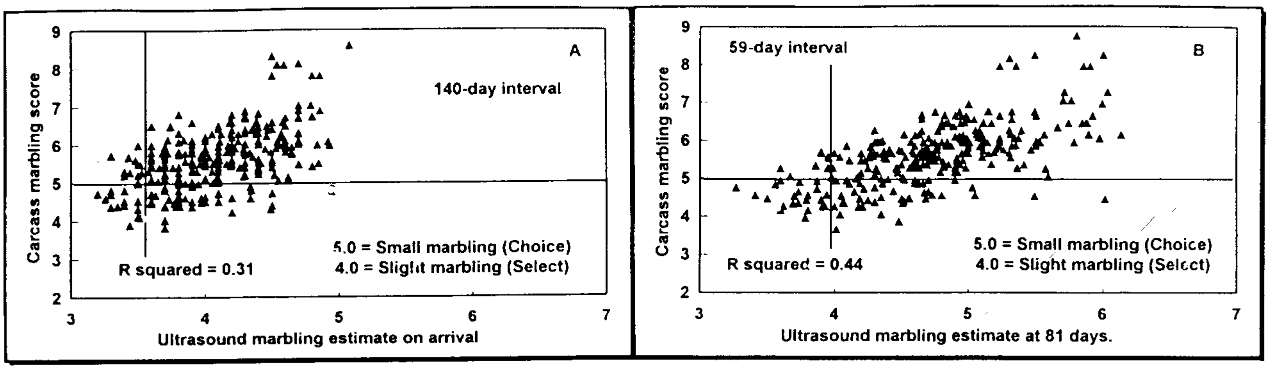

Figure 4. Estimating carcass marbling from ultrasound evaluations made periodically throughout the feeding period. Group 2

Influence of Implants during Suckling on Pre- and Postweaning Performance of Steer Calves

John E. Huston, Eric S. Vanzant, and John R. Brethour

Assistant Scientist, Ruminant Nutritionist, and Beef Cattle Scientist

Summary

Calves that received growth implants during the suckling phase had greater pre-weaning average daily gain and weaning weights than calves that did not receive growth implants during the suckling phase. This improved performance did not continue through the finishing phase. When the cattle reached the desired endpoint (.4 inches of backfat as determined by ultrasound), calves that had not received growth implants during the suckling phase had greater feedlot gains and therefore had reached similar final live weights compared to calves that had received growth implants during the suckling phase. All calves had similar carcass weights, ribeye areas, backfats, and marbling scores.

Introduction

Research has shown that growth implants improve the weight gain of cattle. Thus, the use of growth implants has become common in our industry. Timing of these implants can have an impact on their profitability. Proper timing can utilize compensatory growth and potentially make the cattle more profitable. When planning an implant strategy, one must consider the point at which the cattle will be marketed. If the cattle are to be marketed at weaning time, a growth implant during the suckling phase can be utilized to increase the total pounds of calf weaned and marketed. These increases can be 20 to 30 lbs. and can more than pay for the cost of the implant. These increases can be greater when two implants are given during the suckling phase. However, if ownership of the cattle is to be retained through the growing and (or) finishing phase, it can be more advantageous for the cattle to receive their first implant at the beginning of the feeding period. This advantage is due to greater gains in previously nonimplanted cattle compared with those that have received implants during suckling. The use of implants containing 72 mg zeranol (Ralgro Magnum®) may allow previously implanted cattle to maintain their weaning weight advantage throughout the finishing phase of production.

The purpose of this experiment was to evaluate the influence of a preweaning implant on the growth and carcass characteristics of steers receiving Ralgro Magnum® implants during the finishing phase.

Methods

Seventy eight spring-born, Simmental X Angus steers were used in a randomized block design. Thirty-seven steer calves received implants containing 36 mg zeranol (Ralgro®) during the suckling phase (average age at implanting = 60 days). During the suckling phase, all calves were assigned, along with their dams, to one of two native range pastures (blocks) with no supplementation. At weaning, all steer calves were placed in the feedlot (n = 78). After a 30-day receiving phase, steers were fed a standard diet of finely ground sorghum grain with approximatley 10% sorghum silage and a protein/mineral supplement containing 300 mg monensin (Rumensin®) and 90 mg tylosin (Tylan®) per steer daily. The implant strategy for the finishing phase consisted of 72 mg zeranol (Ralgro Magnum®) upon arrival at the feedlot and at re-implanting time (approximately 90 days after arrival). Backfat was measured by ultrasound, and cattle were slaughtered when they reached a target backfat measurement of .4 inches or when liveweight exceeded 1400 lbs. Thus, cattle were slaughtered in two groups (balanced across treatments) at average ages of 14 and 15 months. Cattle that were slaughtered at 15 months of age (n = 17) received an implant containing 140 mg trenbolone acetate and 20 mg estradiol-17β (Revalor®) 45 days before slaughter. Because birth weight differed between treatments (P = .05; average birth weight = 86 lb), it was used as a covariate within a randomized block design in the statistical analysis of weight and gain responses using the General Linear Models program of SAS. Carcass data were analyzed as a randomized block design without the use of a covariate.

Results and Discussion

Calves that received a growth implant during the suckling phase were 32 lbs. heavier (P = .02) at weaning than calves that did not receive a growth implant during the suckling phase (Table 1). The implanted calves had greater preweaning average daily gain (P = .04), although this advantage did not continue through the finishing phase. Calves that did not receive a growth implant during the suckling phase gained at a similar (P = .62) rate as previously implanted calves during the early finishing phase but tended (P = .20) to gain more rapidly during the latter portion of the finishing phase. Thus, weights still tended (P = .10) to differ at reimplanting time but were similar (P = .45) by the end of the finishing period. Carcass weight, backfat, marbling score, and ribeye area were similar for both groups. Responses to treatments were similar when the late-marketed cattle were excluded from the data set. If calves are to be marketed at weaning time, the use of preweaning growth implants provides a clear advantage in weaning weight. However, implanted calves had lower average daily gain on feed and, therefore, might prove to be less profitable in retained-ownership programs. The use of preweaning growth implants had no significant effect on any of the carcass traits measured.

Table 1. Influence of implants during suckling on growth and carcass characteristics of steers.

Item	No Implant	Implant	SEM[a]	P - Value[b]
Weaning weight, lb[c]	576.4	608.9	9.42	.02
ADG, birth to weaning, lb/d[c]	2.16	2.28	.040	.04
Weight at reimplanting, lb[c,d]	889.3	917.9	11.84	.10
ADG, weaning to reimplanting, lb/d[c]	3.46	3.41	.060	.62
Final weight, lb[c]	1202.5	1218.9	14.96	.45
ADG, reimplanting to final, lb/d[c]	3.51	3.35	.083	.20
Carcass weight, lb	769.0	762.8	11.74	.71
Carcass backfat, in	.43	.42	.02	.66
Carcass marbling score[e]	5.1	5.0	.13	.60
Ribeye area, in^2	13.25	13.13	.355	.81

[a] SEM = standard error of the mean
[b] P-value = probability of a greater F-value.
[c] Means adjusted for influence of birth weight.
[d] All steers reimplanted after approximately 90 days on feed.
[e] Marbling score: 5.0 = small marbling (Choice); 6.0 = modest marbling (CAB).

Intake, Digestion, and Rumen Fermentation Responses by Beef Steers to Sunflower Meal Supplementation of Forage-Sorghum Hay Diets[1]

Eric S. Vanzant

Ruminant Nutritionist

Summary

Beef steers consuming moderate-quality forage sorghum hay were supplemented with sunflower meal pellets in amounts that provided the equivalent of 100 to 200% of the crude protein requirements for third-trimester beef cows consuming equivalent amounts of forage (as a percentage of body weight). Intake of digestible organic matter was increased with levels of supplemental protein well in excess of those predicted to meet crude protein requirements. Thus, these data support the contention that the crude protein system used in the 1984 Nutrient Requirements of Beef Cattle does not accurately depict the true requirements for dietary protein. Furthermore, preliminary calculations suggest that the responses seen in this study would be predicted accurately by incorporating protein degradability values and assuming that maximum digestible organic matter intake occurs when degradable intake protein equals 11.5% of digestible organic matter intake. These results are in close agreement with results of research using other forages and protein supplements.

Introduction

Adding supplemental protein to low-protein forage diets can lead to dramatic increases in voluntary intake and digestion of the forages by beef cattle. These improvements in intake and digestion have been attributed mainly to the portion of the supplemental protein that is degraded within the rumen. This protein fraction often is referred to as degradable intake protein or DIP. The portion of the protein that escapes the rumen without degradation often is called undegradable intake protein or UIP. Recently, the National Research Committee updated the approach to formulating protein requirements for beef cattle by eliminating the traditional use of crude protein (CP) and using instead requirements for metabolizable protein (MP) and DIP. In general, greater amounts of total protein are required in supplements to meet DIP needs than would be required to meet CP needs. However, available information is insufficient to allow us to accurately predict the benefits of providing additional protein to meet the DIP needs of beef cattle. In this experiment, sunflower meal (SFM) pellets were used as a protein supplement for a moderate-quality forage sorghum hay because previous research has indicated that SFM is reasonably high in DIP. The objectives of this experiment were to quantify the responses in intake, digestion, and ruminal fermentation by beef cattle consuming a moderate-quality forage sorghum hay supplemented with increasing amounts of protein from SFM.

[1] Appreciation is extended to Archer Daniels Midland Co. for providing the sunflower meal pellets used in this experiment.

Methods

Seven ruminally fistulated beef steers (average weight = 991 lb) were used in a four-period incomplete Latin square design with seven treatments. Treatments included 1) no supplement and SFM pellets (30.4% CP; 42.6% NDF) fed in increasing amounts: 1) no supplement; 2) 1.5 lb DM/d; 3) 3.0 lb DM/d; 4) 4.5 lb DM/d; 5) 6.0 lb DM/d; 6) 7.5 lb DM/d; and 7) 9.0 lb DM/d. These levels corresponded to 0, 7, 14, 21, 28, 35, and 42 g of SFM DM/kg $BW^{.75}$ daily. All steers received a mineral mixture including salt, dicalcium phosphate, trace minerals, and vitamin A. Additionally, limestone was added to SFM to maintain a Ca:P ratio of 1:1. Steers were fed moderate-quality forage sorghum hay (7.4 % CP; 61.3% NDF) once daily at 130% of ad libitum intake in individual metabolism pens under continuous lighting, with free access to water. The forage sorghum hay was conserved in large round bales and processed through a tub grinder with a 2.5 in screen. Refused feed was removed, weighed, and sampled daily. Sunflower meal pellets were mixed with minerals and fed daily before feeding forage sorghum. Before data collection in each period, steers were adapted to diets for a minimum of 10 days. Following 6 days of voluntary intake measurement, steers were fitted with fecal collection bags for measurement of total fecal output across a 6-day period. After the fecal collection period, steers were dosed with 1.3 g chromium as Cr:EDTA as a fluid dilution marker, and ruminal fluid samples were obtained at 3 h intervals for 12 h for measurement of ruminal fermentation characteristics and Cr concentrations. An additional sample was obtained 24 h after dosing for measurement of fluid dilution rate. Samples of forage sorghum, supplements, and feces from daily collections were dried immediately at 122° F in a forced-air oven for determination of dry matter concentrations. Samples were pooled across days within each period for subsequent chemical analyses.

Results and Discussion

Forage organic matter (OM) intake ranged from 19.7 to 23.8 lb per day and total OM intake ranged from 19.7 to 28.9 lb per day (data not shown). Although steers were assigned randomly to treatment sequences within this experiment, small differences in body weight were detected ($P < .10$) among the treatments. Therefore, intake values were adjusted for body weight differences in the data presented (Figure 1). Voluntary forage intake increased with the first increment of SFM and then leveled off and decreased as the amount of supplemental SFM increased. Above 3 lb SFM daily, each lb of OM from SFM replaced approximately .7 lb of OM from forage in the steers diets. Because this substitution was less than 1 to 1, total OM intake continued to increase as the level of SFM increased, although total OM intake also reached a plateau when SFM levels reached around 6 lb/day.

As with forage OM intake, OM digestion increased with the first increment of SFM and reached a plateau thereafter (Figure 2). With no supplemental protein, OM digestibility of the forage sorghum hay was around 57%. With all levels of supplement, total diet digestion was around 62%, suggesting that the potential OM digestibility of the forage sorghum was similar to the digestibility of the SFM (also about 62%).

Digestion of neutral detergent fiber (NDF) was increased with the first increment of SFM, leveled off with increasing SFM, and was depressed when SFM levels exceeded 4.5 lb/d. This response suggests that the protein in the SFM stimulated forage fiber digestion and that the fiber contained in the SFM was somewhat less digestible than the fiber in the forage sorghum hay.

The intake of digestible OM gives us a reasonable prediction of the influence of SFM on energy consumption. As with total OM intake, digestible OM intake reached a plateau at around 6 lb of SFM/day, suggesting that overall energy status should be improved by supplemental SFM up to about 0.6% of body weight with forage of similar quality.

Because volatile fatty acids (VFA) are the primary energy-containing compounds remaining after ruminal fermentation of feedstuffs, they give us a good indication of the relative energy supply available to the animal. The response of total VFA concentrations in the rumen was similar to that of digestable OM intake, further suggesting that energy supply would be maximized at around 0.6% of body weight of SFM. Additionally, changes in ruminal pH responded in concordance with the ruminal VFA patterns, decreasing from 6.8 with no supplemental protein to reach a plateau of around 6.4 when SFM was supplemented at or above 6.0 lb/day. Even with the highest level of supplemental SFM, ruminal pH remained above levels considered to be detrimental to ruminal fiber digestion. Only small shifts were seen in the proportions of acetate, propionate, and butyrate in the rumen, and consequently, acetate: propionate ratios declined only slightly as SFM increased. Relative proportions of valerate, isobutyrate, and isovalerate, which are required by ruminal cellulolytic bacteria, increased in response to increasing SFM. Increases in the proportions of these VFA have been shown in other research when protein supplements are added to forage-based diets and could account for some of the increase in forage digestion seen with the addition of supplemental protein.

Estimates of CP requirements and intake for 1200 lb beef cows were calculated assuming similar intake as a percent of body weight as was measured in this study and using equations published in the 1984 Nutrient Requirements of Beef Cattle (Table 2). Results suggest that the CP requirements of mature cows in the third trimester of gestation would have been met without any supplemental protein and that our highest level of SFM would have provided approximately twice the CP needs of these cows. However, our results suggest that cows would be able to respond positively to supplemental CP up to approximately 170% of the 1984 NRC CP requirement. Previous research from Kansas State University has suggested that the intake and digestion of low-quality forages by beef cows can increase in reponse to increased supplemental protein up to the point at which DIP reaches approximately 10 to 13% of the digestible OM intake. Using previous estimates of the protein degradability in the forage sorghum (52% of CP) and SFM (74% of CP), we estimate that intake of digestible OM was maximized when total DIP intake was 11.5% of digestible OM intake, in agreement with previous studies. Additional research is ongoing to obtain estimates of the DIP concentrations of the forage sorghum and SFM used in the present study.

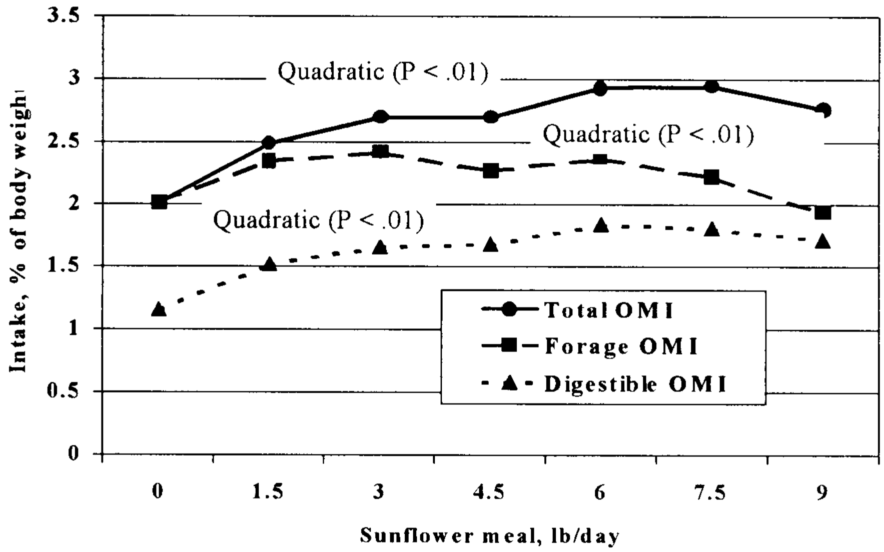

Figure 1. Effect of increasing amounts of sunflower meal pellets on organic matter intake (OMI).

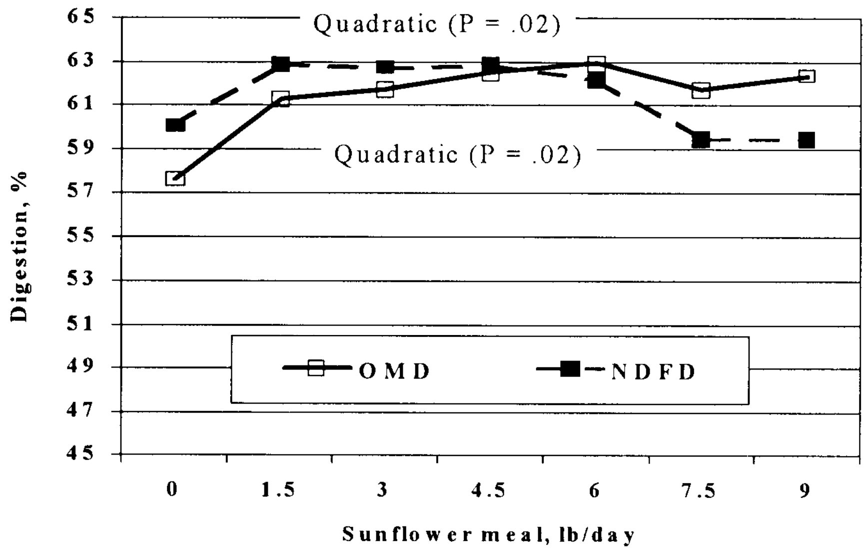

Figure 2. Effect of increasing amounts of sunflower meal pellets on organic matter (OM) and neutral detergent fiber (NDF) digestion.

Table 1. Effects of increasing amount of sunflower meal on ruminal liquid dilution rate and fermentation characteristics.

	Sunflower Meal, lb/day							
Item	0	1.5	3.0	4.5	6.0	7.5	9.0	SEM[a]
Liquid dilution, %/h[b]	8.31	9.16	8.19	9.92	8.57	9.29	8.77	.253
VFA, mM[b]	73.6	90.8	98.7	97.4	108.2	109.3	110.7	3.63
A:P[c,d]	4.59	4.63	4.41	4.35	4.19	4.27	4.29	.080
pH[b]	6.80	6.64	6.53	6.51	6.38	6.41	6.33	.050
	moles/100 moles							
Acetate[b]	73.0	72.3	71.6	71.2	70.4	70.4	70.3	.24
Propionate[c]	16.0	15.7	16.3	16.5	16.9	16.7	16.6	.28
Butyrate[b]	9.5	10.3	10.2	10.2	10.6	10.5	10.5	.19
Valerate[b]	.69	.77	.88	.92	.97	1.01	1.07	.026
Isobutyrate[c]	.44	.46	.56	.57	.58	.67	.72	.051
Isovalerate[c]	.34	.36	.49	.59	.55	.72	.85	.067

[a] SEM = standard error of the mean (n = 7).
[b] Quadratic effect of treatment ($P < .10$).
[c] Linear effect of treatment ($P < .10$).
[d] A:P = acetate:propionate ratio.

Table 2. Estimates of CP requirements and supply for 1200 lb beef cows in the third trimester of gestation using dry matter intake estimates from steer digestion study.

	Sunflower Meal, lb/day						
Item	0	1.5	3.0	4.5	6.0	7.5	9.0
CP required, lb[a]	2.05	2.33	2.49	2.51	2.65	2.63	2.63
CP supplied, lb[b]	2.09	2.90	3.52	3.95	4.56	4.98	5.34
CP supply/ CP requirement	102%	124%	141%	158%	172%	190%	203%

[a] Calculated according to NRC (1984): CP required = $(.0334 * DMI + 2.75 * BW^{.5} + .2 * BW^{.6} + 55)/(.90 * .66)$.
[b] CP supplied = DMI (%BW) * 1200 lb * CP concentration of diet.

Performance Responses by Beef Cows to Increasing Levels of Supplemental Sunflower Meal Pellets[1]

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Summary

Weight and body condition changes of beef cows responded positively to supplemental protein from sunflower meal in excess of NRC (1984) CP requirements. These results suggest that the CP system does not adequately account for beef cow responses to dietary protein and that other approaches must be evaluated. The economic benefit of protein in excess of CP requirements will depend on the energetic status of the cows at the beginning of the supplementation period.

Introduction

Previous research has indicated that when ruminally degraded intake protein (DIP) is below optimal levels, beef cows have the ability to respond to supplemental protein in excess of that predicted using the traditional approach of balancing for crude protein (CP). Digestion and intake responses of steers consuming a moderate-quality forage sorghum hay indicated that energy consumption by beef cows would be increased by supplementing sunflower meal (SFM) at levels up to 28 g/kg metabolic body weight ($BW^{.75}$; approximately 7 lb for a 1200 lb cow). This study was conducted to determine whether beef cows would respond positively to supplemental protein in excess of their predicted CP requirements and to quantify the benefits obtained from incremental increases in supplemental protein supplied by SFM pellets.

Methods

One hundred four crossbred, spring-calving, beef cows (average initial weight = 1183 lb; average initial body condition score = 4.5 on 1-9 scale) were assigned randomly to eight groups, while balancing for cow weight, body condition, age, genotype, estimated days pregnant, and previous nutritional treatment. Two groups were assigned randomly to receive each of four supplemental levels of SFM pellets, beginning at the start of the third trimester of gestation and continuing until the beginning of the breeding season in mid-May. Treatment levels during the prepartum period were: 1) 3 lb DM, 2) 4 lb DM, 3) 5 lb DM, and 4) 6 lb DM from SFM (CP = 34.2% of DM) daily. During the postpartum period, SFM was fed at 1) 4 lb DM, 2) 5 lb DM, 3) 6 lb DM, and 4) 7 lb DM daily. These treatments corresponded to approximately 12, 16, 20, and 24 g SFM DM/kg $BW^{.75}$ during the prepartum period and 16, 20, 24, and 28 g SFM DM/kg $BW^{.75}$ during the postpartum period. Furthermore, treatment 1 was calculated to meet the CP requirements of these cows based on the 1984 Nutrient Requirements of Beef Cattle whereas treatment 4 was formulated to meet the protein requirements following the recommendations for DIP

[1] Appreciation is extended to Archer Daniels Midland Co. for supplying the sunflower meal pellets used in this experiment.

requirements published in the 1996 Nutrient Requirements of Beef Cattle. On February 11, all cows were moved to a single calving pasture. While in the calving pasture, cows were fed 3 lb SFM DM daily. Once weekly, all cows that had calved were gathered, shrunk overnight, weighed, and scored for body condition and then returned to their original pasture where they received the postpartum levels of SFM. All cows had free-choice access to forage sorghum hay (5.9 % CP), a salt/mineral/vitamin A mixture, and water. Cows were weighed following an overnight shrink and scored for body condition by three trained individuals at the beginning of the experiment (December 10), January 10, February 11, following calving (average calving date = March 8), at the beginning of the breeding season (May 16), and at the time of pregnancy diagnosis (September 24). Calves were weighed within 24 h of birth and at weaning (October 8). All cows were bred by artificial insemination (AI) using a timed mating after synchronization using Syncro-Mate B®. Cows from each treatment were divided evenly between tow summer pastures where each group was exposed to two fertile bulls (approximately 1 bull per 40 cows). Bulls remained with the cows until 60 days after first exposure to AI.

Results and Discussion

Weight gains during the third trimester were substantial with all treatments in this experiment (Figure 1). On average, cow weight gains and body condition gains (Figure 2) during the third trimester were equivalent to the respective losses at calving. Although quadratic and cubic weight responses to treatment were recorded during the first 30 d and 60 d, respectively, in each case, cows receiving 6 lb SFM DM gained the most weight. Condition changes across the first 60 d of the experiment were not affected significantly by treatments. Just after calving, however, both weight and condition changes were improved linearly with increasing level of SFM. Each pound of SFM DM fed across the 90 days before calving resulting in an additional 8 lb of body weight and .11 units of body condition score. A body condition of 5.0 often is recommended for beef cows at calving to ensure adequate postpartum reproductive performance. In this experiment, body condition scores just following calving ranged from 4.3 to 4.7. Treatment responses generally were maintained through the beginning of the breeding season, although weight changes at this time were much more variable than at other measurement times, and, thus, no significant differences were detected. After supplementation ended at the beginning of the breeding season, weight differences generally were maintained through weaning. During this same time interval, cows with the lowest body conditions at the beginning of the summer tended to increase in body condition more rapidly than cows in greater body condition, so that by weaning time, treatment effects on body condition were somewhat erratic.

Calf birth weights, weaning weights, and average daily gains from birth through weaning were unaffected ($P > .10$) by treatments. Pregnancy rates were not significantly different among treatments (Table 1), although rates tended ($P = .23$) to be greater at the two highest levels of SFM than at the two lowest levels of SFM.

The marginal improvements in weight and condition of beef cows in the present experiment do not seem to justify supplementation at levels greater than 3 lb SFM DM. However, trends in reproductive performance suggest that additional CP could be economically beneficial. Benefits would be expected to be greater with cows in low body condition at the start of the third trimester. Other research suggests that the marginal benefits of increasing protein supplement levels are greater in cows that are in negative energy balance. Thus, beef cows consuming poor- to moderate-quality forages appear to be able to respond to levels of supplemental protein in excess of that assumed using traditional CP-balancing systems. The relative merits of such supplementation will depend primarily on the body condition of the cows at the start of the supplemental period.

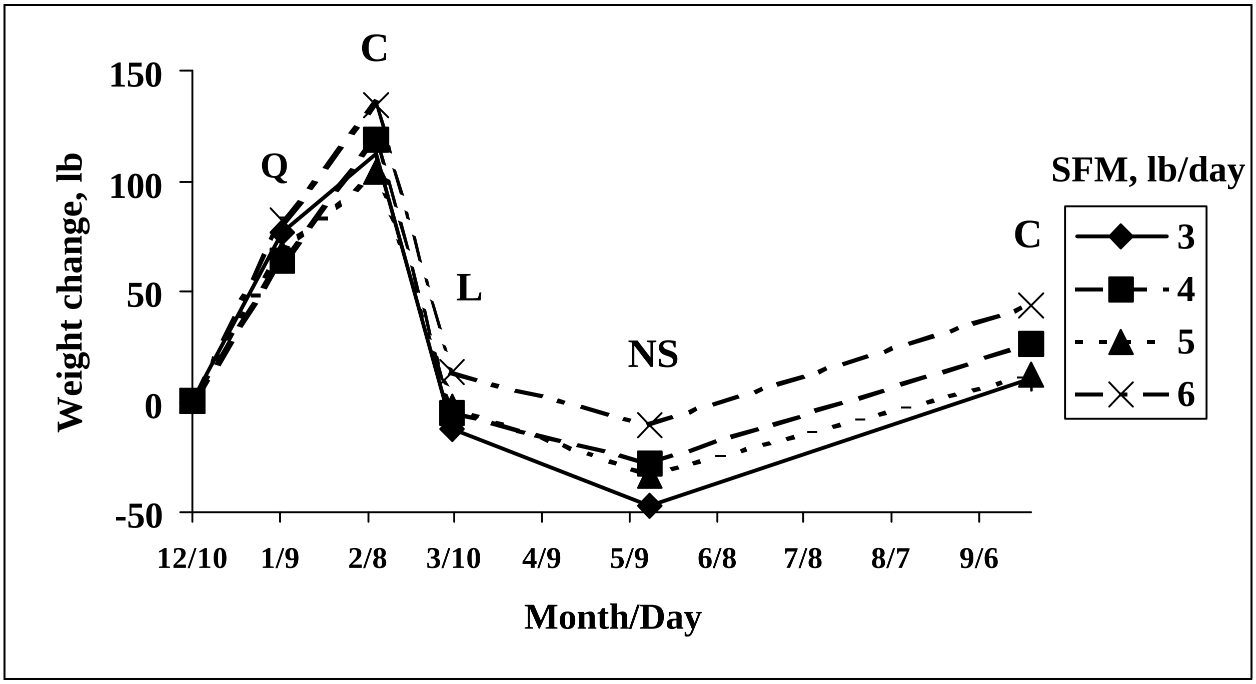

Figure 1. Cow weight change in response to increasing levels of supplemental sunflower meal. NS = no significant effect of treatment (P > .10); L = linear treatment effect (P < .10); Q = quadratic treatment effect (P < .10); C = cubic treatment effect (P < .10).

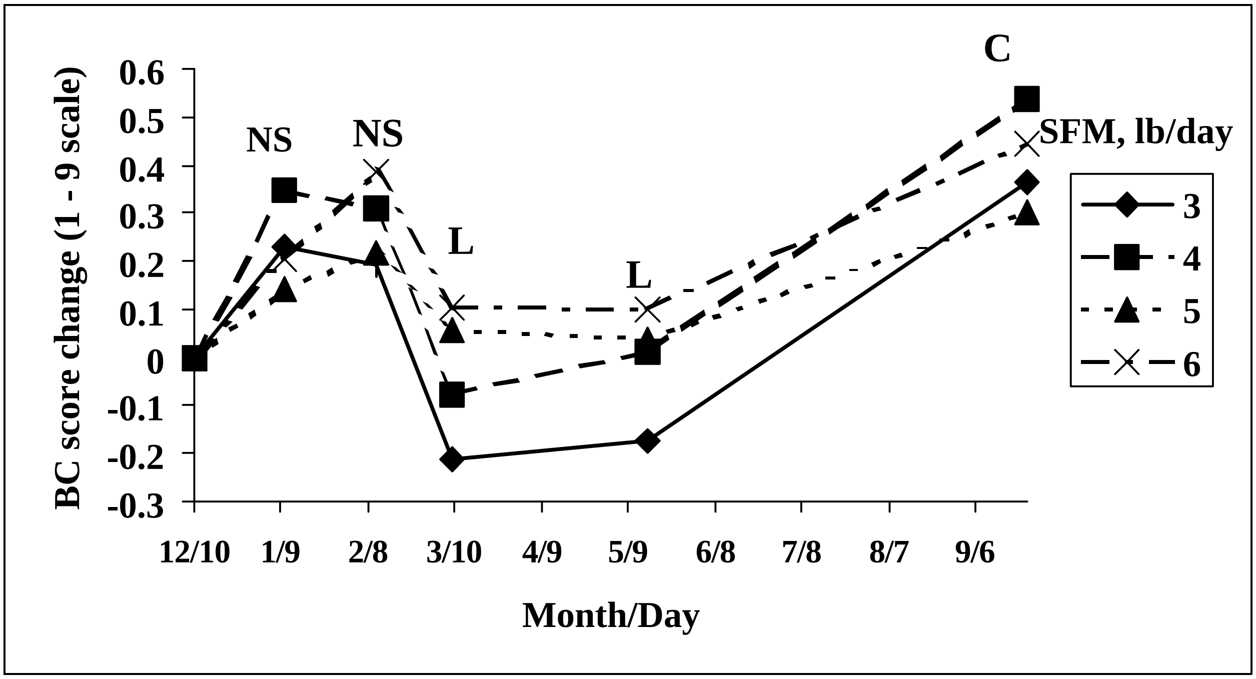

Figure 2. Cow body condition score changes in response to increasing levels of supplemental sunflower meal. Initial BC score = 4.5 on 1 – 9 scale. NS = no significant effect of treatment (P > .10); L = linear treatment effect (P < .10); C = cubic treatment effect (P < .10).

Table 1. Influence of increasing amounts of sunflower meal on calf performance and pregnancy rates of crossbred beef cows.

	Sunflower Meal, lb/day[a]				
Item	3	4	5	6	SEM[b]
Calf birth wt, lb	94.4	90.6	93.6	92.4	1.72
Calf weaning wt, lb	577.85	582.3	582.6	578.9	10.02
Calf ADG, lb/d	2.36	2.40	2.38	2.37	.043
Pregnancy rate, %	91.7	91.3	100.0	100.0	-

[a] Treatment levels listed correspond to prepartum levels. Postpartum SFM levels were 1 lb greater for each treatment.
[b] Standard error of the mean.

Effect of Supplement Type on Gain by Stocker Steers Grazing on Summer Native Range in West-Central Kansas

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Summary

Steers receiving a moderate-protein, soybean meal (SBM) /sorghum grain (SG) supplement at 3 lb of DM per head daily gained more weight across a 140-day summer grazing season than steers receiving either 3 lb of DM from SG or 1.5 lb of DM from SBM daily. Both the moderate- and high-protein SBM supplements gave conversion efficiencies of approximately 1 lb of gain per 6 lb of supplement, whereas steers converted SG into gain at a ratio of about 1 lb of gain per 9 lb of supplement. Weight differences at the end of the grazing season were maintained throughout the finishing phase, although steers all had similar backfat thickness at slaughter. Cattle receiving moderate- and high-protein supplements during the grazing period had slightly lower quality grades than cattle receiving SG, whereas quality grades from cattle in the nonsupplemented group were intermediate.

Introduction

Research on tallgrass prairie has demonstrated that stocker steers will utilize low levels of grain supplements with partial conversion efficiencies of around 10 to 1 during early intensive stocking programs. Additionally, low-level supplementation affords the opportunity for incorporating various feed additives to improve performance of grazing animals. It also may aid in conditioning cattle to consume feed from bunks, which would be beneficial during the receiving period in the feedlot. Research evaluating supplementation of stocker cattle grazing shortgrass range is quite limited. The objectives of this study were to evaluate the ability of fall-born calves to respond to different supplement types during a summer-long grazing program in west-central Kansas.

Methods

One hundred sixty fall-born, steer calves (average initial weight = 497 lb) were used in each of 2 years of this experiment (320 calves total). Within each year, steers were stratified by sire group and weaning weight and allotted randomly within strata to one of 16 pastures (two blocks of eight pastures each). Four pastures were assigned randomly to each of four treatments (randomized separately within each year of the study): 1) no supplement (NS); 2) 1.5 lb DM/day from soybean meal (SBM); 3) 3.0 lb DM/day from sorghum grain (SG); 4) 3.0 lb DM/day from a soybean meal/sorghum grain mix (MIX) with a 24.7% crude protein (CP). The MIX supplement was formulated to provide a similar amount of CP as the SBM supplement and a similar energy level as the SG supplement. No feed additives were included with any of the supplements. Prior to the experiment, all steers were vaccinated against IBR, BVD, BRSV, PI^3, pinkeye, and seven strains of clostridia. Steers were implanted with 200 mg progesterone and 20 mg estradiol benzoate (Synovex-S®) at the beginning of the grazing period and were stocked at an average of 3.7 acres/steer, corresponding to stocking rates of 134 lb initial live weight/acre, which would be considered a light stocking rate. Steers had free choice access to white salt and water throughout the 140-d grazing periods in each of the 2 years. Supplements were hand-fed daily to each pasture group. Steers were weighed following an overnight shrink at the beginning of each year and at approximate 28-day intervals throughout the grazing period. After removal from pastures in the fall of each year, steers were grouped into feedlot pens, each of which had equal numbers of animals from each treatment group. All steers were implanted with Synovex-S® at the beginning of the finishing period and after approximately 90 days on feed. Feedlot diets consisted of finely rolled SG with approximately 10% sorghum silage and a protein/mineral supplement containing 300 mg monensin and 90 mg tylosin per steer daily. Steers were slaughtered as a single group when the average backfat, as determined by ultrasound measurement, reached .4 inches. Weights obtained during the finishing phase were taken on 2 consecutive days, just before feeding. Feedlot performance is reported only for the first year of the study.

Results and Discussion

In both years of the study, precipitation preceding the grazing season (January to April; Figure 1) was below the long-term average of 4.5 inches for this interval. In 1996, total precipitation during the early grazing period (May – July) was 14.7 inches, compared with a long-term average of 6.5 inches. However, late-season (August – October) precipitation (5.3 inches) was only about half of the long-term average of 10 inches. In 1997, early- and late-season precipitation amounts (8.2 and 9.0 inches) were much closer to the long-term average values. Average monthly maximum and minimum temperatures were very similar to long-term averages, except for the latter half of the grazing season in 1996, during which monthly average maximum temperatures varied from 2 to 6 °F below normal.

Despite variations in precipitation patterns between years, average daily gains in both years were lower during the early season (May – July) than during the late-season (July – October) and were greatest ($P < .10$) when steers received MIX, intermediate with SG and SBM, and lowest with NS (Figures 2 and 3). In 1996, early-season gains averaged 1.14, 1.55, 1.42, and 1.36 lb/day and late-season gains averaged 1.55, 2.04, 1.90, and 1.79 lb/d for NS, MIX, SG, and SBM, respectively. Total gains were lower during 1997, with early-season gains of .56, .85, .68, and .70 lb/day and late-season gains of 1.49, 1.98, 1.87, and 1.76 lb/d for NS, MIX, SG, and SBM respectively. The low early-season weight gains in 1997 may have been partially artifacts of weighing conditions. In 1996, the initial weight for the experiment was obtained after steers had been on grass for at least 1 week. In 1997, however, the initial weight was obtained before cattle were turned out to pasture. Thus, decreases in gut fill during the early grazing period may have been responsible for the low apparent weight gains, rather than true differences in body tissue gain. Treatment differences in cumulative weight change were apparent after 28 days in the first year and after 56 days in the second year. Because supplement effects on average daily gains were consistent across the grazing season in both years, treatment effects on cumulative weights increased as the grazing seasons advanced. Cumulative weight gains across the 140-d grazing seasons for NS, MIX, SG, and SBM were 195, 260, 241, and 228 lb in 1996 and 155, 211, 193, and 185 lb in 1997. Because more ruminally degraded protein was provided with SBM than with MIX, and because gains were greater with MIX, these data suggest that, unlike winter range, ruminally degraded protein was not first-limiting in the summer range grazed by these steers. However, whether CP or energy was first-limiting for gain is less clear. The fairly similar response in gain with either SG or SBM suggests that energy and protein may have been colimiting. This is substantiated by the greater response to MIX than to either of the other supplements. In other words, when additional energy was added to a protein supplement or when additional protein was added to an energy supplement, the gain response of steers increased.

Although no statistical differences were detected for partial conversion efficiencies (lb additional gain/lb supplement; Table 1), supplements containing higher levels of protein (SBM and MIX) tended to give greater relative responses than the SG supplement. Furthermore, these responses were consistent across both years of the study and agree with other supplementation studies with stocker cattle. Averaged across years, 9 lbs of SG were required for each additional lb of steer gain compared with 6 lb of SBM or MIX per additional lb of gain. The relatively efficient use of the protein-containing supplements suggests that these supplements allowed steers to maintain intake and digestion of native range forage. Conversely, the partial conversion efficiencies with SG indicate that some depressions in forage intake and/or digestion were likely.

Average daily gains during the finishing period (Table 2) were unaffected by supplementation treatment during the grazing period. Thus, differences in steer weight at the end of the grazing period were maintained throughout the finishing phase and were reflected in carcass weights. This occurred despite the facts that all steers were slaughtered on the same day, and all groups had similar backfats (P > .10) at this time. Quality grade was slightly lower (P < .10) for MIX and SBM than for SG and was intermediate for NS. However, yield grades were unaffected.

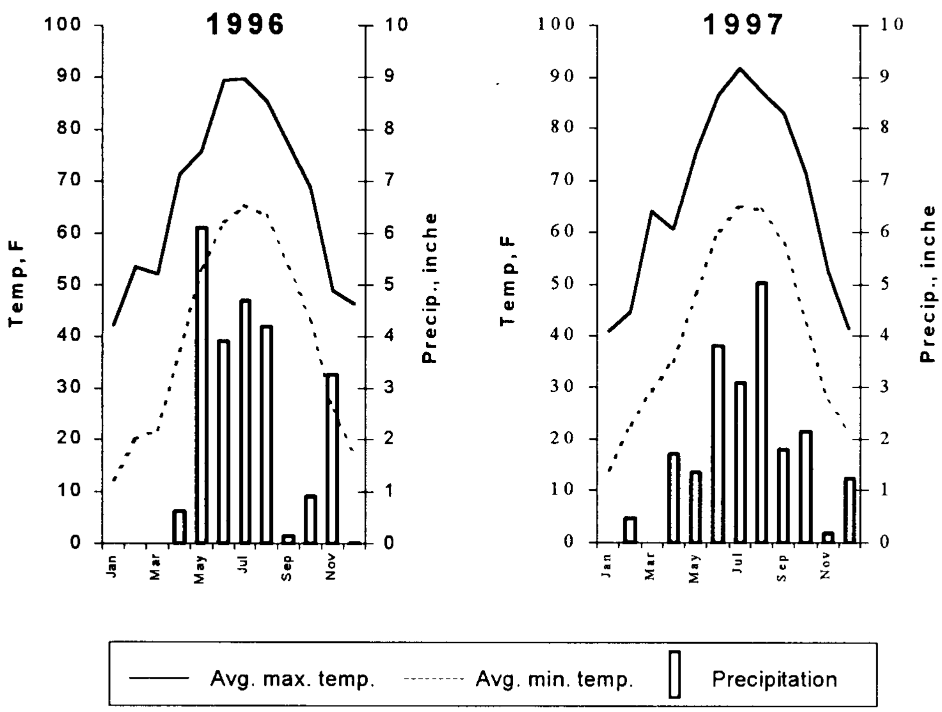

Figure 1. Monthly average maximum and minimum temperatures and monthly total precipitation during 1996 and 1997 at Hays, KS.

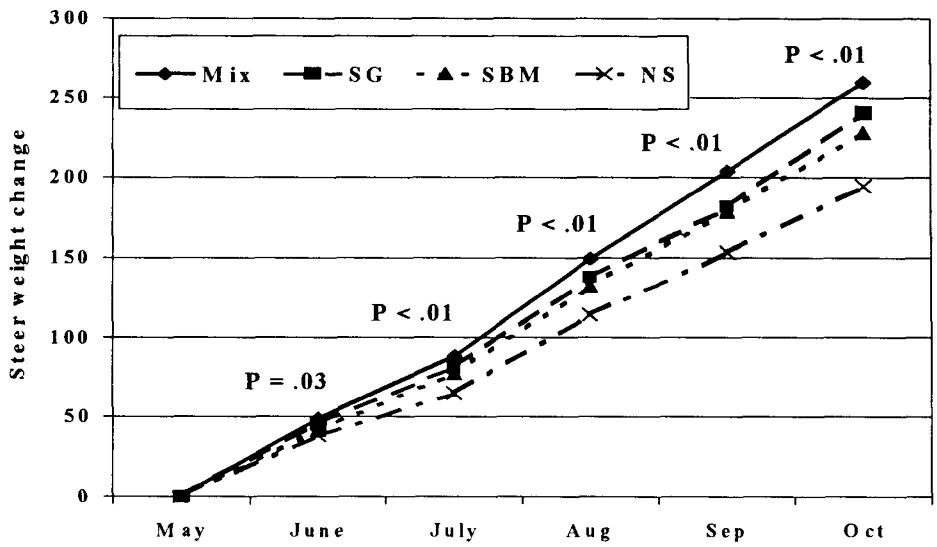

Figure 2. Effect of supplement type on steer weight gains, 1996. Initial weight = 493 lb.

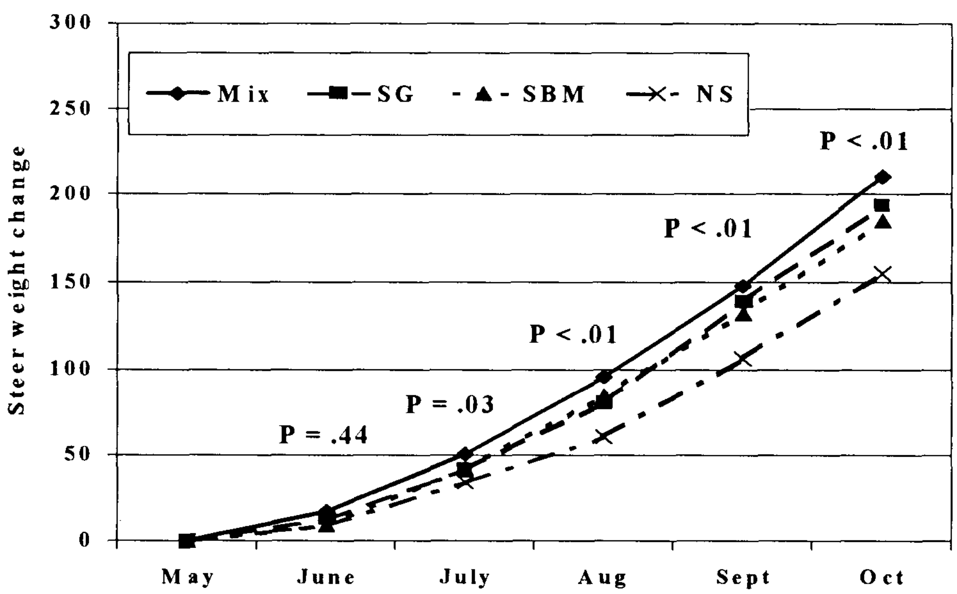

Figure 3. Effect of supplement type on steer weight gains, 1997. Initial weight = 521 lb.

Table 1. Partial conversion efficiencies (lb gain/lb supplement) of supplements for grazing cattle.

	Supplement Type[a]			
Year	MIX	SG	SBM	SEM[b]
1996	.167	.118	.169	.029
1997	.150	.102	.162	.022

[a] MIX = 3.0 lb DM/day from a 22% CP soybean meal/sorghum grain mix; SG = 3.0 lb DM/day from sorghum grain; SBM = 1.5 lb DM/day from soybean meal.
[b] SEM = standard error of the mean.

Table 2. Feedlot performance and carcass characteristics of steers receiving different supplements during the summer grazing period and treated similarly during the finishing period[a].

	Supplement Type[b]				
Item	NS	MIX	SG	SBM	SEM[c]
Initial weight, lb	690.2[e]	752.0[g]	736.2[f,g]	715.9[f]	9.99
Weight at reimplanting, lb	1024.9[e]	1090.9[g]	1074.5[f,g]	1051.8[e,f]	12.51
Final weight, lb	1269.6[e]	1331.9[g]	1315.5[f,g]	1289.7[e,f]	13.68
Average daily gain, lb/d	3.22	3.22	3.22	3.19	.044
Carcass weight, lb	788.7[e]	838.2[g]	819.6[f,g]	802.4[e,f]	8.84
Carcass backfat, in	.40	.43	.41	.41	.024
Quality grade[d]	5.1[e,f]	4.9[f]	5.3[e]	5.0[f]	.09
Yield grade	2.50	2.55	2.58	2.55	.113

[a] Only data from 1996 study are included.
[b] NS = no supplement; MIX = 3.0 lb DM/day from a 22% CP soybean meal/sorghum grain mix; SG = 3.0 lb DM/day from sorghum grain; SBM = 1.5 lb DM/day from soybean meal.
[c] SEM = standard error of the mean.
[d] 4 = USDA Select; 5 = USDA Choice.
[e, f,g] Means with different superscripts are different ($P < .10$).

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