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1994 South Dakota Beef Report

Department of Animal and Range Sciences, South Dakota State University

Agricultural Experiment Station, South Dakota State University

Cooperative Extension Service, South Dakota State University

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Department of Animal and Range Sciences

1994 South Dakota BEEF REPORT

Agricultural Experiment Station
Cooperative Extension Service
South Dakota State University

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September 1994

Dear Beef Producers,

We hope this 1994 South Dakota Beef Report is useful to you. The reports contained in this publication represent an update of the research effort in the beef cattle area over the past year. The overall goal of our beef cattle research is to increase the profitability for South Dakota's beef producers by increasing returns and lowering costs of production. These reports show some of the progress being made to address these goals.

In addition to a very active research program, teaching and extension are the other functions of our overall mission. For fall semester 1994, the department will have approximately 230 Animal Science majors, 30 Range Science majors and 20 graduate students. Animal Science continues to be one of the most popular majors in the College of Agriculture and Biological Sciences. This is because we have an excellent faculty and also because the job market has been very strong.

Our beef cattle extension program is also very active. In addition to Integrated Resource Management and the marketing alternatives demonstration project, there are two exciting new educational opportunities. The feedlot group has taught their third Feedlot Short Course. This hands-on learning experience has been well received. This fall the National Beef Cattle Satellite Short Course will be starting. This cooperative effort among South Dakota State University, University of Nebraska, University of Georgia and Washington State University was the brain child of Don Boggs. Don has also been the driving force in getting this innovative program off the ground.

The beef industry is extremely important to South Dakota. South Dakota State University through research, teaching and extension works to support the beef industry. Please share your ideas with us for research that will benefit you. We need to know the problems that you need answers to. You also have an open invitation to visit any of our experiment stations and see the research being carried out in person.

Sincerely,

Jim

James R. Males
Head, Department of Animal and Range Sciences

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SDSU

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September 1994

Dear Beef Industry Friends,

Thank you for examining the 1994 edition of the South Dakota Beef Report. This report summarizes beef cattle related research activities at South Dakota State University. We hope you find the information useful in your farm, ranch, or agribusiness enterprise.

As you can see, we have many exciting activities going on. Most of the results have immediate application in your business. However, some of the studies involve improving our understanding of the biology of beef cattle. These studies hopefully will lead to the development of new technology aimed at improving your bottom line.

As many of you know, I was involved in a serious automobile accident in March. I wish to take this opportunity to publicly thank all of you for the outpouring of cards, letters, and concern from all corners of the state. Your thoughtfulness certainly helped speed my recovery. I hope to see you at meetings during the coming year.

In closing, the Extension, Research and Teaching staff in the Department of Animal and Range Sciences certainly welcome your comments and suggestions. We look forward to hearing from you.

Sincerely,

John J. Wagner

John J. Wagner
Editor, South Dakota Beef Report

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South Dakota State University, South Dakota Counties and U.S. Department of Agriculture Cooperating
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TABLE OF CONTENTS

SECTION V - MANAGEMENT

SECTION VI - ECONOMICS

Interpreting Experimental Results

Donald M. Marshall[1]
Department of Animal and Range Sciences

SDSU

CATTLE 94-1

A typical experimental format involves evaluating the response caused by application of different treatments to experimental subjects (animals, carcasses, pens, pastures, etc.). The effect of a given treatment might be evaluated by comparison to a control group or to one or more other treatment groups. However, a problem with animal research (and other types as well) is that variation not due to treatments often exists among experimental subjects.

For example, suppose that animals receiving ration A grow faster than animals receiving ration B. Was the observed difference in growth rates actually due to differences in the rations or to other factors (i.e., genetics, age, sex, etc.) or some of each? Statistical analyses evaluate the amount of variation between treatment groups relative to the amount of variation within treatment groups. In addition, variation caused by factors other than treatments can sometimes be eliminated by the statistical analysis.

The statement "the difference was statistically significant ($P = .05$)" indicates the probability of a difference of that magnitude occurring from chance rather than from the research treatment is about 5%.

A correlation coefficient provides an indication of the relationship between two factors and can range from -1 to +1. A strong, positive correlation (close to 1) indicates that as one factor increases the other factor tends to increase, also. For example, several studies have shown a positive correlation between cow milk yield and calf weaning weight. A strong negative correlation (close to -1) indicates that as one factor increases the other factor tends to decrease. A correlation near zero indicates the two factors are unrelated.

Several of the reports in this publication refer to least squares means. In balanced experimental designs, least squares means are often the same as the simple raw means. However, when numbers of experimental subjects are not evenly distributed across treatments, adjustments to the means are needed. Appropriate adjustments are made by least squares procedures. In addition, least squares means are sometimes adjusted for extraneous sources of variation through a so-called analysis of variance.

Means (averages), correlations and other statistics presented in research results are sometimes followed by $\pm$ some figure known as the standard error. The standard error provides an indication of the possible error with which the statistic was measured. The size of the standard error of a treatment mean depends on the animal to animal variation within a treatment group and on the number of animals in the group.

All other factors being equal, the greater the number of animals and(or) replications per treatment, the smaller the difference required to achieve a given value for probability of significance. Stated another way, increasing the number of animals or replications increases the likelihood of detecting differences due to treatments when such differences do indeed exist.

Several of the research reports in this publication contain statistical terminology. Although such terms might be unfamiliar to some readers, the statistical analyses allow for more appropriate interpretation of results and make the reports more useful.

[1]Associate Professor.

Net Energy of Finishing Diets Containing Light or Normal Test Weight Corn

C.P. Birkelo[1], R.H. Pritchard[2], M. Buhman[3], S. Grosch[4], and C. Willms[5]
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SDSU

CATTLE 94-2

Summary

Net energy (NE) of diets containing 77.7% whole corn of either normal (53.8 lb/bushel, NC) or light (40.8 lb/bushel, LC) test weight was determined by total collection and indirect respiration calorimetry using six crossbred steers (avg wt 327 kg). Diet treatments were applied in a switchback design. The steers were initially adapted to ad libitum intake of either NC or LC diets for 32 days followed by 7 days total feces and urine collection. Gaseous exchange was subsequently measured for at least 48 hours. Intake was then reduced to an estimated 1.1 times maintenance for 6 days and collections were repeated. The steers were then switched between NC and LC diets and the entire process was repeated. As a percentage of gross energy consumed, fecal energy losses were 32% greater for the NC diet compared to LC ($P<.01$). Urinary energy losses were unaffected by diet ($P>.20$). Although energy lost as methane did not differ between diets at high intake, it was 27% greater for LC than NC at low intake (interaction $P<.05$). Adjusted to a common metabolizable energy (ME) intake, neither heat production nor retained energy differed between diets ($P>.20$). Partial efficiencies of ME used for maintenance (k_m) and gain (k_g), as well as ME required for maintenance, also were not different ($P>.20$). Diet NE for maintenance and gain was 13% greater for LC than NC. NE estimates calculated by difference for light and normal whole corn were 2.48, 1.65, 2.15 and 1.43 mcal/kg dry matter, respectively. These data demonstrate that corn of low test weight is not inherently lower in NE content than normal corn.

Key Words: Test Weight, Corn, Energy

Introduction

Late planting, cool growing seasons and early frost all contribute to the frequent occurrence of light test weight corn in the upper midwest. It has been assumed that useful feed energy content declines with test weight. This idea was supported by early Minnesota research conducted with sheep. However, feedlot performance and more recent research from Nebraska with cattle have indicated that this may not be the case.

The objective of this study was to determine the effect of light test weight, whole corn on energy partitioning and net energy estimates of finishing diets fed to cattle.

Materials and Methods

Six crossbred steers averaging 327 kg were tamed to lead and adapted to the metabolism facilities and collection procedures prior to the first collection period. The steers were paired by weight and allotted within pair to two groups which were alternately fed finishing diets containing whole corn of light (LC) or normal (NC) test weight in a switchback design. Corn analyses are presented in Table 1. Diet composition and analyses are presented in Table 2. Diet analysis differed with respect to

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[2]Professor.
[3]Former undergraduate student.
[4]Former graduate student.
[5]GTA Feeds, Sioux Falls, SD.

Table 1. Chemical composition of light (LC) and normal (NC) test weight corn

Item	LC	NC
Dry matter, %	87.0	87.7
Crude protein, %	12.1	9.4
Ether extract, %	3.9	4.2
Test wt, lb/bushel	40.8	53.8

Table 2. Diet composition (dry matter basis)

Ingredient		
Whole corn		77.665
Ground corn cobs		9.000
Beet molasses		3.000
Soybean meal		8.469
Dicalcium phosphate		.330
Calcium carbonate		1.042
Potassium chloride		.144
Trace mineral salt		.250
Fat		.100
Analysis	LC	NC
Dry matter, %	86.8	87.4
Gross energy, kcal/g	4.33	4.31
Crude protein, %	13.9	11.9
Calcium, %[a]	.55	.55
Phosphorus, %[a]	.35	.35

[a]Calculated.

crude protein. However, crude protein levels were both considered in excess of requirements and were unlikely to bias the results. Corn supplies were acquired through normal commercial sources. Variety and maturity are unknown.

The steers were initially adapted to Ad libitum intake of either NC or LC diets for 32 days followed by 7 days of total feces and urine collection. Gaseous exchange was subsequently measured for at least 48 hours. Intake was then reduced to what was estimated to be 1.1 times the maintenance requirement. The steers were readapted for 6 days and collections were then repeated at this intake. Diet assignments of the steers were then switched and the entire process was repeated.

Weights of feed offerings and refusals, feces and urine were recorded during each collection period. With the exception of urine, samples were analyzed for dry matter (DM). Samples, including urine, were also analyzed for gross energy (GE) content by complete combustion.

Gaseous exchange (oxygen consumption and methane production) of the steers while fed each diet at high and low intakes was measured in one of four indirect, respiration calorimeters. Heat production (HP) was subsequently calculated as 5 kcal/liter of oxygen consumed. The calorimeters were designed to enclose only the animal's head but still allow free access to water and prescribed amounts of feed. Air flow through each calorimeter was measured by a dry gas meter and continuous samples of air were taken prior to entering and immediately after leaving the calorimeter.

Digestible energy (DE) was calculated as feed GE minus energy lost in the feces (FE). Metabolizable energy (ME) was calculated as DE minus urinary energy (UE) and energy lost in the form of methane (CH4E). Retained energy (RE)was equal to ME minus HP. The partial efficiencies of ME used for maintenance (k_m) and gain (k_g) represent the change in energy retained in the body per unit change in ME consumed (i.e., higher k_m and/or k_g imply more efficient metabolism). Diet k_g was derived from the linear regression of RE on ME. The ME requirement for maintenance (ME_m) represents ME intake necessary to result in no gain or loss of body energy by the animal and is determined from this regression. Diet k_m, on the other hand, was calculated by assuming fasting HP to be 77 kcal/kg body weight$^{.75}$ and dividing this by ME_m.

The data were statistically analyzed for the discrete effects of diet, intake level, diet x intake level and animal. HP and RE were additionally analyzed with the covariate ME intake replacing intake level.

Results and Discussion

Energy partitioning data are presented in Table 3. Twenty of 24 energy balances were successfully completed. The four uncompleted

Table 3. Partitioning of diet gross energy

Item	LC[a] Low intake	LC[a] High intake	NC[b] Low intake	NC[b] High intake	P Corn	P Intake	P Corn x intake
	kcal·body $wt^{-.75}$·day^{-1}						
Gross energy intake	199.2	403.1	191.0	379.5	.20	.01	.50
Fecal energy	33.4	90.4	40.6	115.3	.01	.01	.09
Urinary energy	8.3	9.4	8.9	8.6	.94	.65	.41
Methane energy	12.4	11.8	9.3	12.4	.26	.22	.09
Heat production	122.3	196.9	120.9	182.0	.21	.01	.27
Retained energy	22.8	89.9	9.3	59.2	.08	.01	.46
	Percentage of gross energy						
Fecal energy	16.7	22.5	21.9	30.0	.01	.01	.25
Urinary energy	4.2	2.4	4.6	2.3	.70	.01	.65
Methane energy	6.2	2.9	4.9	3.3	.33	.01	.05
Digestibility	83.3	77.5	78.1	70.0	.01	.01	.25
Metabolizability	72.9	71.7	68.3	64.1	.01	.10	.34

[a]LC = light test weight corn diet.
[b]NC = normal test weight corn diet

balances consisted of two NC and two LC fed steers.

Ad libitum GE intakes/$wt^{.75}$ (collection periods 1 and 3) for NC and LC diets were not different (P>.20). However, as a percentage of GE consumed, FE losses were 32% greater for the NC diet compared to LC (P<.01) resulting in average digestibilities of 74.0 and 80.4%, respectively (P<.01). Additionally, digestibility decreased 3.6 percentage points per 100 kcal increase in GE consumed (P<.01).

Urinary energy losses as a percentage of GE intake were unaffected by diet (P>.20) but decreased by almost half at the high intake compared to low ()<.01). At high intake, energy lost as methane was also not affected by diet. However, it was 27% greater for LC than NC at low intake (interaction P<.05). Metabolizability averaged 8.5% greater for the LC diet compared to NC (P<.01), primarily reflecting differences in FE. Level of intake effect on metabolizability, while significant (P<.10), was less than that on digestibility because increasing FE was partially offset by declining UE and CH4E.

The amount of heat produced by a growing animal is, to a large degree, a function of ME intake relative to ME required for maintenance. Although ad libitum GE intake did not differ between diets, metabolizability was greater for LC than NC, resulting in 19% greater ME intake for LC fed steers (287.3 vs 241.4 kcal·$wt^{-.75}$·day^{-1}; P<.01). Despite this, HP did not differ between diets (P>.20). Because energy retained in the body as new growth is equal to the difference between ME consumed and HP, high intake RE was 52% greater for LC fed steers (P<.08), a reflection of more ME being available above maintenance requirements. When adjusted to a common ME intake, neither HP nor RE differed between diets (P>.20).

Partial efficiency of ME used for growth (k_g) was determined from the linear regression of RE on ME intake. Lack of an interaction between diet and ME intake (P>.20) indicated that k_g did not differ between diets and the data from both were pooled (Figure 1). The pooled estimate of k_g was .48 and is in close agreement with other published estimates for similar diets.

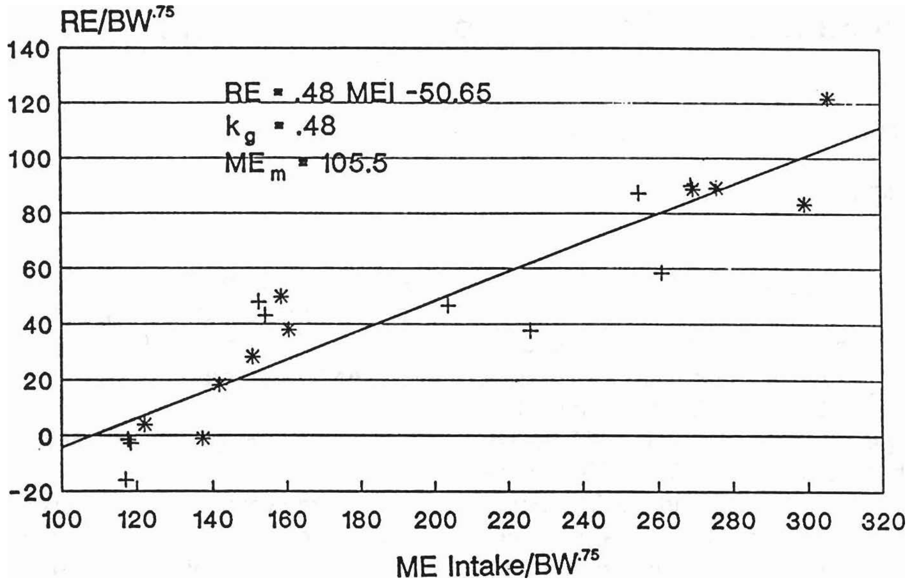

Figure 1. Regression of retained energy (RE) on metabolizable energy (ME) intake (+ = normal corn diet; * = light corn diet).

Extrapolation to zero RE yielded an ME_m estimate of 105.5 kcal·wt$^{-.75}$·d^{-1}.

Direct determination of k_m requires energy balance data for intakes below maintenance. In this study, all measurements were made near or above maintenance. Alternatively, one can estimate it by assuming fasting HP (RE at zero ME intake) equal to 77 kcal·wt$^{-.75}$·d^{-1}, the constant used in the current net energy system and divide this by ME_m. By the latter approach, k_m was equal to . 73.

Diet and corn energy estimates calculated from the high intake data are expected to be most applicable to diet formulation in production situations and are presented in Table 4. Regardless of the energy expression used, diet estimates were 13% greater for LC than NC. Differences in energy estimates reflect the greater FE loss of the NC diet. Energy estimates for light and normal whole corn were calculated by difference using published values for the noncorn components of the diet. Normal whole corn NE estimates for maintenance and gain were 2.15 and 1.43 mcal/kg dry matter, respectively. Net energy estimates for LC were 15% greater and more comparable to values one might expect for flaked or high moisture corn.

In conclusion, these data demonstrate that corn of low test weight is not inherently lower in NE content than normal corn.

Table 4. Diet and corn energy estimates (high intake)

	Diets		Corn	
Item	LC	NC	LC	NC
	Mcal/kg dry matter			
DE	3.35	2.99	3.51	3.05
ME	3.08	2.73	3.31	2.86
NE_m	2.25	1.99	2.48	2.15
NE_g	1.48	1.31	1.65	1.43

Effect of Supplement Crude Protein Source and Dietary Crude Protein Levels on Feedlot Performance of Yearling Steers

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SDSU

CATTLE 94-3

Summary

The effect of crude protein level and source on production rates of yearling steers was evaluated during an 88-day finishing period. The overall average daily gain of 240 steers implanted with Revalor was 4.35 lb. Diets were formulated to contain 11.25 and 13.5% crude protein. Protein sources included urea, soybean meal, an isonitrogenous blend of blood meal-corn gluten meal (BM-CGM) and dried distillers grains with solubles (DDGS). Increasing dietary crude protein from 11.5 to 13.3% with all urea supplements depressed ($P<.05$) dry matter intake without compromising average daily gain or feed efficiency. Feeding soybean meal in 11.1% crude protein diets improved the energetic efficiency of steers. The BM-CGM supplement depressed ($P<.05$) dry matter intake and average daily gain when compared to the 11.5% crude protein soybean meal diet. The 13.6% crude protein diet containing 11% DDGS and urea supported performance comparable to the 11.1% soybean meal diet at a lower cost.

Key Words: Steers, Crude Protein, Feedlot

Introduction

The new generation estradiol-trenbolone acetate implants cause marked increases in the average daily gain of feedlot cattle. Previous studies indicated that steer performance, although improved, was being limited by either the amount or source of dietary crude protein. Diets formulated to provide varying levels of metabolizable protein do not necessarily support increased performance. Specifically, using urea, blood meal, and corn gluten meal supplements did not stimulate production rates. This experiment was designed as a screening test to evaluate the potential of supplemental crude protein sources that have substantially different chemical characteristics to affect growth traits of yearling steers.

Materials and Methods

Mixed yearling steers were purchased during June and July. The receiving-holding diet was a chopped, high moisture ear corn-liquid supplement-soybean meal mix, limit fed to restrict average daily gain to less than 2 lb per day. At the time of arrival, steers were vaccinated for 7 clostridia sp., IBR, BVD, PI_3, and Haemophilus s. Ivermectin was used for parasite control. Sorting to 8 head pens was based on allotment weights determined 4 days prior to the start of the test. The range of body weights was stratified within each of 30 pens. These pens were then blocked within the feedlot and randomly assigned to one of six diets (Table 1). Diets were formulated to contain 11.25 or 13.5% crude protein, using various feed sources (urea, soybean meal, blood meal, corn gluten meal, and dried distillers grain (corn) with solubles). Hay content and dry to high moisture corn ratios were held constant among diets. Minor ingredients were included as a pelleted feed ingredient that provided 11 g tylosin per ton diet (DBM). Macro- and micro-minerals and vitamins were included in a custom liquid supplement. The liquid also contained monensin at a level that provided 26.8 g monensin per ton of diet.

Initial body weight of steers and subsequent 28-day, 56-day, and 88-day body weights were determined in the morning before steers were fed. Revalor implants were administered to all steers during initial body weight measurement.

[1]Professor.

Table 1. Diet formulation

Treatment	1	2	3	4	5	6
Crude protein, %	11.25	13.5	11.25	13.5	13.5	13.5
Source	Urea	Urea	SBM	Urea/SBM	Urea BM-CGM[a]	Urea/DDGS[b]
Ingredient						
Grass hay	8.000	8.000	8.000	8.000	8.000	8.000
Whole shelled corn	49.201	48.702	50.414	49.208	49.207	42.643
High moisture corn	32.801	32.468	33.610	32.805	32.804	28.429
Liquid supplement[c]	3.600	3.600	3.600	3.600	3.600	3.600
DDGS						10.961
Ground corn[d]	5.500	5.500			2.250	5.500
Urea[d]	.622	1.449		.622	.622	.622
SBM[d]			4.159	5.548		
Blood meal[d]					1.394	
Corn gluten meal[d]					1.886	
Limestone[d]	.157	.157	.157	.157	.177	.185
Dicalcium phosphate[d]	.059	.064				
Fat[d]	.060	.060	.060	.060	.060	.060

[a]Blood meal-corn gluten meal.
[b]Dried distillers grain (corn) with solubles.
[c]Included supplemental minerals and vitamins, contained 744 g/T monensin (DMB).
[d]Included as a pelleted supplement.

Feed was delivered once daily. On day 1 of the experiment, the diet assigned (Table 1) was fed at a rate of 14 lb per head. Subsequent feed deliveries were gradually increased such that ad libitum feed consumption was possible for most pens of steers by day 21.

Feed ingredient composition and dry matter intake data were collected and summarized weekly throughout the experiment. The initial source of soybean meal used was found to contain high urease activity. The supplements containing this product were replaced after 21 days. After the day 88 weights were determined, steers remained on experimental diets for 5 days awaiting slaughter. Treatment identification was maintained during the slaughter process to allow comparisons of population distribution among yield and quality grades.

Feedlot performance data were statistically analyzed by procedures appropriate for a completely random design. Mean separations were accomplished via Duncan's New Multiple Range test. Pen mean data were used in this analysis. Carcass yield grade distribution and percentage of choice were tested by Chi square analysis.

Results and Discussion

Dietary crude protein values were close to calculated values and treatment imposed differences were consistent (Table 2). The dietary neutral detergent fiber content was higher ($P<.05$) for treatment 6 where relatively higher fiber dried distillers grains with solubles (DDGS) replaced corn.

Increasing dietary crude protein from 11.1 to 13.3% with urea reduced ($P<.01$) dry matter intake without affecting average daily gain or feed conversion (Table 3). This response was consistent throughout each interim period of the experiment. Using soybean meal rather than urea in 11.1% crude protein diets increased ($P<.05$) average daily gain and reduced ($P<.05$)

Table 2. Diet composition[a]

Treatment	1	2	3	4	5	6	SEM
Dry matter, %	82.6[b]	82.7[b]	82.7[b]	82.8[b]	82.8[b]	83.2[c]	.10
Crude protein, %	11.11[b]	13.33[cd]	11.10[b]	13.26[c]	13.42[cd]	13.60[d]	.097
Neutral detergent fiber, %	13.0[b]	13.1[b]	13.3[b]	13.1[b]	13.1[b]	17.9[c]	.24

[a]n = 13, back calculated from daily batch sheets and weekly ingredient analysis.
[b,d,d]Means without common superscripts differ (P<.05).

Table 3. Cumulative feedlot performance

Treatment	1	2	3	4	5	6	
Crude protein, %	11.25	13.5	11.25	13.5	13.5	13.5	
Source	Urea --	Urea --	SBM --	Urea SBM	Urea BM-CGM[a]	Urea DDGS[b]	SEM
Initial body wt	801	796	799	799	801	799	4.4
Final body wt	1176[cde]	1162[c]	1196[ef]	1173[cd]	1187[def]	1198[f]	6.9
Avg daily gain	4.26[c]	4.16[c]	4.51[d]	4.25[c]	4.39[cd]	4.54[d]	.083
Dry matter intake	22.74[d]	21.57[c]	22.80[d]	21.78[c]	21.77[c]	22.80[d]	.256
Feed/gain	5.35[c]	5.20[cd]	5.06[d]	5.13[cd]	4.98[d]	5.03[d]	.089

[a]Blood meal-corn gluten meal.
[b]Dried distillers grain (corn) with solubles.
[c,d,e,f]Means without common superscripts differ (P<.05).

feed/gain. The dry matter intake associated with these two treatments were virtually identical, indicating an energetic efficiency response due to feeding soybean meal.

Steers fed a 13.26% crude protein urea-soybean meal combination (treatment 4) had lower (P<.05) average daily gain and higher (P<.05) feed/gain than steers fed 11.1% crude protein soybean meal (treatment 3). It should be noted that in the 11.1% CP SBM diet SBM provided two percentage points of dietary CP or 18% of total CP intake. Theoretically the response to this diet should have been equal or better performance. The lower (P<.01) dry matter intake for treatment 4 may have been caused by urea degradation in the urea-soybean meal pellet, although urease activity was detected in soybean meal only during the initial feeding period.

Treatment 5 was the highest metabolizable protein diet and should have allowed maximum performance responses. The dry matter intake of steers fed treatment 5 was comparable to steers on treatments 2 and 4 and lower (P<.05) than when steers were fed diets 1, 3, or 6. The numerical feed/gain value was lower for treatment 5 and comparable to treatments 2, 3, 4, and 6.

When DDGS were added to the base 11.1% crude protein urea diet, average daily gain increased (P<.05) and feed/gain decreased (P<.05) without affecting dry matter intake. This performance response was quite similar to replacing urea with soybean meal in 11.1% crude protein diets. The higher neutral detergent fiber content of treatment 6 did not cause increased dry matter intake that would be predicted by some intake models.

The carcass weights followed the same trend as final body weight (Table 4). There were more (P<.01) yield grade 3 steers and fewer yield grade 1 steers on treatments 1 and 6. The percentage of choice steers varied from 35 to 60% among treatment groups. The numerical

Table 4. Carcass weight and grade distributions

Treatment	1	2	3	4	5	6	
Crude protein, %	11.25	13.5	11.25	13.5	13.5	13.5	
Source	Urea --	Urea --	SBM --	Urea SBM	Urea BM-CGM[a]	Urea DDGS[b]	SEM
Carcass wt, lb	705[de]	694[d]	712[ef]	712[ef]	709[def]	721[f]	7.0
Yield grade[c]							
1, %	7.5	12.5	17.5	22.5	12.5	15.0	
2, %	45.0	72.5	57.5	52.5	57.5	25.0	
3, %	45.0	15.0	25.0	25.0	30.0	60.0	
4, %	2.5	0	0	0	0	0	
Choice, %	52.5	60.0	47.5	50.0	35.0	52.5	

[a]Blood meal-corn gluten meal.
[b]Dried distillers grain (corn) with solubles.
[c]Yield grade distribution varied among treatments ($P<.01$).
[d,e,f]Means without common superscripts differ ($P<.10$).

differences in percentage of choice carcasses could not be related to diet, yield grade, or feedlot average daily gain of steers.

Protein source does affect the energetic efficiency of steers capable of high production rates. Current models are not effective in predicting the appropriate source of supplemental crude protein or the optimum dietary crude protein levels.

SDSU

Effect of a Yeast Culture Product (Yea-Sacc) on Feedlot Performance of Yearling Cattle Fed a High Concentrate Finishing Diet

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CATTLE 94-4

Summary

The objective of this study was to determine if yeast culture (Yea-Sacc, Alltech, Inc., USA) affects feedlot performance and carcass characteristics of yearling steers fed a corn-based finishing diet containing less than 10% roughage. Crossbred yearlings (108 steers, avg 874 lb) were fed a rolled corn diet (8.44% ground alfalfa hay) without (CON) or with Yea-Sacc (YS, 9 g per head per day) for 95 days. Final weights were 15 lb greater ($P<.07$) for YS steers than CON as a result of a 12.3% increase in daily gain between day 29 and day 57 ($P<.03$). Daily gains were 4.1% greater for YS-fed steers overall ($P<.07$). Dry matter intake was not affected by treatment ($P>.20$). Feed efficiency tended to be improved for YS steers between day 29 and day 57 ($P<.11$) but did not differ at other times or overall ($P>.20$). Treatment increased carcass weights by 13 lb ($P<.09$) but did not affect dressing percentage or frequency of abscessed livers ($P>.20$). Effects on quality and yield grade, while significant, were small. The inclusion of yeast culture in a corn-based diet containing less than 10% roughage improved daily rate of gain but did not affect intake or efficiency and had minimal effect on carcass characteristics.

Key Words: Steers, Feedlot Performance, Carcass Traits, Yeast

Introduction

Many direct-fed microbial products have been introduced into the marketplace over the past decade. Although evidence for a positive effect on animal performance has existed for many years, adoption by cattle producers has been slow. This is probably due to the lack of performance data indicating in which specific production situations the various products are or are not effective.

The objective of this study was to determine if a yeast strain specifically selected to complement high grain diets (Yea-Sacc, Alltech, Inc., USA) affects feedlot performance and carcass characteristics of yearling steers fed a high concentrate, corn-based finishing diet (less than 10% roughage).

Materials and Methods

One hundred twenty-four yearling, crossbred steers were purchased in early July 1993 and delivered to the SE South Dakota Research Farm feedlot. The steers were weighed, identified with individual ear tags and vaccinated with IBR, BVD, Lepto pomona, BRSV, and 7-way clostridial vaccines. They also received Ivermectin[3] and a single Revalor[4] implant. Light and heavy extremes were sorted off and the remaining 108 steers were randomly allotted to treatments with nine head per pen and six pens per treatment. Half of the cattle on each treatment were housed in semi-confinement on cement while the rest were

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housed in conventional dirt lots with mounds and wind breaks.

The steers were fed diets with (Yea-Sacc, 9 g per head per day) or without (control) the yeast product. A series of four receiving/step-up diets were used in addition to a finishing diet (Table 1) which was initially fed on day 17 of the study. The diets were formulated to provide 12% crude protein, .60% Ca, .35% P, and .75% K. Analyzed diet crude protein contents were 11.7% and 11.9% for control and Yea-Sacc, respectively. Feed was provided once per day in amounts necessary to result in a stable, ad libitum intake while minimizing feed carryover.

Table 1. Finishing diet composition (as fed basis)

Ingredient	Percent
Rolled corn	84.33
Alfalfa hay	8.44
Molasses	2.75
Soybean meal	1.49
Dicalcium phosphate	.07
Limestone	1.13
Potassium chloride	.41
Trace mineral salt	.44
Fat	.06
Urea	.77
Premix[a]	.11

[a]Contained Rumensin 60, vitamin A and Yea-Sacc (when appropriate) to provide 28 g/ton (DM), 50,000 IU and 9 g per head daily, respectively. The supplement was pelleted.

Initial and final weights were determined after an overnight shrink off feed and water. Interim weights were determined after an overnight shrink off water only. All data were statistically analyzed as a complete block design. Percentage of abscessed livers was tested by chi-square analysis.

Results and Discussion

Performance data are presented in Table 2. Feed intakes and feed efficiencies are reported on a dry matter basis. Slaughter weights were significantly greater for cattle fed the Yea-Sacc treatment ($P<.07$). This was the result of a 12.3% increase in daily gains between days 29 and 57 of the study ($P<.03$). Although no differences were found at other times during the study, daily gains for the Yea-Sacc cattle were also better overall (days 1 through 95) by 4.3% ($P<.07$). Feed intakes were not affected by treatment ($P>.20$). This fact, coupled with the increase in daily gains, resulted in a tendency toward improved feed efficiencies between days 29 and 57 ($P<.11$). However, this effect was not evident in the overall feed efficiencies.

Carcass weights were 13 lb greater ($P<.09$) for steers fed the Yea-Sacc diet, reflecting the greater live weight gain (Table 3). Dressing percent was not affected by treatment ($P>.20$). Quality grade was reduced ($P<.04$) and yield grade was increased ($P<.08$) by treatment. However, changes in each were small. Percentage of livers containing abscesses was not affected by treatment ($P>.20$).

The results of this study indicated that this particular yeast product is effective in improving performance of yearling cattle fed corn-based finishing diets containing less than 10% roughage while having minimal effect on carcass characteristics.

Table 2. Performance of yearling steers fed finishing diets with or without Yea-Sacc

Item	Treatment[a] Control	Yea-Sacc	P<[b]
No. of steers	54	54	
Initial weight, lb	871	877	NS
Final weight, lb	1,227	1,242	.07
Daily gain, lb			
1 to 28 days	4.26	4.31	NS
29 to 57 days	3.33	3.74	.03
58 to 95 days	3.62	3.65	NS
1 to 95 days	3.72	3.88	.07
DM intake, lb			
1 to 28 days	19.1	19.1	NS
29 to 57 days	23.5	23.8	NS
58 to 95 days	23.3	23.3	NS
1 to 95 days	22.2	22.2	NS
Feed:gain			
1 to 28 days	4.57	4.44	NS
29 to 57 days	7.18	6.38	.11
58 to 95 days	6.45	6.47	NS
1 to 95 days	5.97	5.75	NS

[a]Least squares mean.
[b]Significance level, NS = not statistically significant.

Table 3. Carcass characteristics of yearling steers fed finishing diets with or without Yea-Sacc

Item	Treatment Control	Yea-Sacc	P<[a]
Carcass wt, lb	739	752	.09
Dressing percent	60.4	60.3	NS
Quality grade[b]	4.8	4.6	.04
Yield grade	2.3	2.5	.08
Abscessed livers, %	16.7	14.8	NS

[a]Significance level, NS = not statistically significant.
[b]4.0 = Select°, 5.0 = Choice°.

Effect of a Yeast Culture Product (Yea-Sacc) on Feedlot Performance of Growing Calves Limit-Fed a High Concentrate Diet

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SDSU

CATTLE 94-5

Summary

Eighty weaned steer calves (initial weight 535 lb) were blocked by weight, allotted within block to 8 pens and limit-fed a high concentrate diet without (CONT) or with Yea-Sacc (YS; 13 g per day). The diet consisted of 69% whole, high moisture corn, 20% ground alfalfa hay, 2% molasses, and 9% supplement (dry matter basis). The diet was fed once daily for an average of 99 days in amounts calculated to result in CONT calf daily gain of 2.25 lb. As intended, dry matter intakes of calves on the two treatments were identical (13.3 lb/day). Daily gains averaged 2.40 and 2.32 lb (P>.20) and feed efficiency 5.55 and 5.73 (P>.20) for CONT and YS, respectively. YS did not improve gain or feed efficiency of growing calves limit-fed a high concentrate diet.

Key Words: Yeast Culture Product, Performance, Limit-fed, Grain Diet

Introduction

Many direct-fed microbial products have been introduced into the market place over the past decade. Although evidence for a positive effect on animal performance has existed for many years, adoption has been slow. This is probably due to the lack of performance data indicating in which specific production situations the various products are or are not effective. A previous study at SDSU indicated that the feeding of a yeast strain specifically selected to compliment high grain diets (Yea-Sacc, Alltech, Inc., USA) was effective in improving daily gain of yearling steers.

The objective of this study was to determine if this same yeast strain could positively affect feedlot performance of growing calves limit-fed a high concentrate (20% roughage) diet.

Materials and Methods

A group of 89 weaned, crossbred steer calves were vaccinated (IBR, BVD, BRSV, Lepto, and 7-way clostridium), dewormed (ivermectin[3]), implanted (zeranol[4]), ear tagged, and weighed upon arrival at the Southeast South Dakota Research Farm feedlot. From these, 80 calves were selected and placed immediately on test. They were randomly allotted within weight block to pens (8 pens, 10 head each) and fed a common test diet (Table 1) without (CONT) or with Yea-Sacc (YS). Grass hay was fed only on the first day. The test diet was initially fed at an average of 7 lb of dry matter per day and this was increased to 12 lb by day 12. Feed offered was increased weekly thereafter by an amount calculated to maintain CONT calf daily gain at 2.25 lb per day. The YS calves were fed the same amounts within weight block as the CONT calves. Feed was offered once daily and, because the amount was considerably below ad libitum intake, was usually consumed within 3.5 hours of feeding. The bunks were empty for the remainder of the day. Yea-Sacc was fed as part of a pelleted supplement. Yea-Sacc intake averaged 17 g per day during the initial 12 days of the test and 13 g for the remainder.

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On-test weights were taken upon arrival at the feedlot but before feeding. Final weights were taken after overnight removal of feed and water. The calves in the heavy weight block were fed 85 days while those in the light weight block were fed 112 days. The data were statistically analyzed on a pen basis as a complete block design.

Results and Discussion

Performance data are presented in Table 2. As intended, dry matter intakes of the calves on both test diets were identical. Daily gains for the CONT calves, while 6.7% greater than predicted, were not different from those of YS calves (P>.20). As a result, feed efficiencies were not affected by treatment (P>.20).

In this study, YS did not improve performance of growing calves limit-fed a high concentrate diet.

Table 1. Composition of the limit-fed, high concentrate growing diet (dry matter basis)[a]

Item	Percent
High moisture whole corn	69.00
Ground alfalfa hay	20.00
Supplement	
Soybean meal	4.92
Molasses	2.00
Urea	1.00
Dicalcium phosphate	.70
Limestone	.80
Potassium chloride	.50
Trace mineral salt	.67
Fat	.10
Premix[b]	.31

[a]Formulated to contain 14.8% crude protein, .76% Ca, .47% P and 1.03% K.
[b]Provided 222 mg Rumensin and 62,000 IU supplemental vitamin A per day. Supplement was pelleted. Yea-Sacc was included at 1 g/lb of diet dry matter for treated calves.

Table 2. Feedlot performance of steer calves limit-fed a high concentrate diet with or without Yea-Sacc

Item	Treatment: Control	Treatment: Yea-Sacc	SE
No. of steers	40	40	
Initial wt, lb	535	536	7.2
Dry matter intake, lb/day	13.3	13.3	--
Wt gain, lb/day	2.40	2.32	.079
Feed:gain	5.55	5.73	.138

[a]Intake fixed within weight block at level calculated to allow 2.25 lb daily gain by the control calves.

Effect of Corn Processing and Reconstitution on the Digestibility of High Grain Diets

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CATTLE 94-6

Summary

Twelve steers (body weight 955 lb ± 37) were allotted to a 4 x 4 Latin square design digestion trial to examine the effects of corn processing on feed utilization. The grain component of the diet was either dry whole corn (WC), dry rolled corn (RC), corn reconstituted 12 hours before rolling (RRC), or corn reconstituted with a commercial surfactant[3] 12 hours before rolling (CRC). Dry matter content of the WC, RC, RRC, and CRC diets were 87.91, 87.30, 82.19, and 82.14%, respectively. Treatment had no effect on the digestibilities of dry matter (71.00% ± 1.57), organic matter (72.22% ± 1.53), crude protein (57.54% ± 1.66), neutral detergent fiber (52.68% ± 3.07), or starch (85.67% ± .98). Neutral detergent fiber digestion was affected by period, but this was not related to bulk density of the corn which ranged from 43 to 56 lb/bu over periods. Processing did not affect dry matter intake (21.76 lb/day ± .41), although reconstitution depressed ($P<.01$) dry matter intake as a percentage of body weight (2.19, 2.24, 2.11, and 2.14%, respectively). To quantify differences in particle size, processed grain samples were separated with #5, 7, 10, and 18 mesh sieves. Mean percentages retained on a #5 mesh sieve were 85.26, 58.74, 84.27, and 83.57% for WC, RC, RRC, and CRC, respectively. Subsequent separated fractions of WC and the reconstituted treatments were similar.

Key Words: Beef, Grain Processing, Digestibility

Introduction

There is a wealth of data that indicates no improvement in corn grain utilization due to dry rolling in high grain diets. Much of the digestion data were collected at intakes of 1 to 1.5% of body weight (BW). Digestibilities would be higher at reduced intakes and may not be applicable to intense production situations.

Many feedlots reconstitute their corn grain to a moisture content of 18 to 20% before rolling. The use of a surfactant is often employed to speed the reconstitution process. Although reconstituting may decrease shrinkage losses of processed grain, it has also been suggested that reconstitution or the surfactant itself may improve grain utilization. Increases in feed efficiency have been reported for ensiled high moisture (HM) corn and grain sorghum when compared to dry corn and grain sorghum. Reconstituting could prove beneficial if some of the advantages of ensiled HM grain could be realized, as reconstituting would be cheaper than storing ensiled grains.

The objective of this research was to determine if rolling of dry or reconstituted corn (with or without a surfactant) would increase corn utilization in high grain diets at intakes common to industry production levels.

Materials and Methods

To examine the effects of corn processing on feed utilization, twelve crossbred steers (initial BW 955 lb ± 37) of British and continental ancestry were used to conduct a

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4 x 4 Latin square design digestion trial. Steers were previously adapted to a 10% ground grass hay, 90% concentrate finishing diet. Experimental diets were 84.5% corn, 7.0% ground grass hay, 4.9% soybean meal, and 3.6% liquid supplement (Table 1). The grain component of the experimental diets was either dry whole corn (WC), dry rolled corn (RC), corn reconstituted with water and allowed to soak at least 12 hours before rolling (RRC), or corn reconstituted with a commercial surfactant at least 12 hours before rolling (CRC). A single lot of corn was used to prepare processed grains throughout each 14-day period. Water was added at 7% of corn weight to the WC in a horizontal ribbon-type mixer to raise the moisture content of the reconstituted grains approximately 6%.

Table 1. Diet composition

Ingredient	Dry matter basis
Corn, %	84.50
Grass hay, %	7.00
Soybean meal, %	4.90
Liquid supplement, %	3.60
Crude protein, %	12.03
Calcium, %	.532
Phosphorus, %	.317
Potassium, %	.894
NE_m (Mcal/cwt)	95.66
NE_g (Mcal/cwt)	65.54
Monensin (g/ton)	26.78
Tylosin (g/ton)	11.0

Chromic oxide was used as an external marker and was incorporated into the diet on days 7 through 14 of each period as a soybean meal based premix (10% Cr_2O_3, 90% SBM). A single batch of premix was used for all periods. This premix replaced soybean meal at 1% of the diet dry matter (DM). Steers were fed twice daily at 10:00 a.m. and 5:00 p.m. Dry matter intake (DMI) was allowed to increase to the point of feed refusal. At this point, intake was managed to reduce weigh backs. Fecal grab samples were collected before feeding on days 10 through 14. Fecal samples were composited within steer and period for analyses.

Diet composition was calculated from composite ingredient samples taken on period days 9 to 13. Diet ingredients, feces, and weigh backs were analyzed for DM, crude protein (CP), neutral detergent fiber (NDF), starch, ash, and chromic oxide.

Differences in particle size due to treatment were obtained by sieving triplicate grain samples (2.2 lb) through #5, 7, 10, and 18 mesh sieves (.157, .111, .080, and .039 in., respectively). Replicate means determined for periods 2 to 4 are reported.

Data were analyzed with the GLM procedure of SAS as appropriate for a Latin square design. Separation of least squares means were conducted with the PDIFF option at the .05 level. Dry matter intake was used as a covariate in the digestibility analyses.

Results and Discussion

Dry matter content of the diets was reduced ($P<.01$) five percentage points by reconstitution (Table 2). Processing did not affect DMI during the digestion trial (21.76 lb/day ± .41). However, reconstitution did depress ($P<.01$) dry matter intake as a percentage of body weight for the RRC and CRC vs the RC diet (2.11, 2.14, and 2.24%, respectively). Treatment had no effect on the digestibilities of DM (71.00% ± 1.57), organic matter [OM] (72.22% ± 1.53), CP (57.54% ± 1.66) NDF (52.68% ± 3.07), or starch (85.67 ± .98) [Table 2]. The least significant difference necessary to detect a difference in DM digestibility was 4.25%. The low apparent CP digestibility may be due to the high DMI of the steers which averaged 2.17% of BW. Correcting fecal CP values for contributions from metabolic fecal N (DMI x .0334) increased CP digestibility to 88.17% ± 1.54.

Diet CP level dropped to 10.1% in period 3 due to lower CP concentrations in the ground grass hay and low bulk density corn (Table 3). Starch and NDF digestibility were affected by period, but this was not related to bulk density of the corn or diet CP level (Table 3).

Orthogonal contrasts showed a decrease ($P<.05$) in diet refusal with the reconstituted corn treatments in the digestion trial (Table 2).

Table 2. Diet analysis, digestibilities, dry matter intake, and diet refusals by treatment

Variable	Treatment WC	RC	RRC	CRC	SE
Diet, %					
Dry matter	87.91[a]	87.30[b]	82.19[c]	82.14[c]	.28
Crude protein	11.17	11.10	11.09	11.08	.04
Neutral detergent fiber	20.10	20.04	19.94	19.74	.23
Starch	61.63	62.06	61.68	61.20	.55
Ash	3.93	3.86	3.93	3.88	.04
Digestibility, %					
Dry matter	70.56	73.09	69.13	71.23	1.57
Organic matter	71.84	74.19	70.33	72.53	1.53
Crude protein	56.85	60.64	56.14	57.33	1.66
Adjusted crude protein[d]	87.32	91.16	86.57	87.63	1.54
Neutral detergent fiber	51.76	56.41	51.09	51.48	3.07
Starch	85.29	86.38	84.21	86.78	.98
Dry matter intake, lb/day	22.08[a,b]	22.30[a]	21.29[b]	21.37[b]	.30
Dry matter intake/body wt, %	2.19[a,b]	2.24[a]	2.11[b]	2.14[b]	.03
Diet refusals, lb/day	.87[a]	.73[a]	.47[a,b]	.19[b]	.17

[a,b,c]Unlike superscripts differ ($P<.05$).
[d]Crude protein digestibility adjusted for contributions from metabolism.

Table 3. Corn bulk density, diet crude protein level, neutral detergent fiber and starch digestibility by period

Variable	Period 1	2	3	4	SE
Bushel wt, lb	56.0	53.5	43.0	52.0	
Diet crude protein, %	11.42[b]	11.69[a]	10.10[d]	11.23[c]	.04
Starch digestibility, %	80.73[b]	86.36[a]	87.28[a]	88.29[a]	.98
Diet starch, %	61.82	61.28	62.14	61.34	.55
Neutral detergent fiber digestibility, %	47.07[c]	59.96[a,b]	48.19[c]	55.52[b,c]	3.07
Diet neutral detergent fiber, %	19.50[c]	20.02[b]	19.66[b,c]	20.55[a]	.23
Dry matter intake, lb/head/day	20.40[c]	21.41[b]	22.42[a]	22.82[a]	.30

[a,b,c,d]Unlike superscripts differ ($P<.05$).

Mean percentage of corn retained on a #5 mesh (4 mm) sieve was lowest for RC (85.26, 58.74, 84.27, and 83.57% for WC, RC, RRC, and CRC respectively). All separated fractions of WC, RRC, and CRC were similar (Figure 1).

Conclusions

No differences in diet component digestibilities among corn processing treatments were detected. Reconstitution reduced fines and feed refusal but highest dry matter intake as a percentage of body weight was achieved with the RC diet which had the highest proportion of fines in the grain.

Reconstitution reduces the proportion of fines associated with dry rolling and this may be an effective tool in reducing the shrink associated with processed grains. RRC corn absorbed as much water as the CRC corn. Dry matter values of the RRC and CRC corn may have been different if the corn was reconstituted in a different manner or rolled soon after reconstitution. With no significant increase in any of the digestibilities measured, the RC, RRC, and CRC treatments may not warrant the cost of processing.

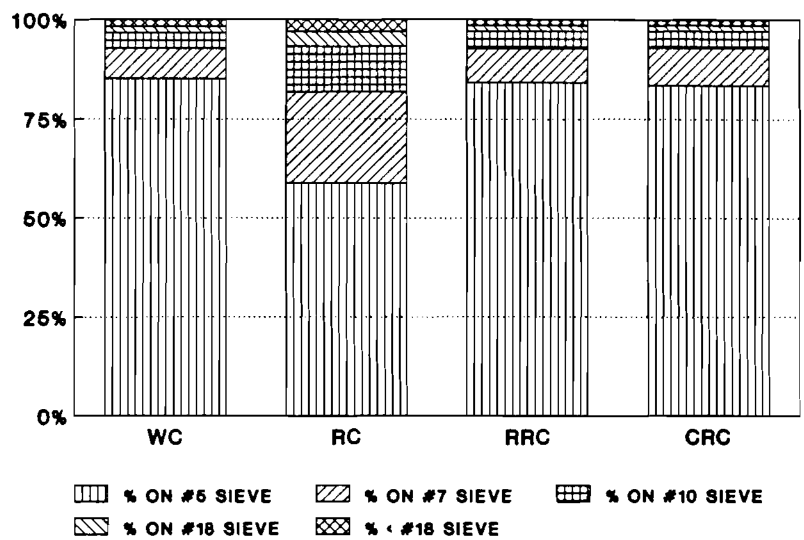

Figure 1. Separated corn particle size fractions (mean of periods 2 to 4).

Effect of Corn Processing and Reconstitution in High Grain Diets on Feedlot Performance and Carcass Characteristics of Steers and Heifers

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CATTLE 94-7

Summary

A 167-day feedlot trial was conducted to examine the effects of corn processing and reconstitution on growth performance and carcass characteristics of feedlot cattle. Initial weights of the continental cross steers (n=95) and heifers (n=63) were 690 and 680 lb, respectively. Diets were 84.5% corn, 7.0% ground grass hay, 4.9% soybean meal, and 3.6% liquid supplement. The grain component of the diet was either dry whole corn (WC), dry rolled corn (RC), corn reconstituted at least 12 h before rolling (RRC), or corn reconstituted with a commercial surfactant[3] at least 12 hours before rolling (CRC). Monensin and tylosin were included at 26.9 and 11.0 g/ton, respectively. Dry matter content of the WC, RC, RRC, and CRC diets were 85.62, 85.03, 80.98, and 80.96%, respectively. Dietary treatment had no effect on the feedlot performance of the steers or heifers. Yield grade (YG) was lower (P=.05) for CRC than for RRC cattle (2.96 vs 3.27). Kidney pelvic and heart fat (KPH) was lower (P<.05) for RC (2.30%) and CRC (2.29%) than for WC (2.48%) and RRC (2.56%) cattle. KPH and YG were the only measured variable affected by dietary treatment indicating little advantage to any of the corn processing methods tested.

Key Words: Beef, Grain Processing, Feedlot Performance

Introduction

This trial is the second part of a research project to evaluate the effects of corn grain processing and reconstitution in high grain diets. The first trial evaluated treatment effects on nutrient digestibility and processed corn grain particle size distribution. Data from the digestibility trial indicated no differences in nutrient digestibility due to processing, reconstitution or treatment with a surfactant. Gain, feed efficiency, and carcass data were not measured in the digestibility trial due to constant handling of the cattle and the low number of experimental units (n=12). The purpose of this trial was to examine the effects of corn grain processing and reconstitution on growth performance and carcass characteristics of feedlot cattle.

Materials and Methods

Ninety-five steers and 63 heifers of crossbred continental ancestry were allotted by gender into 20 pens (8 head/pen) to examine the effects of corn processing and reconstitution on growth performance and carcass characteristics of feedlot cattle. All but three of the steers and heifers were purchased from one ranch. Initial weights of the steers and heifers were 690 and 680 lb, respectively. Diets were 84.5% corn, 7.0% ground grass hay (2 in. screen), 4.9% soybean meal (SBM), and 3.6% liquid supplement (Table 1). The grain component of the diet was either dry whole corn (WC), dry rolled corn (RC), corn reconstituted at least 12 hours before rolling (RRC), or corn reconstituted with a commercial surfactant at least 12 hours before rolling (CRC). The same lot of corn was used to prepare all treatments for a week or more depending on the size of the

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Table 1. Diet composition

Ingredient	(DMB)
Corn, %	84.50
Grass hay, %	7.00
Soybean meal, %	4.90
Liquid supplement, %	3.60
Crude protein, %	12.03
Calcium, %	.532
Phosphorus, %	.317
Potassium, %	.894
NE_m (Mcal/cwt)	95.66
NE_g (Mcal/cwt)	65.54
Monensin (g/ton)	26.9
Tylosin (g/ton)	11.0

lot. Monensin and tylosin were included at 26.9 and 11.0 g/ton, respectively.

Cattle were fed once daily (a.m.) in outside concrete floored pens that are 25 ft.^{2} with an automatic waterer and 25 feet of fence-line feed bunk. Bedding was supplied equally to all pens as environmental conditions dictated. Steers were implanted with Synovex-S[4] on day 1 and Revalor[5] on day 65. Heifers were implanted with Synovex-H[4] on day 1 followed by Synovex-H and Finaplix-H[5] on day 65. All cattle were weighed in the morning at 0, 23, 44, 65, 93, 121, 149, and 167 days on feed. At 107 days on feed the source of grass hay changed and .4% urea was added to the diet to maintain crude protein levels. Cattle were slaughtered on two consecutive days. Carcass data collected included hot carcass weight (HCW), rib eye area (REA), rib fat thickness (RF), kidney pelvic and heart fat (KPH), and marbling score.

Reconstituted treatments (RRC and CRC) were prepared by adding 7% water to the whole corn grain in a horizontal ribbon-type mixer. The corn was left in the mixer overnight and rolled in the morning. The same roller with the same distance between the rolls was used for all grain processing. Two batches of RRC and CRC were prepared each week and stored in gravity flow bulk bins.

Data were analyzed with the GLM procedure of SAS (1985) appropriate for a randomized complete block design. Least squares means were separated with the PDIFF option at the .05 level. Pen means were used as the experimental unit for feedlot performance data. There were three pens of steers and two pens of heifers assigned to each diet. Animal was the experimental unit for carcass data.

Results and Discussion

An addition of 7% water by weight increased ($P<.001$) the moisture of the RRC and CRC corn by an average of 5.5%, while dry rolling increased ($P<.01$) the moisture content of the RC by .7%. Excess reconstituted grain carry-over in the bulk bins was not a problem in the colder months (January through April). When daytime temperatures exceeded 70 °F, reconstituted corn would begin to get warm after 4 days. During warmer weather, care was taken to match the supply of reconstituted corn to consumption in order to empty bins once weekly. Even though reconstituted corn occasionally became warm, it did not produce a offensive smell and had cooled by the time it was delivered to the feed bunk. Corn processing had no effect on cumulative feedlot performance (Table 2). Orthogonal contrasts showed that the increase in dry matter intake of the RRC and CRC over the RC diets neared significance ($P=.06$). During the first half of the trial, feed deliveries were not managed to reduce the accumulation of fines in the bunk giving a rather high mean (.24 ± .03 lb per head per day) for diet refusal. Diet refusal was not affected by dietary treatment. Steers exhibited greater ($P<.05$) ADG and dry matter intake than heifers (Table 3). Steers tended ($P=.09$) to be more efficient than heifers.

[4]Syntex Animal Health, Des Moines, IA.
[5]Hoechst Roussel, Somerville, NJ.

Table 2. Diet analysis, cumulative feedlot performance, diet refusals, and carcass characteristics by treatment

Variable	Treatment WC	RC	RRC	CRC	SE
Corn dry matter, %	86.35[a]	85.65[b]	80.81[c]	80.78[c]	.11
Diet dry matter, %	85.62[a]	85.03[b]	80.98[c]	80.96[c]	.09
Crude protein, %	11.67	11.76	11.81	11.78	.06
Neutral detergent fiber, %	12.53	12.56	12.57	12.56	.004
Acid detergent fiber, %	5.45	5.47	5.47	5.47	.003
Ash, %	3.75	3.90	3.93	3.94	.03
NE_m, Mcal/cwt	92.63	92.54	92.57	92.57	.02
NE_g, Mcal/cwt	63.29	63.26	63.25	63.25	.006
Feedlot Performance					
Initial wt., lb	686	685	686	684	2.8
Final wt., lb	1240	1246	1242	1240	15.1
Average daily gain, lb	3.28	3.30	3.30	3.31	.09
Dry matter intake, lb	20.40	20.19	20.79	20.83	.23
Feed/gain	6.24	6.14	6.31	6.31	.14
Diet refusals, lb/head/day	.26	.25	.27	.21	.03
Carcass Characteristics					
Hot carcass wt, lb	753	756	751	751	9.0
Dressing percent	61.1	61.1	60.7	60.7	.21
Yield grade	3.10[ab]	3.03[ab]	3.27[a]	2.96[b]	.10
Kidney, pelvic, heart fat, %	2.48[ab]	2.30[b]	2.56[a]	2.29[b]	.07
Quality grade[d]	5.14	5.07	5.10	5.03	.12

[a,b,c]Unlike superscripts differ ($P<.05$).
[d]5.0 = low choice.

Hot carcass weight was not influenced by diet. KPH was lower ($P=.03$) for RC (2.30%) and CRC (2.29%) than for WC (2.48%) and RRC (2.56%) cattle. Yield grade (YG) was lower ($P=.05$) for CRC than for RRC cattle (2.96 vs 3.27). YG was lower ($P<.001$) for heifers than for steers (2.37 vs 2.85). REA was larger ($P<.001$) for heifers than for steers (13.4 vs 12.5 in.^{2}). RF (.56 in.) and dressing percentage (60.9%) were not affected by diet or gender. Average quality grade (5.0 = low choice) was lower ($P<.01$) for heifers than for steers (4.91 vs 5.26). Heifers and steers graded 41.3 and 68.4% choice, respectively. It was noted upon palpating the implant sites that of the Revalor and Finaplix-H implants only 60% were normal. Cattle were wet when the implanting was performed and a less than ideal implant placement was necessary due to ear conditions. The heifers also received a Synovex-H implant (right ear) which had a much higher normal rate (90%). This may explain the larger rib eyes and lower quality grades of the heifers.

Table 3. Feedlot and carcass data by gender

Variable	Heifers	Steers	Root MSE
Number[a]	63	95	--
Initial wt	680	690	52.9
Final wt	1207	1264	84.5
Average daily gain, lb[c]	3.15	3.44	.198
Dry matter intake, lb[c]	20.10	21.00	.518
Feed/gain	6.38	6.12	.313
Diet refusals, lb/head/day	.26	.23	.069
Carcass Characteristics			
Hot carcass wt, lb	737.8	768.4	56.64
Rib eye area, in.^{2}[c]	13.4	12.5	1.22
Rib fat, in.	.54	.57	.16
Yield grade[c]	2.84	3.34	.66
Kidney, pelvic, heart fat, %	2.37	2.45	.47
Quality grade[bc]	4.91	5.26	.74
Dressing percent	61.0	60.8	1.32

[a]n = 62 for heifer carcass data.
[b]5.0 = low choice.
[c]Gender effect ($P < .05$).

Conclusions

Cold rolling and reconstitution of whole shelled corn offered no advantages in feedlot performance or carcass characteristics. The addition of the conditioner to the reconstituted diets lowered yield grade. Although feed refusals were reduced by reconstitution in the digestion trial, no differences were noted in this feedlot trial. Reconstituted treatments showed the highest dry matter intake in the feedlot trial and the lowest dry matter intake in the digestion trial. CRC diets showed the least diet refusals in both trials. Processed grain treatments did not increase utilization or performance enough to cover the cost of processing. Reconstitution does reduce the fines and dust associated with processed grains. This is an advantage that could not be measured by animal performance.

Evaluation of Wheat Middlings as a Supplement for Beef Cows Grazing Native Winter Range

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CATTLE 94-8

Summary

A winter grazing trial was conducted at the SDSU Cottonwood Research Station near Cottonwood, SD, to compare wheat middlings to soybean meal and corn-soybean meal supplements. During December and January 122 pregnant Simmental-Angus crossbred cows grazing two pastures with differing amounts of available forage were fed four supplemental treatments that provided the following amounts of crude protein (lb) and metabolizable energy (Mcal) per cow daily: 1) soybean meal .75 and 2.40, 2) corn-soybean meal 1.50 and 9.40, 3) low wheat middlings .75 and 4.76, and 4) high wheat middlings 1.50 and 9.40. Cows grazing the high available forage pasture gained 56 lb more than those grazing the low available forage pasture. Cows grazing the high available forage pasture were able to select a diet higher in crude protein and lower in acid detergent fiber. The supplement x pasture interaction indicates that level of forage availability is a factor in determining a cow's response to the supplemental treatment. When forage availability was low, wheat middlings was a less effective source of supplemental protein than soybean meal and a less effective source of supplemental energy compared to a corn-soybean meal supplement balanced to provide equal protein and energy. For cows grazing the high available forage pasture, soybean meal and the low wheat middlings supplements produced similar cow weight gains and the high wheat middlings supplement was a less effective source of supplemental energy than the corn-soybean meal supplement. Cows grazing the high forage pasture receiving 1.89 lb soybean meal had similar weight gains and lower supplement cost than cows grazing the low forage pasture receiving 6.59 lb of the corn-soybean meal supplement.

Key Words: Beef Cows, Winter Range, Available Forage, Wheat Middlings

Introduction

Previous studies at the SDSU Cottonwood Research Station demonstrated the importance of adequate cow body condition at calving and prior to the breeding season for high reproductive performance. Supplementation of cows grazing mature low protein forage can be used to maintain adequate body condition by minimizing cow weight loss in the winter.

Protein is typically the first limiting nutrient for cows grazing native winter range pastures. The use of all natural high protein supplements has been shown to increase cow weight change during the winter grazing period by improving forage intake and digestibility.

The use of grain which is high in starch can be detrimental to cow performance due to a reduction in intake and digestibility of the base forage. Previous research at the Cottonwood Station indicates that grain supplements are more likely to be beneficial when there is abundant forage to graze or when additional protein is provided with the grain supplement. Lower starch by-product feeds such as wheat middlings, soybean hulls, brewers grains, and

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sugar beet pulp have the potential to increase energy consumption without the detrimental effects of the starch in grains.

This study was conducted to compare wheat middlings to soybean meal and corn-soybean meal supplements on the performance of beef cows grazing native winter range with two levels of forage availability.

Materials and Methods

A winter grazing trial was conducted with 122 pregnant Simmental-Angus crossbred cows grazing native winter range pastures at the SDSU Cottonwood Research Station. Cows were allotted by age and weight to four supplemental treatments (Table 1) and grazed on pastures with either high or low available forage. A soybean meal supplement was used as a base to provide .75 lb crude protein per cow daily. A low wheat middlings supplement was balanced to provide the same amount of protein daily. A high wheat middlings supplement was balanced to provide twice the amount of energy as the low wheat middlings supplement. A corn-soybean meal supplement was balanced to provide the same amount of protein and energy as the high wheat middlings supplement. Supplements were pelleted (3/16 in. diameter) and balanced to exceed NRC (1984) requirements for phosphorus and potassium (Table 2).

Two pastures used in the study were predominately western wheatgrass. The low available forage pasture (270 acres) was grazed for 5,575 animal unit days prior to the start of the trial to create differences in available forage. The high available forage pasture (351 acres) had not been grazed since the previous year.

From December 4 to January 30, cows were gathered every morning, sorted into treatment groups, and bunk fed their respective supplements. At the beginning and end of the trial, cows were weighed in the morning on two consecutive days after overnight removal from feed and water. At the end of the supplemental feeding period, cows were grazed on a common pasture without supplementation for four days to equalize fill. Initial and final cow weights were the average of the two consecutive weights. Condition scores (1 to 9, 1 = extremely emaciated) were assigned by two trained technicians at the beginning and end of the trial. On the second weigh day at the beginning and end of the trial, subcutaneous fat was measured at the twelfth rib with an Aloka 500V ultrasound system using a 5 MHz, 5.8 cm probe. Cows were bred to either Angus or Simmental bulls and had mean calving dates of February 21 and April 9 for first calf heifers and mature cows, respectively.

In early January, forage samples were collected using four esophageally fistulated steers fitted with screened collection bags. Steers grazed with the cows for 30 minutes following morning supplementation on two consecutive days per pasture. Samples were frozen, lyophilized, and ground for later analysis.

Data for the grazing trial were analyzed as a 2 x 4 factorial arrangement with two pastures and four treatments as main effects using the

Table 1. Supplemental treatments[a]

	Supplement			
Item	Soybean meal	Corn-soybean meal	Low wheat middlings	High wheat middlings
Soybean meal	90.00	32.25	--	--
Corn	--	64.63	--	--
Wheat middlings	--	--	97.27	97.27
Molasses	2.17	2.28	2.73	2.73
Dicalcium phosphate	7.83	.84	--	--

[a]Percentage on a dry matter basis.

Table 2. Composition of daily supplemental intake per cow[ab]

Item	Supplement			
	Soybean meal	Corn-soybean meal	Low wheat middlings	High wheat middlings
Dry matter, lb	1.89	6.59	4.15	8.36
Metabolizable energy, Mcal/lb	2.40	9.40	4.76	9.40
Crude protein, lb	.75	1.50	.75	1.50
Phosphorus, lb	.041	.041	.040	.081
Potassium, lb	.039	.070	.052	.103
Calcium, lb	.039	.020	.005	.011
Price/lb supplement, $	.135	.104	.080	.080
Price/cow/day, $	.29	.78	.38	.77
Price/cow/period, $	16.82	45.24	22.04	44.66

[a]ME values are calculated from NRC feed tables. Other values are based on chemical analysis.
[b]Costs are as fed based on delivered feed without bulk discounts.

GLM procedures of SAS and treatment means were separated by the PDIFF option. Dependent variables include initial, final, and change in cow weight, condition score, and rib fat. Independent variables include supplement, pasture, cow age, and supplement x pasture. Initial measurements were included as covariates for weight change, condition score change, and change in rib fat.

Results and Discussion

Esophageal samples indicate that cattle on the high available forage pasture were able to select a diet higher in crude protein ($P<.05$) and lower in acid detergent fiber ($P=.06$). Neutral detergent fiber, acid detergent lignin, and ash content were similar (Table 3) between pastures.

Table 3. Composition of forage samples[ab]

Item	Forage available			
	Low		High	
Organic matter basis, %				
Crude protein	3.34[c]	(.26)	4.40[d]	(.18)
Neutral detergent fiber	85.87	(.90)	84.20	(.64)
Acid detergent fiber	56.80[e]	(.75)	54.75[f]	(.53)
Acid detergent lignin	5.52	(.28)	5.97	(.20)
Dry matter basis, %				
Ash	13.26	(.36)	12.82	(.25)

[a]Least squares means followed by standard errors.
[b]Uncorrected for salivary contamination.
[c,d]Means with uncommon superscripts differ ($P<.05$).
[e,f]Means with uncommon superscripts differ ($P=.06$).

Cows grazing the high available forage pasture gained 56 lb more ($P<.001$) and lost less body condition ($P<.001$) than cows grazing the low available forage pasture. There was a treatment x pasture interaction ($P<.05$) for both weight and condition score change, indicating that supplement response was dependent on the amount of available forage (Table 4).

When forage availability was low, cows that were fed .75 lb crude protein from soybean meal lost less weight ($P<.05$) and condition score ($P<.05$) than the low wheat middlings cows. Cows that received 1.5 lb crude protein from the corn-soybean meal supplement had greater weight ($P<.05$) and condition score changes than high wheat middlings fed cows. Cows fed high wheat middlings lost less weight ($P<.05$), condition score ($P<.05$), and rib fat than low wheat middlings. When forage availability is limited wheat middlings appears to be a less effective protein source compared to soybean meal. When forage availability is low or when cows are thin and maximum weight gain is important, a corn-soybean meal supplement will provide the highest weight gains, but it has the highest feed costs.

When forage availability was high, cows that received .75 lb crude protein from soybean meal had similar weight gains and condition score changes compared to cows fed low wheat middlings. Cows that received 1.5 lb crude protein from corn-soybean meal gained 32 lb more ($P<.05$) and had a greater condition score change than high wheat middlings supplemented cows with a similar cost per day. Cows fed high wheat middlings had a 22-lb weight change advantage ($P<.05$) over cows fed low wheat middlings.

Previous studies have shown that a grain supplement may be detrimental to cow performance. Grain supplements are more likely to improve cow weight change when there is abundant forage or when the amount of protein in the supplement is high. In this study, the lower starch wheat middlings supplement did not improve weight change compared to the corn-soybean meal supplement that was balanced to provide the same level of protein and energy as the wheat middlings. Regardless of forage availability, the lower starch wheat middlings supplement did not improve performance over the higher starch corn-soybean meal supplement.

The wheat middlings supplements had the lowest price per pound of supplement (Table 2). The soybean meal supplement cost the least per day and for the entire feeding period. Cows fed low wheat middlings had intermediate feed costs. The corn-soybean meal and high wheat middlings supplements resulted in the highest daily and 58-day feeding period feed costs.

A digestibility trial is in progress to determine the effects of the same supplements on the intake and digestibility of mature native grass hay. The grazing trial will be repeated.

The results from this study indicate that forage availability is a factor in determining the response to a supplement. When forage availability is low, wheat middlings is a less effective source of supplemental protein compared to soybean meal. With limited forage availability wheat middlings does not appear to be as beneficial as a corn-soybean meal supplement when added energy is needed. If abundant forage is available, wheat middlings will provide similar gain responses as a protein supplement compared to soybean meal. With a high amount of grazeable forage, wheat middlings and corn-soybean meal supplements had positive and beneficial weight gains when used as a source of additional energy, but they also have the highest feed costs. When maximum weight gains are needed, usually when cows are thin in the fall, a corn-soybean meal supplement will provide the greatest weight gains. However, it also has the highest feed costs associated with it. Soybean meal supplements appear to be the most beneficial supplement for minimizing weight and body condition losses at the least cost.

Table 4. Effect of available forage and supplement on cow performance

Level of forage	Low				High			
Supplement	Soybean meal	Corn-soybean meal	Low wheat middlings	High wheat middlings	Soybean meal	Corn-soybean meal	Low wheat middlings	High wheat middlings
No. cows	14	16	15	15	16	15	16	15
Initial wt, lb	1140	1141	1154	1114	1129	1118	1122	1124
Init. condition score, 1-9	5.5	5.4	5.4	5.4	5.5	5.4	5.3	5.4
Initial rib fat, in.	.17	.14	.15	.11	.15	.15	.13	.12
Wt change, lb	2^{d}	34^{bc}	-73^{f}	-23^{e}	35^{bc}	72^{a}	18^{cd}	40^{b}
Condition score change	-.1^{ab}	.0^{ab}	-.6^{c}	-.2^{b}	-.0^{ab}	.2^{a}	-.1^{b}	-.0^{ab}
Rib fat change, in.	-.04^{a}	-.02^{ab}	-.05^{a}	-.02^{ab}	-.03^{ab}	-.00^{b}	-.03^{ab}	-.00^{b}

^{a,b,c,d,e,f}Means with uncommon superscripts differ ($P<.05$).

Breed-Type and Mating System Effects on Beef Cattle Carcass Characteristics

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CATTLE 94-9

Summary

The effects of dam breed-type (Simmental x Hereford, Angus x Hereford, and Tarentaise x Hereford) and mating system (rotational versus rota-terminal) on carcass characteristics were evaluated. Means for dam breed-type and mating system were adjusted in separate analyses to one of three slaughter endpoints: 437-day slaughter age, 734-lb carcass weight, or .49 inches of carcass fat thickness. Calves from Simmental x Hereford dams had heavier carcasses compared to the other two dam breed-types when adjusted to a constant slaughter age or fat thickness. Calves from Angus x Hereford dams tended to have more external fat, smaller rib eye area, and more marbling than calves from the other two dam types on an age-constant and carcass weight-constant basis. Terminal-sired (Charolais) calves had less external fat and larger rib eye area than rotational calves at a constant age or carcass weight. The dam breed-type x mating system interaction generally did not approach significance.

Key Words: Breed-type, Mating System, Carcass

Introduction

In order to compete with other sources of food protein, the beef industry must produce meat products that are desirable to consumers and relatively cost-efficient. Genetics and various management alternatives are among the tools that producers can use to alter carcass value. The objective of this study was to evaluate specific dam breed-types and mating systems with regard to beef carcass characteristics.

Materials and Methods

Carcasses evaluated in this study were from calves born from 1988 through 1992 at the Antelope Range Livestock Station in northwestern South Dakota. The cow herd consists of two-breed rotations of Angus x Hereford, Simmental x Hereford, and Tarentaise x Hereford with annual additions of replacement females. A terminal breeding segment was added to provide comparisons between rotational versus rotational-terminal (i.e., rota-terminal) breeding systems. The mating design of the study is shown in Table 1. Some cows within each of the three dam types are mated to Charolais sires (rota-terminal matings) and the others are mated within rotation (rotational matings).

Calves were weaned in the fall at an average age of about 7 months. Following a preconditioning period of 2 to 3 weeks at the station, steers and terminal-cross heifers were sent to a commercial feedlot. Calves received a high energy finishing diet in the feedlot. Calves were slaughtered in commercial packing plants in either one or two groups per year at an average age of 437 days. Carcass information obtained on samples of calves included carcass weight, external fat thickness, estimated KPH fat, rib eye area, and carcass quality grade.

The statistical model included the effects of dam type (Simmental x Hereford, Angus x Hereford, and Tarentaise x Hereford), rotation phase within dam type (high percentage Hereford dams versus low percentage dams), mating system (rotational versus rota-terminal), and the interaction between dam type and mating system. Means for dam breed-type and

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Table 1. Mating design used to produce calves in the study

Dam breed-type	Sire breed: Rotational	Sire breed: Rota-terminal
Simmental x Hereford	Polled Hereford or Simmental	Charolais
Angus x Hereford	Polled Hereford or Angus	Charolais
Tarentaise x Hereford	Polled Hereford or Tarentaise	Charolais

mating system were adjusted to one of three slaughter endpoints: 437-day slaughter age, 734-lb carcass weight, or .49 inch of carcass fat thickness. Within the Tarentaise x Hereford dam group, F_1 dams were combined with low percentage Hereford dams for analyses. No F_1 dams remained in the other two dam groups for the years included in this study.

Results and Discussion

Carcass trait means by dam breed-type and mating system are presented in Table 2. The statistical adjustment for alternative slaughter endpoints (i.e., age, carcass weight and fat thickness) estimates the expected performance if all calves had been slaughtered at the overall average value for the particular endpoint. For example, the slaughter age-adjusted values in Table 2 estimate the dam breed-type and mating system means that would have resulted if all calves had been slaughtered at 437 days of age. The dam breed-type x mating system interaction generally did not approach significance, indicating that dam breed-type differences were relatively consistent across the two mating systems. Therefore, means are presented only for the main effects of dam breed-type and breeding system.

Calves from Simmental x Hereford dams had heavier carcasses compared to the other two dam breed-types when adjusted to a constant slaughter age or fat thickness. Calves from Angus x Hereford dams tended to have more external fat, smaller rib eye area, and more marbling than calves from the other two dam types on an age-constant and carcass weight-constant basis. KPH fat was similar across the three dam groups for each endpoint adjustment. Rota-terminal calves sired by Charolais had less external fat and larger rib eye area than rotational calves at a constant age or carcass weight.

Implications

Decisions made by the cow-calf producer directly impact the final beef products available to consumers. Differences between breed-types and breeding systems were found for several important carcass characteristics in this study. Such differences should be among the factors considered by the cow-calf producer in developing a breeding program.

Table 2. Carcass characteristics adjusted to a common slaughter age, carcass weight, or fat thickness

Dam type[a]	n	Carcass wt, lb	Fat cover, in.	Rib eye area, sq. in.	KPH fat, %	Marbling score[b]
		Adjusted for Slaughter Age (mean = 437 days)				
S x H	89	751	.43	13.1	2.0	10.0
A x H	137	718	.54	12.3	2.0	10.9
T x H	91	707	.46	12.6	2.0	9.5
F-test		**	**	**	NS	**
Mating system						
Rotational	221	720	.53	12.3	2.0	10.0
Rota-terminal	96	730	.43	13.1	2.0	10.3
F-test		NS	**	**	NS	NS
		Adjusted for Carcass Weight (mean = 734 lb)				
S x H			.42	12.9	2.0	10.0
A x H			.56	12.5	2.0	11.0
T x H			.48	12.8	2.0	9.6
F-test			**	**	NS	**
Mating system						
Rotational			.54	12.4	2.0	10.1
Rota-terminal			.43	13.1	2.0	10.3
F-test			**	**	NS	NS
		Adjusted for External Fat Thickness (mean = .49 in.)				
S x H		756		13.1	2.0	10.2
A x H		711		12.4	1.9	10.8
T x H		710		12.6	2.0	9.6
F-test		**		**	NS	**
Mating system						
Rotational		716		12.3	2.0	9.9
Rota-terminal		736		13.0	2.0	10.5
F-test		+		**	NS	+

[a]S = Simmental, A = Angus, and T = Tarentaise.
[b]8 = slight, 9 = slight +, 10 = small -, 11 = small.
+P<.10, ** P<.01, NS nonsignificant.

Relationship of Beef Sire Birth Weight and Weaning Weight Expected Progeny Differences to Actual Performance of Crossbred Offspring

SDSU

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CATTLE 94-10

Summary

Performance records from 1982 to 1992 on 1365 calves for birth weight (BW) and 1492 calves for weaning weight (WW) were analyzed to estimate relationships of purebred sire expected progeny difference (EPD) values for BW and WW to actual crossbred progeny performance. Sires of the calves were Polled Hereford, Simmental, Angus, Salers, Tarentaise, or Charolais. The pooled-across-breed regressions (lb/lb ± SE) of BW and WW of calves on sire EPD were 1.17 ± .31 and .75 ± .28, respectively. Residual correlations of BW with BW EPD and WW with WW EPD were .16 ($P<.01$) and .05 ($P=.10$), respectively. Additional regression and residual correlation analyses were conducted in which records from progeny of low-accuracy sires (Acc. <.50) were deleted. The reduced data set included 967 records for BW and 962 records for WW. The pooled-across-breed regressions (lb/lb ± SE) of BW and WW of calves on higher-accuracy sire EPD were 1.28 ± .35 and .71 ± .31, respectively. Residual correlations using higher-accuracy sire data of BW with BW EPD and WW with WW EPD were .18 ($P<.01$) and .09 ($P=.02$). Breeders who use BW and WW EPDs as a selection tool should expect such selection to be effective, on average, and reasonably consistent with theoretical expectation. However, some sires and small progeny groups may not rank as expected based on sire EPDs.

Key Words: Cattle, Expected Progeny Difference, Birth Weight, Weaning Weight

Introduction

Herd sire selection represents the major directional force available to the beef producer for creating genetic improvement. Expected progeny differences (EPDs) enhance the accuracy of selection decisions by establishing an evaluation of the relative genetic value of a sire within a breed for traits of economic importance.

It is important to validate tools such as EPDs under typical commercial production conditions. The impact of such an effective selection resource potentially would allow commercial beef cattle producers to make more appropriate choices of sires for particular production environments, improving the economic productivity of the commercial cow-calf producer. The purpose of this study was to evaluate the relationship of birth weight and weaning weight EPDs of purebred beef sires to actual performance of crossbred offspring.

Materials and Methods

Performance records of calves born from 1982 through 1992 at the Antelope Range Livestock Station in northwestern South Dakota were analyzed. Calves were born in the spring, weighed at birth, and male calves were castrated at birth. Calves were not creep-fed, and weaning weights were taken in the fall when the entire group averaged approximately 7 mo of age. Progeny dam breeds evaluated in this study were considered representative of females typically available to commercial producers. Progeny dam breeds included straightbred Hereford, F_1 Salers x Hereford, and

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three two-breed rotations (Simmental x Hereford, Angus x Hereford, and Tarentaise x Hereford). For purposes of analysis, each record was assigned to one of eight dam breed groups, based upon breed percentages. Sires of the calves were Polled Hereford, Simmental, Angus, Salers, or Tarentaise (rotational matings) or Charolais (terminal sire matings).

The only records retained for analysis were for calves whose sires' 1993 EPD values were available from the respective breed associations, except that Tarentaise EPD values were from a Fall 1991 analysis. A new Tarentaise analysis was not performed until Fall 1993. To be included in the analysis, at least two sires of the same breed must have been represented by progeny in the same year. Numbers of records remaining after editing were 1365 for birth weight and 1492 for weaning weight in the overall data set. There were 95 sires represented, of which 77 had semen available through commercial outlets. The remaining 18 sires were purchased for use as natural-service "cleanup" sires from various seedstock producers.

No data from this herd were reported to breed associations. Therefore, the data used in these analyses were independent of those used in the calculation of sire EPD values. No attempt was made to practice divergent selection of sires for birth weight or weaning weight in this herd. Rather, a range of EPDs has been used for most sire breeds. This sire sampling may be more representative of typical commercial herds in the United States than if sires of extreme high and low EPD values had been chosen.

Pooled-across-breed analyses which accounted for the effects of breed of sire, dam breed group, cow age, year calf born, calf sex, and either calf date of birth or calf weaning age were conducted to compute the regression of progeny birth weight or weaning weight on sire EPD. Regressions were computed for each breed and then averaged across breeds in the pooled analysis. The theoretical expected value for each regression coefficient was 1.0. That is, for each 1-lb difference in sire EPD, we theoretically expect a 1-lb difference in progeny performance. Residual correlation coefficients among calf birth weight, sire birth weight EPD, weaning weight, and sire weaning weight EPD also were obtained. A second set of analyses was conducted on a subset of the data in which records of progeny of low accuracy (Acc. $<.50$) sires were deleted.

Results and Discussion

Overall means for calf birth weight (BW) adjusted to 82-day Julian calving date and 208-day calf weaning weight (WW) in the present study were 91.2 lb and 531.5 lb, respectively. Table 1 presents the ranges and averages of within-breed EPDs for all active sires reported by breed associations from Spring 1993 sire summaries (Fall 1991 for Tarentaise). The ranges in BW EPD and WW EPD reported for active sires were largest in Charolais and Simmental.

Table 2 examines ranges and means of sire BW EPD sampled in the study. BW EPD means of Polled Hereford, Simmental, Salers, and Tarentaise sires used in this study were similar to or slightly less than breed averages for active sires. Angus and Charolais sire BW EPD means in this study were slightly greater compared to overall breed means.

Table 3 examines ranges and means of sire WW EPD sampled in the study. WW EPD means of Polled Hereford and Salers sires were less than breed averages for active sires. Simmental, Angus, Tarentaise, and Charolais sire WW EPD means in this study were similar or slightly greater compared to overall breed means.

The overall pooled-across-breed regression for calf BW on sire EPD was $1.17 \pm .31$ lb/lb of BW EPD and was similar to its expected value of 1.0 (Table 4). Table 4 also presents individual breed regression coefficients for BW on sire EPD. These regression coefficients were all positive as per expectation. Only the value for Tarentaise ($2.05 \pm .47$ lb/lb) differed significantly from the expected value of 1.0. It may be important that Tarentaise sire EPD values were only available from a Fall 1991 analysis. The present results suggest that prediction of BW based on published sire EPD agrees closely with the expected value of 1.0 when averaged across breeds, although

Table 1. Ranges (lb) and accuracies for expected progeny differences (EPDs) for all sires in each breed[a]

Breed	Birth wt EPD range	Birth wt EPD mean	Weaning wt EPD range	Weaning wt EPD mean
Polled Hereford	-4.41 to 13.88	3.96	-20.93 to 61.89	25.99
Simmental	-9.91 to 15.42	.66	-29.74 to 85.24	5.07
Angus	-6.61 to 12.56	3.52	-40.97 to 66.08	22.91
Salers	-5.51 to 7.71	.88	-23.57 to 40.97	7.49
Tarentaise	-3.96 to 9.91	1.98	-55.07 to 48.90	2.64
Charolais	-12.11 to 11.67	1.10	-76.43 to 63.44	5.07

[a]Reported by respective breed association in Spring 1993 sire summaries, except that Tarentaise ranges and means were from all sires in a Fall 1991 summary.

Table 2. Numbers of sires and progeny evaluated, range and mean values for 1993 BW expected progeny difference (EPD), and mean accuracy values for full and reduced data[ab]

Item	No. of sires	No. of progeny	Sire BW EPD, lb Range	Sire BW EPD, lb Mean	Mean BW EPD accuracy
Polled Hereford	22 (18)	623 (463)	-.66 to 6.83	2.36 (3.13)	.78 (.91)
Simmental	13 (12)	228 (110)	-2.42 to 2.86	-1.50	.71 (.93)
Angus	14 (11)	268 (160)	2.64 to 10.13	5.15 (4.76)	.67 (.91)
Salers	5	32	-1.76 to 1.10	-.48	.76
Tarentaise	12 (11)	99 (95)	-3.30 to 6.83	2.00 (2.05)	.89
Charolais	11 (10)	115 (107)	-5.51 to 8.15	3.08 (3.17)	.84
Overall	77 (67)	1365 (967)	--	--	.78 (.87)

[a]Tarentaise sires EPD values were only available from a Fall 1991 analysis.
[b]Values in parentheses represent reduced (higher accuracy sire) data only.

Table 3. Numbers of sires and progeny evaluated, range and mean values for 1993 WW expected progeny difference (EPD), and mean accuracy values for full and reduced data[ab]

Item	No. of sires	No. of progeny	Sire WW EPD, lb Range	Sire WW EPD, lb Mean	Mean WW EPD accuracy
Polled Hereford	25 (18)	750 (463)	-.44 to 42.73	20.75 (26.28)	.72 (.89)
Simmental	13 (11)	228 (105)	-3.52 to 21.81	5.53 (4.60)	.72 (.94)
Angus	14 (11)	268 (160)	.22 to 51.81	28.35 (26.19)	.66 (.90)
Salers	5	32	-16.08 to 4.19	-7.16	.68
Tarentaise	12 (11)	99 (95)	-21.81 to 26.43	5.29 (5.31)	.87
Charolais	11 (10)	115 (107)	-11.23 to 25.55	9.65 (9.85)	.83
Overall	80 (66)	1492 (962)	--	--	.75 (.85)

[a]Tarentaise sires EPD values were only available from a Fall 1991 analysis.
[b]Values in parentheses represent reduced (higher accuracy sire) data only.

Table 4. Regression coefficients for calf BW on sire EPD for full and reduced[a] data sets

Breed	Regression coefficient, $b \pm SE$		P-value ($Ho: b = 1$)
Overall (average)	1.17 ± .31	(1.28 ± .35)	.59 (.43)
Polled Hereford	1.16 ± .36	(.89 ± .53)	.66 (.84)
Simmental	1.90 ± .66	(2.37 ± 1.14)	.18 (.23)
Angus	.38 ± .36	(.84 ± .40)	.08 (.68)
Salers	1.12 ± 1.51	(1.05 ± 1.46)	.94 (.97)
Tarentaise	2.05 ± .47	(2.09 ± .46)	.03 (.02)
Charolais	.40 ± .54	(.42 ± .52)	.26 (.27)

[a]Values in parentheses represent reduced (higher accuracy sire) data.

individual breed coefficients were somewhat variable.

The overall pooled-across-breed regression of calf WW on sire EPD was .75 ± .28 lb/lb of WW EPD (Table 5). This value is not significantly different from the theoretical expected value of 1.0. Table 5 also presents the individual breed regression coefficients for calf WW on sire EPD. These regressions were positive except for Polled Hereford sires (-.29 ± .33 lb/lb) which was significantly different from the expected value of 1.0. Note that Polled Hereford sires were mated to several different dam breed groups. Nevertheless, a negative regression coefficient was unexpected.

Results from residual correlation analysis from the overall data set are presented in Table 6. Positive significant correlations were obtained for calf BW with sire BW EPD (.16, $P<.01$) and sire WW EPD (.12, $P<.01$). A lower positive significant correlation of calf WW with sire BW EPD was observed (.08, $P=.02$). The correlation of calf WW with sire WW EPD only approached significance (.05, $P=.10$). Larger positive and significant correlations were observed between BW and WW and BW EPD and WW EPD (.48 and .64, $P<.01$, respectively).

To examine the effect of deleting data from progeny of low-accuracy sires on the results of this study, additional regression and correlation analyses were conducted in which records from progeny of low-accuracy (Acc. <.50) were deleted. Data remaining after editing included 67 sires of 967 progeny for calf BW and 66 sires of 962 progeny for calf WW. The mean accuracy value for sire EPD increased to .87 (Table 4) and .85 (Table 5) for BW and WW respectively, compared to .78 and .75 using the full data set. The overall pooled-across-breed regression coefficient for BW on higher accuracy sire EPD increased from 1.17 to 1.28 ± .35 lb/lb and remained similar to the expected value of 1.0 (Table 4). For individual breed regression coefficients, Polled Hereford and Angus sires approximated closer to their theoretical expectation of 1.0. Salers, Tarentaise, and Charolais sires regression coefficients remained similar since only 12 records were deleted from the full data set.

The overall pooled-across-breed regression coefficient for calf WW on higher accuracy sire EPD decreased slightly from .75 to .71 ± .31 lb/lb but remained similar to the expected value of 1.0 (Table 5). For individual within-breed regression coefficients, Polled Herefords approximated and were similar to the expected value of 1.0 with a regression coefficient of 1.13 ± .59 lb/lb. A total of 7 Polled Hereford sires of 287 progeny were deleted from the full data set. The regression coefficient for Simmental sires also decreased from 1.63 to .12 ± .95 lb/lb but was not significantly different from expectation. Of 228 total Simmental progeny in the original data set, two sires representing 123 progeny were deleted to perform the higher accuracy analysis. Regression of actual WW on EPD for Angus sires decreased from .39 to .28 ± .37 lb/lb and differed from the expected value of 1.0. All other sire breed regression coefficients remained

Table 5. Regression coefficients for calf WW on sire EPD for full and reduced[a] data sets

Breed	Regression coefficient, $b \pm$ SE		*P*-value (*Ho* : b = 1)
Overall (average)	.75 ± .28	(.71 ± .31)	.37 (.35)
Polled Hereford	-.29 ± .33	(1.13 ± .59)	<.01 (.83)
Simmental	1.63 ± .68	(.12 ± .95)	.35 (.36)
Angus	.39 ± .34	(.28 ± .37)	.07 (.05)
Salers	1.15 ± 1.23	(1.53 ± 1.21)	.66 (.66)
Tarentaise	.65 ± .51	(.67 ± .50)	.49 (.51)
Charolais	.55 ± .59	(.55 ± .58)	.44 (.44)

[a]Values in parentheses represent reduced (higher accuracy sire) data.

Table 6. Residual correlation coefficients among sire expected progeny difference (EPD) values and calf production trait for full and reduced[a] data sets

Item	Birth weight EPD	Weaning weight	Weaning weight EPD
Birth weight	.16** (.18**)	.48** (.45**)	.12** (.17**)
Birth weight EPD		.08* (.11**)	.64** (.64**)
Weaning weight			.05+ (.09*)

[a]Values in parentheses represent reduced (higher accuracy sire) data.
+P=.10.
* P=.02.
** P<.01.

similar to those from the analysis of the full data set.

For the residual correlation analyses, trends were also similar to those from using the full data set (Table 6). Pooled-across-sire breed correlations observed between actual progeny performance and sire EPDs increased from .16 to .18 for BW and from .05 to .09 for WW. Results suggest that average relationships between sire EPD and progeny performance were not appreciably changed when data from progeny of low-accuracy sires were deleted. Genetic prediction theory indicates that the accuracy value for a mean EPD associated with a group of animals is greater than the accuracy associated with the EPD of an individual from the group.

In interpreting the results of this study, it is important to consider some of the assumptions made and potential shortcomings of the experimental methods. This analysis assumes that bulls' EPD was estimated with a high degree of accuracy, on average, and that various bulls were mated to cows of similar average genetic potential. In our study, cows were randomly assigned to bulls used within a given year and sire breed. It is uncertain how heterosis for calf preweaning growth affects the prediction of crossbred performance from purebred sire EPD compared to prediction of the performance of purebred descendants. The present study mainly utilizes records of progeny produced through rotational crossbreeding.

In summary, sire EPD was positively related to actual calf BW and WW when the sires were used for crossbreeding. The results of this study suggest that differences in BW were more adequately predicted than differences in WW based on published sire EPD among purebred sires used in crossbreeding when averaged over breeds and across large numbers of sires and progeny. Breeders who use BW and WW EPDs as a selection tool should expect such selection to be effective, on average, and reasonably consistent with theoretical expectation. However, some sires and small progeny groups may not rank as expected based on sire EPDs.

Effect of Weaning Date on Performance of Beef Cows

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CATTLE 94-11

Summary

Records from 92 mature crossbred cows calving in March and April were used to determine the effect of weaning calves 40 days earlier than the traditional weaning time on cow weight change, body condition, and reproductive performance. When calves were weaned early (September 14 versus October 23), their dams gained more weight from September 14 to early December and had higher body condition scores in December than the dams of later weaned calves. The two nutritional treaments imposed after calving were important in explaining the effects of earlier weaning on cow reproductive performance. For cows that were fed grass hay at 75% of NRC energy requirements in drylot after calving, the advantage of higher weight change and body condition scores from early weaning persisted until the following May. This resulted in a higher percentage conceiving during the first 21 days of the breeding season. For cows on Moderate postcalving nutrition, the advantages of weaning early on weight change and body condition were gone by early May, resulting in no difference in reproductive performance. For spring calving cows with access to abundant forage for at least 30 days prior to the breeding season to compensate for undernutrition during the winter, weaning calves earlier than the traditional weaning time may only be beneficial to reproductive performance when winter nutrition is severely limited.

Key words: Beef Cow, Weaning Date, Nutrition, Reproduction

Introduction

Winter nutrition of the beef cow has a large impact on reproductive performance. The challenge is to minimize winter feed costs and still have a high percentage of cows that cycle and conceive early in the breeding season to maintain high pregnancy rates over the long term. Previous studies at the SDSU Cottonwood Research Station have demonstrated the importance of adequate cow body condition at calving and prior to the start of the breeding season to obtain high reproductive performance. There is recent interest in weaning calves earlier than the traditional weaning times to allow cows to gain weight and improve body condition prior to the winter feeding period. This would seem to be an advantage for cows with the genetic potential for above average growth and milk production that tend to be thinner in the fall. In theory this would allow lower winter feed costs for the cow herd. A previous study (Pritchard et al., 1988 SD Beef Report) indicated that calves weaned at 5 1/2 months of age could be marketed for slaughter at a younger age than calves weaned at 7 months of age with no adverse effects on feedlot performance or carcass traits when an accelerated feeding program was used.

It is a common practice to wean calves earlier when feed supplies are scarce or expensive such as under drought conditions. There is limited information on the effects of weaning calves 30 to 60 days early as a routine practice to improve reproductive performance of the cow herd. The objective of this analysis is to evaluate the effect of weaning 40 days earlier than the traditional weaning time on the weight change, body condition, and reproductive performance of cows managed under western South Dakota range conditions.

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Materials and Methods

Records from 92 mature (4.5 to 6.5 years) Simmental x Angus crossbred cows with Charolais sired calves were used to evaluate the effect of weaning earlier than the traditional weaning date on cow performance. The cow herd is maintained on native range pastures at the SDSU Cottonwood Research station west of Philip, SD, from late October to early May and near Sturgis, SD, from early May to late October.

The early weaned group was weaned on September 14 when calves were an average age of 162 days and the late weaned group was weaned at the traditional weaning time on October 23. Following weaning, cows were maintained as a group on native range pasture until calving. Within two weeks following calving, cows were weighed and allotted by calving date to a Low or Moderate postcalving nutritional treatment. Cows on the Low nutritional treatment were limit fed grass hay in drylot to 75% of NRC requirements for energy. The cows on the Moderate nutritional treatment grazed winter range. All cows received 2 lb of pelletted soybean meal to provide .75 lb crude protein per cow daily from December 4 to May 9. Postcalving nutritional treatments continued until May 9 when all cows grazed native range as one group without supplementation until the following winter.

Blood was collected by jugular venipuncture from all cows on June 1 and June 8. Blood was centrifuged and serum frozen for later progesterone analysis by radioimmunoassay. Cows with greater than 1 ng progesterone per ml of serum on either bleeding date were considered cyclic. Cows were observed for estrus and artificially inseminated during the first 21 days of the breeding season (starting June 8) followed by exposure to 4 bulls for 39 days. Conception date was estimated by subtracting 283 days from the calving date the following year. Cows were palpated for pregnancy on October 24 and open cows were sold for slaughter. All weights were taken after removal from feed and water overnight. Condition scores (1-9; 1 = extremely thin and 9 = obese) were assigned by two people immediately after weighing.

Results and Discussion

Calves that were weaned 40 days earlier than the traditional weaning date were 103 lb lighter ($P<.05$) when weaned (Table 1). The calf average daily gain of 2.58 lb indicates that the available forage and cow milk production was not greatly limiting calf growth during late September and October. Cows whose calves were weaned early gained more during the period between early weaning and the traditional weaning date even while overcoming the stress of weaning. There was a 41-lb difference in cow weight change from mid September to early December between the two weaning groups ($P<.05$) and a .5 condition score difference ($P<.05$) in early December. Prior to the beginning of the calving season in March, the advantage in weight change was 26 lb ($P<.05$) and the cow condition scores of the two groups were similar.

The interactions between weaning date and postcalving nutrition are important in evaluating the potential benefits of early weaning (Table 2). For cows on the Moderate postcalving nutrition treatment, later weaning resulted in less weight loss from March to May ($P<.05$). This is probably due to compensation for greater weight loss earlier. Weaning date did not affect weight change from March to May for cows on the Low postcalving nutrition treatment. When feed was restricted after calving (Low treatment), the effect of weaning date was reflected in weight change from mid September to early May and May condition score. When cows received the Moderate postcalving nutrition, the advantages in weight and condition score due to weaning date disappeared by May.

Cow weight change from May to June demonstrates the potential for cows to compensate for under nutrition during the winter if abundant spring forage is available. Those treatment groups that lost more weight from September to May gained the most from May to June. While postcalving nutrition still affected cow condition just prior to the breeding season in early June, weaning date only affected condition scores for those cows on Low postcalving nutrition which was a relatively severe restriction in energy consumption.

Table 1. Effect of weaning date on cow and calf performance

Weaning date	September 14	October 23
Number of cows	49	43
Calf age at weaning, days	162	202
Calf weight, lb		
September 14	494	492
Weaning day	494[a]	597[b]
Cow weight September 14, lb	1112	1140
Cow weight change, lb		
September 14 to October 23	74[a]	53[b]
September 14 to December 4	19[a]	-22[b]
September 14 to March 4	68[a]	42[b]
Cow condition score, 1-9		
September 14	5.3	5.2
October 23	6.4[a]	6.0[b]
December 4	6.0[a]	5.5[b]
March 4	5.2	5.1

[a,b] Means with uncommon superscripts differ ($P<.05$).

Table 2. Effects of weaning date and postcalving nurition on cow perforamnce

Postcalving nutrition	Low		Moderate	
Weaning date	Sepember 14	October 23	September 14	October 23
Number of cows	23	23	26	20
Cow weight change, lb				
March 4 to May 9	-140[a]	-138[ab]	-118b	-86[c]
September 14 to May 9	-151[a]	-194[c]	-98[b]	-103[b]
May 9 to June 1	85[a]	106[a]	44[b]	49[b]
September 14 to June 1	-66[ab]	-89[a]	-54[b]	-54[b]
Cow condition score				
May 9	4.1[a]	3.6[c]	4.7[b]	4.7[b]
June 1	4.2[a]	3.9[a]	4.8[b]	4.6[b]
Percentage cycling by the beginning of the breeding season	39.1[a]	43.5[a]	76.9[b]	55.0[ab]
Percentage in estrus during a 21-day AI period	82.6	73.9	92.3	95.0
Percentage pregnant				
21-day AI preiod	69.6[a]	34.78[b]	76.9[a]	70.0[a]
Entire breeding season	96	100	100	95
Conception date	June 26	July 3	June 25	June 26

[a,b,c]Means with uncommon superscripts differ ($P<.05$).

The pregnancy rate during the breeding season was greater than 95% for all four treatment groups. The lower cow condition scores and winter weight change of the later weaned cows in the Low nutrition group resulted in fewer cows conceiving in the 21-day AI period ($P < .05$) and a tendency for later average conception date. Although the percentage pregnant for the entire breeding season was not affected by treatment, the cumulative effect of later calving over several years could be expected to cause a reduction in pregnancy rates.

The potential advantages on reproductive performance of mature cows from weaning calves earlier than the traditional 7 months of age appears to depend on winter nutrition. Based on the conditions of this study, weaning earlier as a standard practice would not produce any advantage in reproductive performance of mature cows. Under conditions of extreme feed shortage or high cow feed costs, weaning earlier than the traditional 7 months may be beneficial to reproductive performance of the cow herd. For most situations, decisions on changing the traditional weaning date should be based on the pasture conditions and potential effects on calf performance, costs of feeding the weaned calf, and changes in calf price due to season and weight.

Effects of Progesterone or Progesterone and GnRH Administration on Blood Serum Progesterone, Estradiol, and Luteinizing Hormone in Prepuberal Beef Heifers

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CATTLE 94-12

Summary

A study using twelve prepuberal Angus heifers was conducted to determine the effects that synthetic progesterone with or without gonadotropin-releasing hormone (GnRH) had on blood serum concentrations of progesterone, estradiol, and luteinizing hormone (LH) over a 48-hour period. Four heifers were given an implant containing the synthetic progestogen norgestomet for 9 days. Four other heifers were given a similar implant and also received an injection of GnRH after implant removal. The remaining four heifers served as controls and received no treatment. Serum progesterone and estradiol concentrations did not differ between treatments ($P > .8$). Heifers receiving norgestomet and GnRH had increased levels of serum luteinizing hormone (LH) during the 4.5 hours following the injection ($P < .0001$). Serum LH concentrations in heifers treated with norgestomet only did not differ from those of controls.

Key Words: Beef Heifers, Puberty, GnRH, Progesterone, LH

Introduction

Yearling heifers should be bred early in their first breeding season since 2-year-old cows have a longer postpartum interval than older females. Previous research has shown that administration of progesterone with or without gonadotropin releasing hormone (GnRH) reduces the age at puberty in beef heifers. This could be an effective management tool for producers that have difficulty in developing their replacement heifers to reach puberty prior to the start of their first breeding season. To be completely effective, the physiological mechanisms by which prepuberal treatment with progesterone or progesterone and GnRH cause earlier puberty must be understood. This knowledge could lead to a more efficient usage of these treatments. The following study was conducted to determine the effects a progesterone implant or a progesterone implant followed by an injection of GnRH would have on the hormonal profile in the prepuberal heifer.

Materials and Methods

Twelve purebred Angus heifers from the Cow-Calf Unit at South Dakota State University were selected from a group of 19 replacement heifers according to the following criteria: 1) no signs of estrus had been detected, and 2) the age of the heifer. Heifers had been observed once daily for signs of heat and were assumed to be prepuberal at the time of the study onset if estrus was not detected. The youngest heifers in the group which had not been observed in estrus were selected over older heifers, based on the theory that the older animals would more likely be pubertal. At an average age of 218 days and 628 lb in weight, heifers were randomly assigned to one of three treatments. Heifers in treatment one were controls and received no hormone treatment. Heifers in treatment two were given an implant[4] containing 6.0 mg of synthetic progestogen

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norgestomet for 9 days. Heifers in treatment three received the norgestomet implant and were also given 2000 μg GnRH[5] in a saline injection upon removal of the implant.

Heifers were fed a diet of corn silage prior to and at the beginning of the study. One day before removal of the norgestomet implant, the heifers were moved into the Animal Science Complex and were housed on concrete floors. Upon entering the building, heifers were provided ground alfalfa hay and water for ad libitum consumption until the termination of the study. Heifers were allowed 16 hours to adapt to their new environment before handling and onset of the serial bleeding. On day 9, all heifers were catheterized with a polyethylene jugular cannula. Catheters were not inserted into hormone treated heifers until implants were removed. A 10-ml blood sample was collected from each heifer after catheterization was completed. Heifers receiving GnRH were given the hormone in saline solution subcutaneously immediately after the first blood sample was collected via the catheter. Thereafter, 10-ml blood samples were collected from the catheters every .5 hour for the first 24 hours following catheterization and every 1 hour for the next 24 hours. Following each blood sample, 2 ml of heparinized saline solution (20 Units/ml) were injected into the catheter to prevent coagulation. Approximately 5 ml of blood were drawn through the catheter and discarded before each sample was collected in order to remove the injected heparin. Upon collection, blood samples were chilled and centrifuged. Serum was frozen in duplicate until assayed for progesterone, estradiol, and LH.

Blood serum progesterone concentrations were analyzed with a one-step radioimmunoassay procedure. Analysis was performed on the 0, 5, 10, 15, 20, 25, 30, 35, 40, and 45 hour samples from each heifer.

Blood serum estradiol-17ß concentrations were analyzed using a commercial estradiol assay. Original analysis was performed on the 0, 5, 10, 15, 20, 25, 30, 35, 40, and 45 hour samples from each heifer in one assay. Later analyses were performed on each hourly sample from 0 through 20 hours for each heifer. Blood serum LH concentrations were analyzed using a monoclonal double antibody radioimmunoassay. Analyses were performed on samples collected every other hour from 0 to 48 hours for all heifers. In addition, analysis was performed on all samples collected from 0 to 6 hours in heifers that received GnRH.

Progesterone, estradiol, and luteinizing hormone concentrations were analyzed using the GLM procedures of SAS (SAS, 1988). All data were analyzed as a split plot design to determine any hormonal differences between treatments, using individual heifer variance within treatment as the error term for the treatment effect. Repeated measures analyses were also performed to detect differences in hormone concentrations within treatments over time.

Results and Discussion

Serum progesterone concentrations were not affected by treatment ($P = .82$) or time x treatment interaction ($P = .99$). However, progesterone levels did differ over time ($P < .0001$). This difference was due to a higher progesterone concentration at the first sampling time than at all other times. Average progesterone concentrations of each treatment group are listed in Table 1. Mean baseline concentrations for the control and norgestomet groups over the sampling period were .02 ± .09 ng/ml and .03 ± .08 ng/ml, respectively. Norgestomet plus GnRH treated heifers had a mean baseline progesterone concentration of .03 ± .09 ng/ml for the 48-hour sampling period.

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Table 1. Average serum progesterone concentrations over a 48-hour period in prepuberal heifers treated with norgestomet or norgestomet + GnRH

Treatment	Serum progesterone, ng/ml
Controls	.02 ± .01[a]
Norgestomet	.03 ± .01
Norgestomet + GnRH	.03 ± .01

[a]Means ± standard error.

Table 2. Average serum estradiol concentrations over a 48-hour period in prepuberal heifers treated with norgestomet or norgestomet + GnRH

Treatment	Serum estradiol, pg/ml
Controls	4.21 ± .29[a]
Norgestomet	3.80 ± .31
Norgestomet + GnRH	4.25 ± .36

[a]Means ± standard error.

Serum estradiol was not affected by treatment ($P=.92$) or time x treatment interaction ($P=.57$). However, serum estradiol was affected by time ($P<.0001$) and individual heifer nested within treatment ($P<.0001$). The three youngest heifers had the highest baseline estradiol levels found in the 12 animals. Each of these heifers had been assigned to a different treatment group. Average estradiol concentrations of each treatment group are listed in Table 2. Baseline levels of estradiol were 4.21 ± 2.99 pg/ml for control heifers, 3.80 ± 3.19 pg/ml for norgestomet treated heifers, and 4.25 ± 3.66 pg/ml for the norgestomet plus GnRH treated heifers. Serum estradiol in control heifers fluctuated during the sampling period. Norgestomet treated heifers did not show any differences from controls in estradiol concentrations, although they had somewhat lower levels between 17 and 20 hours after onset of collection. Norgestomet plus GnRH treated heifers also had similar estradiol concentrations to controls but appeared to have elevated levels between 3 to 5 hours and at 7 hours following onset of the serial bleeding. Mean values at these times ranged from 6.05 ± 4.75 pg/ml to 8.21 ± 3.62 pg/ml.

Serum luteinizing hormone was affected by individual heifer nested within treatment ($P<.0001$), time x treatment interaction ($P<.0001$), time ($P<.0001$), and treatment ($P=.0384$). The heifer effect was due to one norgestomet treated heifer having a higher baseline LH level than the other three heifers in that treatment group and also to a large variability in the amount of LH released in response to GnRH in the norgestomet plus GnRH treated heifers. The time x treatment interaction was due to the elevated levels of serum LH found in the norgestomet plus GnRH treated heifers between 0 and 6 hours after onset of collection. Control heifers and norgestomet treated heifers did not display any LH elevations. Baseline LH levels for the norgestomet plus GnRH treated heifers were calculated as the average of the values not included in the peak. Mean LH baseline values for each treatment group are shown in Table 3. Baseline LH concentrations were 1.58 ± .52 ng/ml, 1.80 ± .43 ng/ml, and 1.71 ± .27 ng/ml for the control, norgestomet, and norgestomet plus GnRH treated groups, respectively. Figure 1 illustrates the average LH concentrations for each treatment group for the 48-hour sampling period. The peak height in norgestomet plus GnRH treated heifers averaged 11.62 ± 5.33 ng/ml and ranged from 6.12 to 18.50 ng/ml. The oldest heifer in this group had the lowest LH peak, while the two youngest heifers had the highest LH peaks. This may be due to the age of the heifers, since the approach of puberty has been associated with the establishment of lower and more stable levels of LH. The peak height occurred 2 hours following injection of GnRH in three of the heifers and 2.5 hours following the injection in the fourth heifer. Duration of the LH peak varied from 3 to 5 hours. Elevations in luteinizing hormone concentrations were first observed in samples collected .5 hour after the GnRH injection in two heifers and within 1 hour in the remaining two heifers. Following the LH peak, all norgestomet plus GnRH treated heifers showed decreased serum LH for 1 to 2 hours before returning to baseline levels. The decrease in LH levels following the peak in norgestomet

Table 3. Average serum luteinizing hormone concentrations over a 48-hour period in prepuberal heifers treated with norgestomet or norgestomet + GnRH

Treatment	Serum LH, ng/ml
Controls	1.58 ± .05[a]
Norgestomet	1.80 ± .09
Norgestomet + GnRH	1.71 ± .14

[a]Means ± standard error.

plus GnRH treated heifers may have been due to a depletion of pituitary stores and(or) down regulation of LH secretion.

Herdmates of the heifers in this study that had entered puberty were approximately 50 days older than the selected heifers. Therefore, it is probable that the heifers used in this serial bleeding had not reached sufficient age to respond to hormonal treatment and enter puberty at the time of treatment. Conversely, it is also possible that the 48-hour study period would have been too brief to observe any physiological changes that may have occurred.

It is unknown why progesterone concentrations were higher in the first blood sample than in all others collected. However, the highest levels of progesterone found in the first blood sample collected are typical of progesterone levels reported in prepuberal heifers. Although not significant because of the high variability among the heifers, there did appear to be an increased production of estradiol in the several hours following GnRH administration in the norgestomet plus GnRH treated heifers in this study. The estradiol increase appeared at approximately the same time as the LH peak. The removal of the norgestomet implant followed by a GnRH injection in the prepuberal heifers may have initiated follicular production of estradiol without completely inducing puberty within the following 48 hours.

Prepuberal progestogen administration in the norgestomet only treated heifers did not alter the LH profile in comparison to the controls in this study. Therefore, assuming the heifers in this study were capable of reaching puberty at the this time, the mechanism by which prepuberal norgestomet treatment induces early puberty in heifers does not appear to be due to an alteration in the release of LH in the 48 hours following implant removal. All of the norgestomet plus GnRH treated heifers had an increase in serum LH following treatment. Although none of these heifers attained the amplitude found during the preovulatory surge in the bovine, they did approach these levels. Therefore, the mechanism that prepuberal progesterone and GnRH treatment causes earlier puberty in beef heifers to occur may be due to a change in LH release from the pituitary.

In summary, administration of a 9-day norgestomet implant with or without GnRH in prepuberal heifers at an average of 218 days of age and 628 lb in weight did not change serum progesterone or estradiol concentrations. However, progesterone and estradiol did vary over time. Prepuberal heifers given both norgestomet and GnRH displayed an LH peak approaching preovulatory levels. This peak lasted 3 to 5 hours with the peak height occurring 2 to 2.5 hours following the GnRH injection. No elevations of LH were present in control or norgestomet treated heifers.

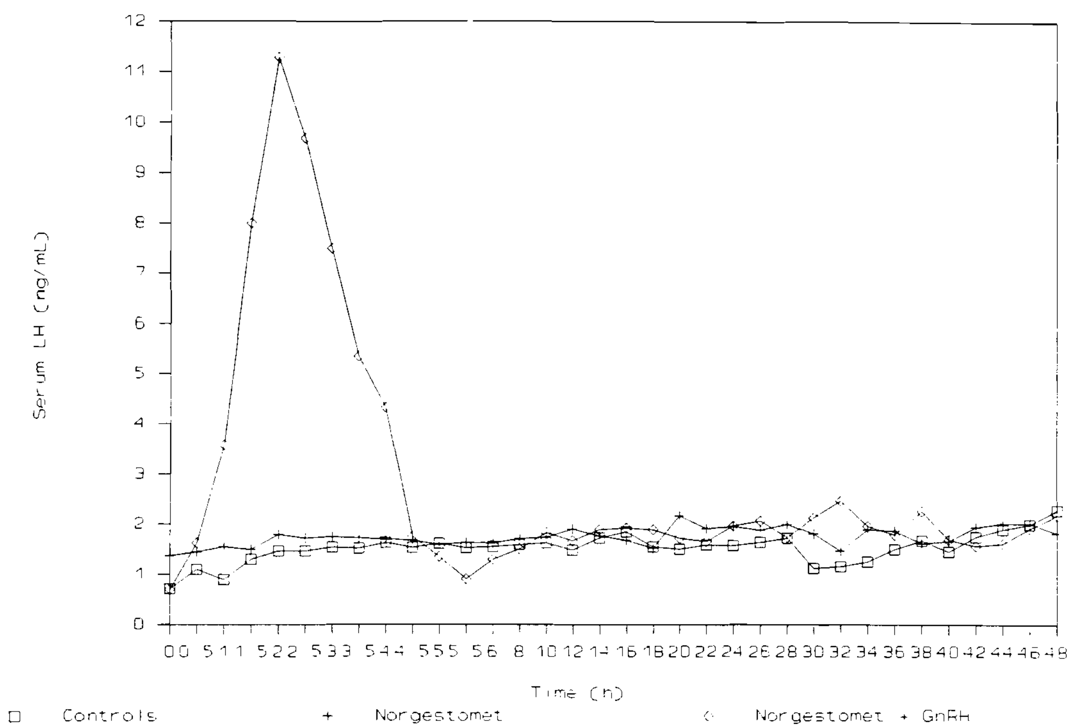

Figure 1. Average luteinizing hormone concentrations (ng/ml) in prepuberal heifers following treatment with norgestomet or norgestomet and GnRH.

Use of Ultrasound in Reproductive Management of Beef Cow Herds

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CATTLE 94-13

Summary

The use of ultrasound technology in reproductive management of beef cow herds is currently being evaluated in ongoing projects with cooperator herds in South Dakota. The projects include the use of ultrasound for the purposes of evaluating 1) cycling activity of heifers on estrous synchronization programs immediately prior to breeding and 2) early pregnancy detection and aging of fetuses in heifers and mature cows. Information obtained from these images will be used by producers to make management decisions associated with the breeding season, selection of heifers, and nutrition. Ovaries are evaluated for the presence of follicles and a corpus luteum, while pregnancies are determined from the presence or absence of a viable fetus. Age of the fetus is determined by the relative size of the fetus which can be measured by the machine. Initial data indicate that ultrasound technology can be used for all of the above mentioned purposes. One hundred fifty-eight heifers have been evaluated for cyclicity and 416 heifers have been scanned for early pregnancy. Pregnancy will be determined in 900 head of mature cows. As this is an ongoing project, calving data will be collected during the 1995 calving season to confirm ultrasound results.

Key Words: Ultrasound, Heifers, Cows, Cycling, Pregnancy

Introduction

Reproductive efficiency continues to be an extremely important factor in determining the profitability of a given cow-calf operation. In addition to reproductive efficiency, cost of production is also important in determining profitability. Management decisions based on sound information can help obtain optimum reproductive performance, minimize production costs, and maximize profits. Incorporation of tools and technology that can help a producer obtain these goals is an ongoing process. New tools or technologies need to be constantly evaluated under environments in which they are to be utilized.

While ultrasound technology itself is not new, the application to the livestock industry and especially the beef industry is relatively new. The technology utilizes high-frequency sound waves generated by the machine and emitted through a transducer. The sound waves then encounter tissues and based upon their density, some, all, or none of the sound waves are reflected back to the transducer and into the computer part of the ultrasound machine. Utilizing shades of gray, the computer interprets the returned sound waves and produces an image on the screen. The images produced will vary in shades of gray from fluid filled structures (black) to bone (white). While many tools or new technologies are limited in the number of potential areas of application, ultrasound is unique in that, by utilizing various sizes of transducers, the machine can be applied to many different areas of production.

Initial uses of ultrasound in the beef industry have been directed at evaluating some carcass traits on the live animal. These include measurement of loin eye area and fat thickness with more recent efforts directed at measuring the amount of marbling in the loin eye muscle. Another area which has received little attention except in research has been the use of ultrasound in reproductive management. Research has demonstrated that images of the

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reproductive tract and fetuses can be produced and used in managing reproductive events. Structures (follicles, corpus luteum, cysts) on the ovaries can be visualized and cyclic activity determined. Such information can aid in developing strategies prior to and during the breeding season on individual animals. Results from research has shown that pregnancy in cattle can accurately be detected as early as days 22 to 25 of gestation. This type of information at this early stage of gestation allows flexibility in management of females for continued breeding, selection of replacements, and nutritional programs.

Incorporation of any new technology or tool by a producer should occur only after proper evaluation of the practicality of utilizing such a tool in a ranching situation. With that in mind projects were developed to evaluate the use of ultrasound technology for purposes of reproductive management with four cooperator herds in western South Dakota as well as the herds at the Cottonwood and Antelope Research Stations.

Materials and Methods

The projects began in the spring of 1994 and will continue through the spring calving season of 1995. This will allow collection of calving data to confirm the data collected with the ultrasound machine. A total of 158 head of bred yearling heifers were scanned to determine cycling activity. Additionally, 416 head of heifers were scanned for early pregnancy determination. These heifers were between days 22 and 90 of gestation. Nine hundred head of mature cows will be scanned for pregnancy determination. Cows will be between day 1 and 90 of gestation.

Ultrasound scanning of heifers and cows is accomplished with an Aloka 500 ultrasound machine equipped with a 5 MHz transducer. The transducer is introduced rectally and held in the palm of the hand. The reproductive tract of heifers is scanned and images of the ovaries are used to determine the presence of follicles and a corpus luteum. Based upon structures found on the ovaries and the size and tone of the reproductive tract, a tract score (1-5: 1 = immature and noncycling to 5 = presence of corpus luteum and good tone indicating cyclicity) was also assigned to each individual. This was done to determine cycling status on the day of prostaglandin injection in heifers that had been on a MGA-PGF estrous synchronization program. Reproductive tracts of mature cows and heifers were scanned for the presence of a fetus to determine pregnancy status. Presence of a viable fetus was used to indicate pregnancy and the age of the fetus was determined by its relative size. In all instances heifers had been artificially inseminated (AI) prior to the use of clean-up bulls. Established pregnancies were determined to be either due to AI or bulls based on size of the fetus.

Calving data from all herds will be collected during the spring calving season of 1995 to confirm the ultrasound data. Additionally, cooperating producers will be asked to evaluate the use of the ultrasound for the above mentioned purposes. Their evaluation will include the amount of time involved in carrying out the ultrasound scans as well as accomplishing the goals they had set for utilizing the machine.

Results and Discussion

Reproductive tracts of heifers (n = 158) from three separate herds were scanned with the ultrasound to determine cycling status. All heifers were on a MGA-PGF estrous synchronization program. Scans occurred on the day of prostaglandin injection to evaluate the ability of the ultrasound to distinguish heifers that would respond to prostaglandin injection due to the presence of a corpus luteum (tract score = 5). All heifers were artificially inseminated subsequent to the prostaglandin injection and following heat detection. Table 1 illustrates the breakdown of tract scores and cyclic activity of the 158 heifers scanned.

Based on ultrasound scans, 81.0% of the heifers had tract scores of 5, while an additional 13.3% had tract scores of 4. Together, a total of 94% of the heifers had the potential to be detected in heat and be bred during the subsequent AI period. Since the heifers with tract scores of 4 would cycle naturally during the AI period and not in response to the prostaglandin injection, one could expect only

Table 1. Tract scores[a] indicating cycling activity of heifers at the time of prostaglandin injection

Number of heifers	158
Tract scores	
1	0
2	1
3	7
4	21
5	128
Cystic ovary	1

[a]Tract scores: 1 = immature tract, no tone; 2 = larger, no tone; 3 = good tone to tract with medium size follicles; 4 = good tone and erect tract, possible C.L.; 5 = good tone and erect tract, C.L. present.

5.0% to cycle per day. At that rate only about 5 heifers out of that group may have cycled. Together, one might only expect 133 or 84.0% of the heifers to cycle during the AI period. In fact, 85.0% of the heifers were detected in heat and bred to AI. Ultrasound scans also indicated that approximately 5.7% of the heifers would have little if any chance of cycling and being bred during the AI period due to tract scores of 2's and 3's and in one instance the presence of a cystic ovary.

Early pregnancy detection was carried out on 416 head of heifers that ranged from day 22 to 90 of gestation. Pregnancies were classified as AI or bull bred as well as nonpregnant. Table 2 illustrates the results of the ultrasound scans for pregnancy status and age. Determination of pregnancy status of heifers early in gestation allows producers to make selection and culling decisions earlier. Such information allows for selection of the early conceiving heifers as replacements. Also, such information adds more flexibility to marketing opportunities of bred and open heifers that will not be kept and added to the cow herd. In addition, costs for keeping replacements that are open or that conceived late in the season can be cut due to earlier identification of such heifers. Yet another advantage of earlier pregnancy detection and subsequent selection of replacements is realized in years when availability of grass may be limited due to less rainfall. Confirmation of the above data will be made with calving data collected in the spring calving season of 1995.

Table 2. Early pregnancy data for heifers ranging in gestational age from day 22 to day 90 as determined from ultrasound scans

Number of heifers	416
Nonpregnant	74
AI conception	239
Bull conception	103

Finally, 900 head of mature cows from two cooperator herds and the Antelope Range Station ranging in days of gestation from 30 to 90 will be scanned with the ultrasound. Data from these scans will be used to accomplish two goals of the cooperators. One is to determine pregnancy in cows that will be sent on to a public lands allotment. The cooperating producer has been concerned that his conception rates coming off of the allotment have been less than satisfactory. His concern is that the terrain in the allotment is extremely rugged and that all cows are not covered properly by the bulls. The goal in this case was to send only pregnant cows to the allotment and to keep open cows in a more desirable breeding pasture for the remainder of the breeding season to determine if conception rates in that herd of cows could be increased. In this herd 137 cows that had been with the bull for 52 days were scanned for pregnancy. One hundred eighteen cows were detected as pregnant and sent to the allotment. Ten head were determined to be open and 9 were classified as unclassifiable due to the fact that some may have been less than 22 days pregnant. As mentioned in the introduction, accuracy of detecting pregnancy prior to day 22 is considerably less than 100%.

The goals of the second cooperating producer is to age the fetuses for the purpose of dividing the cow herd into management groups as they relate to nutrition and calving and to get an indication as to fetal mortality in the cow herd. Ultimately, the producer hopes to better manage the herd for nutrition immediately prior to calving and to reduce both feed costs and labor. A video tape record of all pregnancies will be made to allow evaluation of fetal mortality through calving. Again, calving data collected during the spring of 1993 will be collected to confirm the ultrasound results.

The initial results of this project indicate that the use of ultrasound imaging for reproductive management can probably be easily justified for several purposes. Obviously a cost factor needs to be considered and will be evaluated at the conclusion of the projects by the cooperating producers. It appears that ultrasound technology may offer an extremely valuable tool for producers to utilize to improve the reproductive efficiency in their herds and help in reducing production costs.

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Effect of Morning, Evening, or Twice Daily Feeding on Yearling Steer Performance

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CATTLE 94-14

Summary

The impact of morning (0730), evening (1600), and twice daily (0730/1600) feeding on feedlot performance was evaluated in yearling steers fed high grain diets. Exp. 1 was conducted from July 20 to October 12, 1993. The 92% concentrate diets were based on dry whole shelled corn. There were four pen replicates per treatment. Exp. 2 was conducted from January 6 to May 10, 1994. The 93% concentrate diets were based on a 50/50 blend of dry whole shelled corn and high moisture corn. There were six pen replicates per treatment. In Exp. 1 evening feeding increased (P<.06) average daily gain and improved (P<.06) feed/gain over morning feeding. The most pronounced effects were during the initial 28 days of the 84-day experiment. Performance of steers fed twice daily was intermediate to evening and morning treatments. Twice daily feeding improved performance over morning feeding (average daily gain, P<.10; feed/gain P<.01). Most of this response occurred during the final 28 days of the experiment. During Exp. 2 there were treatment effects on interim period performance but no responses (P>.10) occurred for cumulative performance variables.

Key Words: Feedlot, Feeding Frequency, Feeding Schedule

Introduction

In the midwest, cattle feeders frequently feed high grain diets once daily, in the early morning. Larger feedlots commonly feed cattle two or three times daily. Published production responses to feeding more than once daily are variable. In most cases, the constraints of limited linear bunk space, bunk feed volume, and feed stability probably dictate how frequently cattle should be fed. There are, however, other variables to consider.

In the summer, cattle must contend with heat loads created by radiant energy and ambient temperature. The heat produced during fermentation and metabolism adds to the heat load. If by altering animal behavior we could cause more of the heat produced by the animal to be shifted to evening when solar energy is diminished, this may allow cattle to be more efficient. In the winter, shifting proportionally more heat production to nighttime hours may also be beneficial since cold stress is more likely to occur or be more acute at night.

If evening eating is advantageous from a thermodynamic perspective, then feeding cattle in the early morning may be counterproductive. We conducted two experiments to evaluate how time of day and frequency of feeding affected performance of steers in summer-autumn or winter-spring seasons.

Materials and Methods

The three treatment schemes involved feeding steers a common diet (Table 1) either at 0730 (AM), 1600 (PM), or twice daily (0730 and 1600, AP). These treatments were applied to finishing cattle experiments. In Exp. 1 steers (83 head) were assembled at the SDSU Research Feedlot between July 15 and July 20. Upon arrival, steers were vaccinated against IBR, BVD, BRSV, Haemophilus s., and PI_3 and were dewormed. During the assembly and subsequent receiving period, steers were limit

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Table 1. Diet formulations[ab]

	Exp. 1	Exp. 2
Hay, %	8.0	7.00
Whole shelled corn, %	85.18	41.60
High moisture corn, %	--	41.60
Liquid supplement, %	3.60	3.60
Ground corn, %	1.34	--
Soybean meal, 44%	--	5.90
Corn gluten meal, %	.74	--
Blood meal, %	.54	--
Urea, %	.55	.20
$CaCO_3$, %	.05	.10
Crude protein, %	12.61	11.8
NE_m, Mcal/cwt	91.6	94.7
NE_g, Mcal/cwt	61.3	64.7

[a]Provided additional vitamins and minerals to meet or exceed NRC nutrient recommendations.
[b]Diet contained 27 g monensin/ton.

fed high moisture ear corn and a protein-vitamin-mineral supplement.

Steers were sorted based on body weight into two blocks. The allotment weights were 753 and 882 lb for light and heavy blocks, respectively. Each steer was individually identified and implanted with Revalor-S on day 1 of the experiment. Allotment included stratifying weight within the blocks across each treatment and then into two replicate pens of seven steers within each treatment. (One replicate pen consisted of only six steers.) The test pens began receiving experimental diets on July 20, 1993, and continued through October 12, 1993.

Exp. 2 was conducted from January 6 to May 10, 1994. The steers had been on a backgrounding experiment since weaning in October. Two blocks representing two ranch sources were equally represented in each treatment. The 18 pens of eight steers provided six replicates per treatment. There were 9 pens of steers in each ranch block. Steers were implanted with Synovex-S on day 1 and day 56 of the experiment.

Adaptation to finishing diets was accomplished by restricted feeding. Initial feed deliveries were set at 1.5% body weight and then gradually increased to achieve ad libitum intake by 21 to 30 days on feed. Diet ingredients were sampled weekly to determine dry matter, crude protein, acid detergent fiber, neutral detergent fiber and ash content. Feed bunk conditions were scored and noted daily. Feed calls were made at 0700 for steers fed in AM and AP. The AP feed call was fed in two equal portions. Bunk conditions for cattle fed in PM were scored and feed calls were made at 1530.

Individual body weights were determined at 0700 on 28-day intervals (Table 2). Feed summaries corresponded with weigh days. In Exp. 2, all steers were fed twice daily for 3 days prior to determining final body weight. Feedlot performance of the steers was evaluated by considering experimental units to be represented by pen mean data.

Results and Discussion

In Exp. 1 during the initial 28-day period, average daily gains were greater ($P<.05$) when the cattle were fed at 1600 versus 0730. Feed/gain was lower ($P<.05$) for the PM treatment, reflecting average daily gain differences since dry matter intakes were similar. This response also occurred in the 57- to 84-day period. Cumulative feed efficiency was improved ($P<.01$) by feeding steers in the evening. Performance of steers fed twice daily was intermediate and not different ($P>.10$) from the AM and PM treatments. Weather was moderate throughout this experiment and there was little obvious evidence of heat stress. Average daily high and low temperatures were 71° and 49°, respectively.

In Exp. 2, interim steer performance varied in an inconsistent fashion (Table 3). As in Exp. 1, PM feeding increased ($P<.01$) average daily gain in the early feeding (1 to 28 days) and later (57 to 84 days) periods. Cumulative 84-day average daily gains were higher for the PM treatment (2.95, 3.31, and 3.05 lb for treatments AM, PM, and AP, respectively). Climatic condition changes during this January through May feeding period were dramatic.

Table 2. Exp. 1 interim and cumulative feedlot performance of steers fed at different times and frequencies (summer-fall)

Item	Treatment			P[a]		
	AM	PM	AP	AM vs PM	AM vs AP	PM vs AP
Initial wt	822	816	820	NS	NS	NS
1-28 days						
Body wt (28)	950	972	959	NS	NS	NS
Avg daily gain	4.52	5.59	4.98	.0119	NS	NS
Dry matter intake	18.43	19.54	18.08	NS	NS	.0817
Feed/gain	4.12	3.49	3.63	.0253	.0638	NS
29-56 days						
Body wt (56)	1073	1099	1079	.0905	NS	NS
Avg daily gain	4.39	4.52	4.29	NS	NS	NS
Dry matter intake	23.68	23.31	22.95	NS	NS	NS
Feed/gain	5.38	5.19	5.37	NS	NS	NS
57-84 days						
Body wt (84)	1182	1221	1203	.0154	NS	NS
Avg daily gain	3.89	4.37	4.41	.0849	.0637	NS
Dry matter intake	26.71	25.68	25.75	NS	NS	NS
Feed/gain	6.90	5.88	5.87	.0235	.0224	NS
Cumulative (84 days)						
Avg daily gain	4.27	4.82	4.56	.0048	.0774	NS
Dry matter intake	22.94	22.84	22.26	NS	NS	NS
Feed/gain	5.36	4.73	4.89	.0009	.0052	NS

[a]NS = P>.10.

Table 3. Exp. 2 interim and cumulative feedlot performance of steers fed at different times and frequencies (winter-spring)[a]

	Treatment			P<[a]		
Item	AM	PM	AP	AM vs PM	AM vs AP	PM vs AP
Initial wt	734	734	730	NS	NS	NS
1-28 days						
Body wt (28)	793	815	792	.01	NS	.01
Avg daily gain	2.02	2.86	2.21	.01	NS	.01
Dry matter intake	16.04	16.50	15.74	.03	.14	.01
Feed/gain	8.19	5.81	7.74	.01	NS	.01
29-56 days						
Body wt (56)	916	932	914	.06	NS	.04
Avg daily gain	4.40	4.18	4.38	NS	NS	NS
Dry matter intake	21.52	22.02	21.15	.06	.13	.01
Feed/gain	4.90	5.30	4.86	.10	NS	.08
57-84 days						
Body wt (84)	984	1013	986	.01	NS	.02
Avg daily gain	2.42	2.89	2.57	.02	NS	.10
Dry matter intake	19.48	19.66	19.24	NS	NS	NS
Feed/gain	8.17	6.82	7.63	.02	NS	.12
85-112 days						
Body wt (112)	1080	1106	1077	.03	NS	.02
Avg daily gain	3.43	3.35	3.24	NS	NS	NS
Dry matter intake	21.32	21.58	20.61	NS	NS	.10
Feed/gain	6.28	6.51	6.45	NS	NS	NS
1-124 days						
Final body wt	1107	1105	1103	NS	NS	NS
Avg daily gain	2.99	2.99	3.01	NS	NS	NS
Dry matter intake	19.85	20.06	19.42	NS	.14	.04
Feed/gain	6.64	6.72	6.48	NS	NS	.15

[a]NS = P>.15.

If eating behavior was altered by treatment, fill differences could be affecting "apparent" performance of steers. When fill was "normalized" by twice daily feeding of all groups to determine final body weight, no differences in 124-day average daily gains were evident.

During the period 112 to 124 days, average daily gains were 2.28, -.10, and 2.15 for treatments AM, PM, and AP, respectively. To normalize fill, the PM steers received 50% of their daily dry matter intake on the evening of day 121 rather than 100% as had been done previously. The AM treatment was handled similarly the morning of day 122. Both groups were thereafter fed at the same time as the AP steers.

The average daily gain of 2.15 lb for the AP treatment during the 112- to 124-day period should not be biased by fill because feeding and weighing conditions were unchanged. If the difference in average daily gain between the AP and PM treatments was due to fill, the PM cattle were carrying 27 lb more fill than the AP treatment on day 112. This represents 2.4% body weight and seems unrealistic since both groups of cattle were on full feed and elapsed time between the last feeding and body weight measurements was similar for AP and AM treatments. The normalized feeding schedule may have adversely affected the PM steers, biasing the estimate of fill. Unfortunately, carcass weight data were not available for either experiment.

These steers were weighed at 0700 and 1430 on days 56, 84, and 112. Differences in body weight within the day are shown in Table 4. On each date at 0700, fill was greater for the PM steers than the AM or AP steers or increased less prior to the 1430 body weight. Less increase in fill seems logical since the AM and AP treatments were fed between the 0700 and 1430 body weight determinations. These body weight differences within a day and changes with time on feed suggest eating and/or drinking patterns are altered dramatically by feeding schedules.

Lacking carcass data, it is unclear how treatments have affected gains by steers in either experiment. In each experiment PM feeding was affecting apparent average daily gain through 84 days on feed. Although other work is necessary to determine the potential advantages of evening feeding, it is apparent from this work that there are no detrimental effects associated with evening feeding.

Table 4. Within day changes in body weight (Exp. 2)[a]

	Treatment			P		
Item	AM	PM	AP	AM vs PM	AM vs AP	PM vs AP
Day 56	-12.0	.8	-7.2	.01	.11	.01
Day 84	-24.2	12.8	-7.8	.01	.01	.01
Day 112	-9.5	15.5	3.3	.01	.01	.01

[a](Body weight at 0700) - (body weight at 1430).

Effect of Synovex, Synovex + FinaPlix, and Revalor on Daily Gain and Carcass Characteristics of Yearling Steers

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CATTLE 94-15

Summary

The objective of this study was to determine if there were differences in daily gain and carcass traits of yearling steers implanted with Synovex-S (S), Synovex-S + Finaplix-S (S+F), or Revalor-S (R). Upon arrival at the feedlot, 264 steers (average weight 731 lb) were allotted to 24 pens and adapted to a 90% concentrate diet over a period of 23 days. They were implanted on day 20 with either S, S+F, or R. No differences were found between S+F and R (P>.10) at any time during the study. However, combination implants (S+F and R) both resulted in 10% greater weight gains (P<.01) between days 57 and 84 of the study (37 and 64 days postimplanting) than S implanted steers. Some of this advantage was lost after day 113 (93 days postimplanting), as combination implant cattle gained almost 8% less per day than those implanted with S (P<.01). During the portion of the study when all implants could be expected to be fully functional (days 9 through 93 postimplanting), combination implant treatments increased daily gain by 3.7% (P<.05) over S. Steers were slaughtered at an average of 115 days postimplanting. No differences in carcass characteristics were found (P>.20).

Key Words: Synovex, Finaplix, Revalor, Yearling Steers

Introduction

Implants have been used for many years to increase rate and efficiency of growth in beef cattle. Management options for their use have increased with the availability of new implants. One such option has been to use Synovex and Finaplix implants in combination. More recently, growth stimulating compounds found in Synovex-S[4] (estradiol) and Finaplix-S[5] (trenbolone acetate) have become available in a single implant, Revalor-S[5].

The objective of this study was to determine if there were differences in the daily gain and carcass characteristics of yearling steers implanted with Synovex-S, Synovex-S plus Finaplix-S, or Revalor-S.

Materials and Methods

A group of 298 crossbred, yearling steers was vaccinated (IBR, BVD, BRSV, and Lepto), ear tagged, and weighed upon arrival at the feedlot. From these, 264 steers were randomly allotted the same day to 24 pens and, after 23 days on receiving and step-up diets, were fed 90% concentrate finishing diets ad libitum or restricted by access time to approximately 90% of ad libitum. The steers were given BRSV booster and 7-way clostridial vaccines, dewormed (Ivermectin[6]), and implanted with either Synovex-S (S), Synovex-S + Finaplix-S (S+F), or Revalor-S (R) 20 days after arrival. Implants were equally represented in each pen.

The steers were weighed at approximately 28-day intervals after overnight removal of water but not feed. Final weights were taken after overnight removal of feed and water.

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Results and Discussion

No interactions between implant and intake treatments were found (P>.10). Only implant effects will be discussed. Because the steers were not implanted until day 20 of the study, little implant effect would be expected by the end of the first weigh period and none was found (P>.10; Table 1). Additionally, no differences were found between S+F and R treatments (P>.10) at any time. However, combination implant treatments (S+F and R) both resulted in 10% greater weight gains (P<.01) between days 57 and 84 of the study (37 and 64 days postimplanting) than S implanted steers. Some of this advantage was lost after day 113 (93 days postimplanting), as combination implant cattle gained almost 8% less per day than those implanted with S (P<.01). This was in spite of the fact that S+F steers were also implanted with S, suggesting that the response was not solely a function of implant exhaustion, although that could have been involved. The result was that overall gains were not different between implants (P>.10)). However, during that portion of the study when all implants could be expected to be fully functional (days 9 through 93 postimplanting), combination implant treatments increased daily gain by an average of 3.7% (P<.05) over S.

It has been suggested that combination implant strategies result in lower carcass quality grades and, as a result, cattle should not be slaughtered earlier than 100 days postimplanting. The cattle on this study were slaughtered an average of 115 days postimplanting. No differences were found in quality grade or other carcass characteristics (P>.20; Table 2).

The results of this study indicate that the use of estradiol and trenbolone acetate, whether in a single implant or two separate implants, elicits a greater daily gain than estradiol for approximately 93 days. However, the advantage can be rapidly lost beyond that point in time.

Table 1. Weights and daily gains of yearling steers implanted on day 20 with Synovex-S, Synovex-S and Finaplix-S, or Revalor-S[a]

	Implant			
Item	Synovex	Synovex + Finaplix	Revalor	SE
No. of steers	88	88	88	
Initial weight, lb	730	726	736	6.9
Final weight, lb	1259	1270	1267	6.7
Weight gain, lb/day				
1-28 days	4.34	4.41	4.38	.15
29-56 days	4.59	4.75	4.57	.11
57-84 days[b]	3.72	4.03	4.16	.11
85-113 days	3.96	4.09	3.88	.10
114-135 days[b]	2.31	2.12	2.16	.13
29-113 days[c]	4.10	4.29	4.21	.06
29-135 days	3.80	3.92	3.88	.05
1-135 days	3.91	4.00	3.97	.05

[a]Least squares means.
[b]Contrast of Synovex vs Synovex + Finaplix and Revalor (P<.01).
[c]Contrast of Synovex vs Synovex + Finaplix and Revalor (P<.05).

Table 2. Carcass characteristics of yearling steers implanted with Synovex-S, Synovex-S and Finaplix-S, or Revalor-S

Item	Implant			SE
	Synovex	Synovex + Finaplix	Revalor	
Hot carcass weight, lb	768	771	770	7.6
Dressing percentage	60.4	60.4	60.4	.27
Fat thickness, in.	.51	.47	.51	.02
Rib eye area, in.^{2}	12.8	13.0	12.7	.17
Kidney, pelvic, heart fat, %	2.2	2.3	2.2	.04
Yield grade	3.0	2.9	3.1	.09
Quality grade[a]	10.0	10.3	10.2	.15

[a]10 = high select; 11 = low choice.

Effect of Implant Strategies on Feedlot Performance and Carcass Traits of Steers

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CATTLE 94-16

Summary

The role of implant selection on feedlot performance and carcass traits was evaluated in 200 yearling steers. The steers (initial body weight 709 lb) were implanted on day 1 or day 70 of the 140-day experiment. Implant combinations (day 1/day 70) included none/none, Synovex-S + Finaplix-S/Synovex-S + Finaplix-S, Ralgro (36 mg)/Revalor, Synovex-S/Revalor, and Ralgro (72 mg)/Revalor. Day 1 implants increased ($P<.05$) average daily gain and reduced feed/gain through 70 days on feed. During the 71- to 140-day period implanted cattle exhibited higher ($P<.05$) average daily gain and lower ($P<.05$) feed/gain than nonimplanted steers. Specific implant combinations were all of comparable value. Implants increased ($P<.05$) carcass weights by 55 lb over nonimplanted steers and increased ($P<.05$) rib eye area 1 in.^{2}. Rib fat thickness and rib eye area/cwt carcass were not affected by implanting. The percentage of choice grade carcasses was reduced ($P<.05$) from 82.5% to 62.3% by implanting. There were no appreciable differences in carcass traits attributable to specific implant combinations.

Key Words: Feedlot, Steers, Implant

Introduction

Implant programs designed to maximize the feedlot performance of steers are often credited with reducing carcass value. There is considerable interest in finding specific implant strategies that may optimize the relationships between performance and carcass quality. Strategy involves choice of implant, timing of administration, and sequence of implant use when reimplanting is practiced.

Commercially available implants contain different active ingredients and payout rates. We chose to consider whether the differences that exist among implants may be used to optimize performance and carcass traits. This experiment was designed to compare the efficacy of implant strategies on feedlot production rates and carcass value of yearling steers.

Materials and Methods

Two hundred yearling steers (709 lb) were allotted across five implant treatments. Implants were administered on day 1 and day 70 of the feeding period as noted in Table 1.

Yearling steers used in this experiment came from two sources. Most of the steers had been used in a backgrounding experiment at the feedlot during November 1992 through January 1993. The basal diet of the backgrounding experiment was composed primarily of corn silage. Backgrounding treatments used were 0, 11, 22 or 33 g monensin/T dry feed. Vaccinations and deworming of these steers was performed upon arrival in the feedlot the last week of October, 1992. The calves had never been implanted. At the termination of the backgrounding experiment (1-22-93) we began feeding a holding diet of 14 lb high moisture ear corn, .5 lb liquid supplement, and .5 lb SBM (as fed basis). This daily feeding rate continued through 2-7-93. An additional group of preconditioned steers were purchased 1-21-93 and were fed this same holding diet. They were vaccinated, dewormed, individually identified, and weighed on 1-25-93. Ears were inspected at processing with no palpable evidence of previous implants.

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Table 1. Implant administration

Treatment	1	2	3	4	5
Day 1	None	Synovex-S + Finaplix-S	Ralgro, 36 mg	Synovex-S	Ralgro, 72 mg
Day 70	None	Synovex-S + Finaplix-S	Revalor	Revalor	Revalor

The final BW from the backgrounding experiment and the BW measured on 1-25-93 were used to stratify BW across all treatments and replicates for allotment to the implant study. Origin of cattle and backgrounding experiment treatments were also balanced across implant treatments. There were 160 steers from the first source and 40 steers from the second source of steers used in this experiment.

Initial and final BW were the average of BW determined on consecutive days (Feb 8-9 and June 28-29, 1993) at 0800. These and all interim BW (35, 70, and 105 days) were determined prior to feeding. Cattle were fed a high concentrate diet (Table 1) once daily throughout the (140 days) experiment. On Feb 8 the diet was offered at a rate of 10 lb/head. Feed deliveries were then systematically increased as could be tolerated by each pen of steers. Daily bunk score readings indicated that ad libitum intake was achieved within the first 30 days. Feed ingredients were sampled weekly and submitted for laboratory analysis. Dry diet formulations and composition were then back calculated each week based on feed analysis and actual quantities of ingredients used in each batch of feed prepared. The data in Table 2 reflect 20 weekly feed summaries.

Table 2. Diet formulation and composition[a]

Corn silage, %	12.000
Whole shelled corn, %	39.408
High moisture corn, %	39.408
Liquid supplement, %	3.600
Dry supplement	
Ground corn, %	2.766
Corn gluten meal, %	1.004
Blood meal, %	.756
Urea, %	.918
Limestone, %	.080
Fat, %	.060
Crude protein, %	12.660
NE_m, Mcal/cwt	93.200
NE_g, Mcal/cwt	62.600
Ca, %	.510
P, %	.283
K, %	.819

[a]Dry matter basis.
[b]Diet provided 26.8 g monensin and 11 g tylosin per ton.

Implant sites were palpated on day 35 and 105 and a record of observations was noted. Synovex and Ralgro implants were placed in the left ear and Finaplix and Revalor implants were placed in the right ear of steers.

Slaughter occurred over a 2-day period at a commercial packing plant 70 miles from the feedlot. Four steers from each pen were shipped to the packing plant the afternoon after the final BW were determined. Steers were randomly co-mingled during the shipping and slaughter procedures. Slaughter on this group started at 0700 the following day. Carcass data were collected 24 hours after slaughter. A similar sequence was followed one day later for the remaining four steers in each pen. Hot carcass weight was recorded and rib eye area and rib fat thickness were measured on each carcass. The Federal Grader on duty assigned marbling scores to the nearest 1/10 score and KPH to the nearest .25%.

Data were analyzed by procedures appropriate for a completely random design experiment using the GLM procedures of SAS. Feedlot performance data were evaluated on a pen mean basis. Carcass data were evaluated using individual carcasses as the experimental unit. Percentage choice data were evaluated as discrete data by chi square analysis.

Results and Discussion

The initial 35-day feedlot performance was inflated by fill. Intake was only 10 lb when initial BW were determined and had increased to approximately 19 lb on day 34. Even so, relative gain differences between implant treatments can be considered. Cattle receiving Synovex-S appeared to start slower than steers implanted with either 36 or 72 mg Ralgro (Table 3). This numerical difference shifted to favor the treatments including estradiol from 36 to 70 days on feed.

All implants stimulated ADG ($P<.05$) during the initial 70 days (Table 4). Only Synovex-S increased DMI above that occurring in the nonimplanted treatment. Implanting reduced feed/gain ($P<.05$). In the comparison of nonimplanted vs Synovex-S the contrast approached significance ($P<.0524$).

Table 3. Feedlot Performance Responses to Implant Treatments[a]

	Implant treatment					
Day 1	None	Synovex-S + Finaplix-S	Ralgro, 36 mg	Synovex-S	Ralgro, 72 mg	
Day 70	None	Synovex-S + Finaplix-S	Revalor	Revalor	Revalor	SEM
Initial BW	709	708	709	714	707	4.8
Day 70 BW	947^{c}	984^{b}	972^{b}	980^{b}	975^{b}	7.2
Final BW	1150^{c}	1241^{b}	1228^{b}	1238^{b}	1232^{b}	11.0
<u>1 to 35 days</u>						
ADG	4.39^{c}	4.74^{bc}	4.81^{b}	4.77^{bc}	4.93^{b}	.123
DMI	16.45^{bc}	16.12^{c}	16.41^{bc}	16.66^{b}	16.56^{bc}	.159
F/G	3.77^{b}	3.41^{c}	3.41^{c}	3.50^{bc}	3.70^{c}	.095
<u>36 to 70 days</u>						
ADG	2.41^{d}	3.14^{b}	2.70^{cd}	2.85^{bc}	2.73^{bcd}	.137
DMI	19.35^{c}	19.37^{c}	19.83^{c}	20.87^{b}	19.92^{c}	.303
F/G	8.05^{b}	6.26^{c}	7.37^{b}	7.44^{b}	7.33^{b}	.327
<u>71 to 105 days</u>						
ADG	2.87^{c}	3.68^{b}	3.59^{b}	3.89^{b}	3.56^{b}	.184
DMI	19.75^{c}	20.30^{bc}	20.31^{bc}	21.41^{b}	20.53^{bc}	.456
F/G	7.07^{b}	5.86^{c}	5.67^{c}	5.55^{c}	5.79^{c}	.343
<u>106 to 140 days</u>						
ADG	2.93^{c}	3.66^{b}	3.71^{b}	3.46^{bc}	3.78^{b}	.196
DMI	20.17^{c}	21.27^{bc}	21.36^{bc}	21.88^{b}	22.10^{b}	.471
F/G	7.10	5.87	5.81	6.39	5.87	.400
<u>1 to 140 days</u>						
ADG	3.15^{c}	3.81^{b}	3.71^{b}	3.74^{b}	3.75	.077
DMI	18.93^{c}	19.27^{c}	19.48^{bc}	20.21^{b}	19.78^{bc}	.285
F/G	6.02^{b}	5.08^{c}	5.27^{c}	5.41^{c}	5.28^{c}	.139

[a]Five pens/treatment.
[b,c,d]Means in the same row without common superscripts differ ($P<.05$).

Table 4. Cumulative 1 to 70 day or 71 to 140 day performance response to implant treatment

	Implant treatment					
Day 1	None	Synovex-S + Finaplix-S	Ralgro, 36 mg	Synovex-S	Ralgro, 72 mg	
Day 70	None	Synovex-S + Finaplix-S	Revalor	Revalor	Revalor	SEM
<u>1 to 70 days</u>						
ADG	3.40[b]	3.94[c]	3.76[c]	3.81[c]	3.83[c]	.094
DMI	17.90[b]	17.74[b]	18.12[b]	18.77[c]	18.24[bc]	.207
F/G	5.27[b]	4.53[d]	4.83[cd]	4.94[bc]	4.77[cd]	.115
<u>71 to 140 days</u>						
ADG	2.90[b]	3.67[c]	3.65[c]	3.67[c]	3.67[c]	.128
DMI	19.96[c]	20.79[bc]	20.84[bc]	21.65[b]	21.31[b]	.416
F/G	6.02[b]	5.08[c]	5.27[c]	5.41[c]	5.28[c]	.139

[a]Five pens/treatment.
[b,c,d]Means in the same row without common superscripts differ ($P<.05$).

Reimplanting at 70 days continued to cause higher ($P<.05$) ADG than that demonstrated by nonimplanted steers. The ADG among implanted steer treatments was similar. Steers implanted initially with Synovex-S or 72 mg Ralgro consumed more feed than nonimplanted steers during this period. Intake and feed conversions were similar ($P>.05$) for implanted steers. Implanting improved feed/gain ratios ($P<.05$).

Dressing percentage noted in Table 5 appears low by industry standards. This is because it was calculated using nonshrunk final body weights. If final body weight is shrunk 4%, dressing percentages range from 63.4 to 64.0% and were not affected by implant treatment. Several responses typical of implant studies terminated at a constant time endpoint are born out in these data. Carcass weight and rib eye area are increased ($P<.05$) by implanting. Rib eye area per cwt carcass and rib fat depth were not affected by implanting. Marbling score was reduced ($P<.05$) for the Synovex-S + Finaplix and 36 mg Ralgro + Revalor treatments and also reduced ($P<.06$) for the 72 mg Ralgro and Synovex-S treatments as compared to nonimplanted steers. Comparisons of carcass traits among implants used indicated no appreciable effects or trends due to implant choice.

Table 5. Carcass traits among implant treatments

	Implant treatment					
Day 1	None	Synovex-S + Finaplix-S	Ralgro, 36 mg	Synovex-S	Ralgro, 72 mg	
Day 70	None	Synovex-S + Finaplix-S	Revalor	Revalor	Revalor	SEM
Carcass wt, lb	701[c]	759[b]	755[b]	759[b]	753[b]	9.000
Dressing percent	60.99	61.20	61.44	61.38	61.11	.242
Rib eye area, in.^{2}	12.26[c]	13.22[b]	13.38[b]	13.04[b]	13.16[b]	.217
Rib eye area, in.^{2}/cwt	1.75	1.74	1.78	1.72	1.75	.043
Rib fat	.45	.51	.45	.49	.49	.022
Marbling score[a]	5.88[b]	5.23[c]	5.38[c]	5.44[bc]	5.44[bc]	.160
Choice, %	82.5	60.5	61.5	60.5	66.7	

[a]Five pens/treatment.
[b,c,d]Means in the same row without common superscripts differ ($P<.05$).

SDSU

Using Ultrasound Technology in Incoming Feedlot Steers to Predict Marbling and the Effect of Anabolic Agents on Marbling

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CATTLE 94-17

Summary

One hundred seventy-four mixed crossbred yearling steers (789 lb) were used to determine if ultrasound technology could be used to predict eventual marbling score in incoming feedlot cattle. Implants were also administered to study the effects of anabolic agents on marbling. Steers were fed in a single pen at a commercial feedlot for an average of 127 days, slaughtered, and carcass data were collected. Implanted cattle gained significantly more weight ($P<.05$) than nonimplanted cattle. Steers implanted with Revalor gained weight more rapidly than Synovex implanted cattle. Steers that were implanted with Revalor showed a significant decrease in marbling score when compared to no implant and Synovex groups. The percentage of choice carcasses for no implant, Revalor, and Synovex were 65.5, 47.4, and 68.4. The correlation between initial ether extract, as estimated by ultrasound, and marbling score was .45 and a prediction equation including coat color, initial ether extract, and Revalor implant accounted for 26.59% of the variability in the final marbling score.

Key Words: Implants, Ultrasound, Marbling

Introduction

Implants have been used in the beef industry to improve growth rates, feed conversion, and cutability. However, some studies have shown that implants may reduce marbling score and, therefore, reduce USDA quality grades. According to the 1991 National Beef Quality Audit, $21.68/carcass was lost due to insufficient amounts of marbling and another $219.25 from excess fat. These nonconformities are pushing the beef industry toward a value based marketing system in order to more adequately meet consumer demand for quality and lean.

With value based marketing, risk will be transferred from buyer to seller. Management and marketing tools will be needed to minimize this risk. Ultrasound technology could provide a means to make decisions such as implant or marketing strategy at feedlot arrival. The objectives of this study were to evaluate the use of ultrasound technology to sort incoming feedlot cattle by marbling potential and to study how implants affect marbling.

Materials and Methods

One hundred seventy-four crossbred yearling steers (789 lb) were delivered to a commercial feedlot[3] in central South Dakota. Steers had been on pasture in western South Dakota and had not been implanted during the grazing season.

At processing, cattle were weighed, vaccinated, treated for parasites with Ivomec[4] and implanted. Hip height was measured and coat color was recorded as red, black, or other. Ultrasound scans for initial rib eye area, 12th rib fat, and percentage of intramuscular fat were collected by Middle America Network of Mapleton, Iowa, and evaluated by Iowa State

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University, Ames, Iowa. Implants (Revalor[5], Synovex[6], or no implant) were administered in a completely random design. Steers were then fed in one pen for an average of 127 days, slaughtered, and carcass data collected after a 24-hour chill. Final weight was determined by dividing hot carcass weight by average dressing percentage at each slaughter date.

Average daily gain and carcass traits were evaluated using GLM procedures of SAS. Class variables included in the model were color and treatment. Treatment means were separated using orthogonal contrasts. The model to predict marbling score was developed using forward selection regression techniques. The full model evaluated was marbling score = a + b (blk) + c (red) + d (Rev) + e (Syn) + f (hpht) + g (in fat) + h (in REA) + i (in EE) + j (in wt) + error, where blk = black steers, red = red steer, Rev = Revalor, Syn = Synovex, hpht = hip height, in fat = initial fat, in REA = initial rib eye area, in EE = initial ether extract, and in wt = initial weight. Two-way interactions were also examined in the analysis. Only variables that were significant ($P<.10$) were left in the reduced model. Percentage choice data were tested using Chi square analyses.

Results and Discussion

Table 1 shows the effect of implant on weight and average daily gain. Implants had a significant effect ($P<.05$) on average daily gain as compared to controls. Steers implanted with Revalor had greater ($P<.05$) average daily gains when compared to Synovex implanted steers.

Table 1. Weight and average daily gain (lb)[a]

Item	Control	Revalor	Synovex
Initial weight, lb	787 ± 8.97	783 ± 8.40	791 ± 8.50
Final weight, lb	1142 ± 14.20	1228 ± 12.02	1186 ± 11.75
Average daily gain, lb[bc]	2.78 ± .07	3.51 ± .09	3.17 ± .09

[a]Means ± standard error.
[b]Implant vs control ($P<.05$).
[c]Revalor vs Synovex ($P<.05$).

Table 2 displays carcass data for the steers. Implants did not affect hot carcass weight, 12th rib fat, rib eye area, or yield grade. Revalor significantly reduced ($P<.05$) marbling score. Percentage of choice carcasses for control, Revalor, and Synovex were 65.5, 47.4, and 68.4, respectively. These differences were statistically significant as determined by Chi square ($P<.10$).

Table 3 shows initial fat, initial rib eye area, and initial ether extract as determined by ultrasound. Initial fat thickness averaged .13 inch and ranged from .06 to .25 in. Initial ether extract as predicted by ultrasound averaged 1.74% and ranged from .957 to 2.85%. The correlation between initial ether extract and marbling score was .45.

Table 4 shows the reduced model predicting marbling score. Initial ether extract entered the model first and accounted for 19.86% of the variability. For each additional percent unit of ether extract, marbling score increased .56 units. The second variable to enter the model was Revalor which accounted for an additional 3.84% of the variation in marbling score. If Revalor was used as the implant, marbling score appears to have been reduced as compared to the nonimplanted control steers. However, the effect of Revalor on marbling appeared to depend on the initial ether extract content as the interaction between Revalor and ether extract

[5]Hoescht-Roussel, Somerville, NJ.
[6]Syntex Animal Health, Des Moines, IA.

Table 2. Implant effect on carcass traits[a]

	Control			Revalor			Synovex		
Hot carcass wt, lb	694	±	8.69	747	±	3.33	722	±	7.17
Fat thickness, in.	.35	±	.02	.43	±	.141	.39	±	.02
Rib eye area, in.^{2}	12.39	±	.15	12.99	±	.18	12.33	±	.97
Yield grade, units	2.54	±	.08	2.53	±	.08	2.75	±	.10
Marbling score units[bcd]	5.01	±	.08	4.76	±	.08	5.01	±	.08
Percentage choice[e]	65.5			47.4			68.4		

[a]Means ± standard error.
[b] 4.00 = slight°, 5.00 = small°.
[c]Implant vs no implant ($P<.05$).
[d]Revalor vs Synovex ($P<.05$).
[e]Chi square analysis ($P<.10$).

Table 3. Initial values determined by ultrasound

Variable	Minimum	Maximum	Average	Std Dev
Initial fat, in.	.06	.25	.13	.03
Initial rib eye area, in.^{2}	6.35	11.69	8.88	1.04
Initial ether extract, %	.96	2.85	1.74	.38

Table 4. Regression statistics for the equation predicting marbling score

	Regression coefficient[a]	Standard error[a]	Partial R^2	P[b]
Intercept	3.98	.23		.0001
Ether extract	.56	.13	.1986	.0001
Revalor	-1.02	.46	.0384	.0280
Black	.19	.10	.0148	.0570
Revalor x ether extract	.45	.26	.0141	.0838

[a]Marbling score units (4.00 = slight°, 5.00 = small°.
[b]Probability that the regression coefficient equals 0.

approached significance ($P=.0838$). For low marbling potential (low initial ether extract) cattle, Revalor tended to reduce marbling. For high marbling potential (high initial ether extract) cattle, Revalor may have had minimal effect (Figure 1).

If a steer was black, marbling was increased by .19 units as compared to steers categorized as other. The partial R^2 for the variable black was .0148.

To adequately test this model, a second independent set of data are necessary. This research is being repeated in 1994 to allow for a proper evaluation of the prediction equation. However, to illustrate the potential effectiveness of the model, the prediction equation was used to sort cattle into high, moderate, and low marbling groups. Table 5 indicates that 85.2% of the cattle that were in the high predicted marbling group graded choice as compared to 52.7% and 43.6% grading choice for the

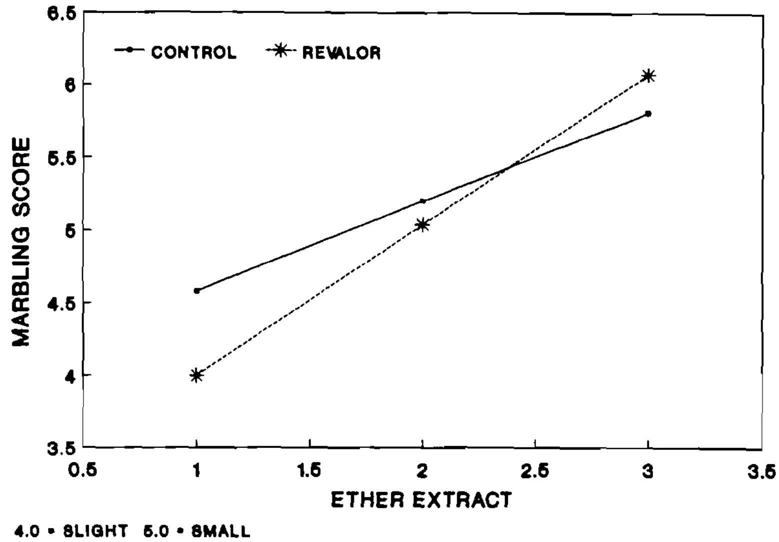

Figure 1. Interaction between Revalor and initial ether extract.

Table 5. Marbling group as determined by prediction equation[a]

Variable	Low 1/3	Middle 1/3	High 1/3
Ether extract, %	1.38 ± .030	1.72 ± .026	2.12 ± .036
Initial fat, in.	.12 ± .002	.13 ± .004	.14 ± .005
Marbling score units[b]	4.65 ± .059	4.84 ± .086	5.30 ± .081
Percentage choice	43.6	52.7	85.2

[a]Means ± standard error.
[b]4.00 = slight°, 5.00 = small°.

moderate and low groups, respectively. Percentage of choice for these categories were significantly different as determined by Chi square (P<.10).

For comparison, data were sorted only by coat color into black, red, and other categories (Table 6). Not as many high quality cattle were identified as with the prediction equation. However, Chi square analysis suggested this method was effective (P<.10).

The data were then sorted based on initial condition. Sixty-eight percent of the steers in the fat category graded choice compared with 53.6 and 56.5 for the thin and moderate categories, respectively (Table 7). These percentages were not significantly different (P>.10) as determined by Chi square analyses, indicating that sorting by initial condition did not adequately identify high marbling cattle.

In conclusion, ultrasound technology may be used to aid producers in making earlier marketing decisions and therefore may help alleviate some of the risks associated with value based marketing. However, additional research is needed to validate the prediction equation developed through this study.

Table 6. Effect of coat color on percentage choice[a]

Variable	Black	Red	Other
Ether extract, %	1.89 ± .06	1.68 ± .04	1.68 ± .09
Initial fat, in.	.14 ± .005	.13 ± .003	.13 ± .006
Marbling score units[b]	5.2 ± .10	4.8 ± .06	4.7 ± .15
Percentage choice	74.5	55.9	50.0

[a]Means ± standard error.
[b]4.00 = slight°, 5.00 = small°.

Table 7. Effect of initial fat thickness on percentage choice[a]

Variable	Thin	Average	Fat
Ether extract, %	1.60 ± .04	1.77 ± .05	1.84 ± .05
Initial fat, in.	.10 ± .001	.13 ± .002	.16 ± .003
Marbling score units[b]	4.75 ± .071	4.89 ± .094	5.11 ± .082
Percentage choice	53.6	56.5	68.3

[a]Means ± standard error.
[b]4.00 = slight°, 5.00 = small°.

Acknowledgements

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South Dakota Retained Ownership Demonstration

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CATTLE 94-18

Summary

Seven hundred six calves representing 81 cow-calf producers were consigned to a custom feedlot. Steer calves (421 head) consigned in October weighed 562 lb initially, gained 2.75 lb per head daily, and averaged 1153 lb at slaughter after an average of 207 days on feed. Average cost of gain and profitability were \$61.48 per cwt and -\$86.61 per head, respectively. Steers consigned in January weighed 738 lb initially, gained 3.36 lb per head daily, and averaged 1,196 lb at slaughter after 137 days on feed. Average cost of gain and profitability were \$55.55 per cwt and -\$123.11 per head, respectively. Heifers consigned in January weighed 683 lb initially, gained 3.17 lb per head daily, and averaged 1063 lb at slaughter after 122 days on feed. Average cost of gain and profitability were \$58.39 per cwt and -\$95.63 per head, respectively. Severe losses observed for 1993-94 were due to a crash in the carcass beef market in late May through July as compared to the previous 3 years of the Retained Ownership Demonstration. As in previous years, average daily gain, days on feed and percentage of choice appear to be related to differences in profit between cattle.

Key Words: Retained Ownership, Feedlot Performance, Feedlot Profitability

Introduction

Retained ownership of feeder calves has been shown to improve profitability of cow-calf operations when examined over many years. Average profit for cattle enrolled in October the first 3 years of the South Dakota Retained Ownership Demonstration were about \$50 per head. The range in profitability for all of the groups of five calves was from -\$63.72 to \$177.36. An understanding of the factors influencing the profitability of retained ownership is essential in order to successfully use retained ownership as a market alternative.

The objective of this multi-year program is to evaluate retained ownership as a marketing alternative for cow-calf producers. This report summarizes data from the fourth year of the project.

Materials and Methods

Forty-nine cow-calf producers consigned 45 groups of steer calves to a custom feedlot[6] in mid-October of 1993. Thirty-two cow-calf producers consigned 39 groups of steer calves to the feedlot at the end of January 1994. Sixteen cow-calf producers consigned 18 groups of heifer calves to the feedlot at the end of January 1994. Cattle that were placed in January had been weaned in the fall and backgrounded at home prior to feedlot arrival.

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Processing procedures included weighing, measuring hip height, and ultrasound[7] determination of initial fat thickness, rib eye area, and intramuscular ether extract concentration at the 12th rib for all steers arriving in the fall or winter. Hip height measurements and ultrasound evaluation were not conducted on the heifers.

All cattle were treated for parasites, vaccinated, implanted and started on feed in the same manner as described in Beef Report articles from previous years describing the Retained Ownership Demonstration. Individual feed yardage and veterinary bills were also allocated as described in previous years.

The only change in the project from previous years concerns the manner in which the cattle were marketed. In previous years, all five cattle in a group went to market as three of the five cattle appeared to reach .4 in. of fat over the 12th rib. This year cattle were marketed as individuals as each calf appeared to reach .4 in. rib fat.

Results and Discussion

A wide variety of cattle types were represented in the program. Initial weight and hip height are displayed in Table 1. Initial ultrasound estimates of ether extract content were not available at the time this article was published. Cattle placed on feed in October averaged 562 lb and ranged from 342 to 760 lb. They averaged 43.97 inches tall at the hip, carried .16 in. of backfat, and had an average rib eye area of 8.42 inches. Cattle placed on feed in January had been weaned in the fall and backgrounded at the ranch prior to feedlot arrival. Steers averaged 738 lb, while heifers averaged 683 lb.

Feedlot performance information is shown in Table 2. Cattle were weighed full the day prior to slaughter. Slaughter weight for each steer was computed by applying a 4% pencil shrink to this full weight. Slaughter weight was greater for the January steers as compared with the January heifers or October steers (1196 vs 1063 and 1153 lb, respectively). Average daily gain

Table 1. Initial data for retained ownership cattle

	Weight, lb	Hip height, in.	Initial fat, in.	Initial rib eye area, in.[2]
October steers				
Average	562	43.97	.16	8.42
Range	342-760	37.00-49.00	.00-.31	5.64-12.11
Standard deviation	62	1.70	.04	1.15
Range (5 head)	398-706	41.70-46.70	.10-.24	6.83-10.35
January steers				
Average	738	47.64	.16	9.08
Range	536-1085	42.00-54.50	.10-.33	6.20-13.50
Standard deviation	104	2.05	.04	1.39
Range (5 head)	571-991	44.20-52.90	.12-.25	7.04-11.22
January heifers				
Average	683			
Range	464-826			
Standard deviation	88			
Range (5 head)	532-775			

[7]Ultrasound scans were conducted by Middle America Network, Mapleton, IA. Images were interpreted by Iowa State University, Ames, IA.

Table 2. Feedlot performance for retained ownership cattle

	Slaughter weight, lb	Average daily gain, lb	Days fed
October steers			
Average	1153	2.75	207
Range	877-1467	1.80-4.02	176-267
Standard deviation	102	.36	27
Range (5 head)	916-1364	2.19-3.28	176-243
January steers			
Average	1196	3.36	137
Range	952-1438	1.42-5.25	83-160
Standard deviation	107	.50	20
Range (5 head)	1050-1408	2.69-4.12	109-160
January heifers			
Average	1063	3.17	122
Range	845-1315	1.52-4.61	83-160
Standard deviation	100	.57	21
Range (5 head)	933-1216	2.54-4.00	109-154

was also greater for January steers than for the January heifers or October steers (3.36 vs 3.17 and 2.75 lb per head daily, respectively). January heifers were fed fewer days than January steers or October steers (122 vs 137 and 207 days, respectively).

Average dry matter intake was 20.01, 22.36, and 21.94 lb per head daily for the October steers, January steers, and January heifers, respectively. Feed to gain ratios were 7.31, 6.69, and 6.93 lb dry matter per pound gain for the October steers, January steers, and January heifers, respectively. Feed to gain and average daily gain for the January placed calves were similar to performance observed in 1992-93. Performance observed for the October calves was lower this year than in previous years. Reasons for this are not clear.

Table 3 shows carcass data collected for the cattle. Carcasses of the January steers were heavier than carcasses of the October steers or January heifers. Percentage choice carcasses for the October steers, January steers, and January heifers were 39.86, 48.73, and 50.25, respectively.

Table 4 shows the feeding period costs for the cattle. Feed and yardage expenses were greater for the October steers than the January steers or heifers due to additional time on feed. Veterinary and death loss costs were much higher for the October steers than for the January steers or heifers. January cattle were backgrounded at the home ranch and probably experienced most of the death loss and veterinary expenses at home prior to feedlot arrival.

Feed and total cost of gain are expressed on a pay weight to pay weight basis. Feed cost of gain was lowest for the October steers, yet their total cost of gain was greater than that observed for the January cattle. Initial pay weight was assumed to be 4% greater than the initial weight obtained at the feedyard. The full weight obtained the day prior to slaughter less the 4% pencil shrink was assumed to equal finished pay weight. Break-even sale prices were $78.73, $73.32, and $74.28 per cwt for the October steers, January steers, and January heifers, respectively.

Table 5 shows the initial and sale values and profitability of cattle fed in the program. Initial price for the October steers was established by

Table 3. Carcass data for retained ownership cattle

	Hot carcass wt, lb	Dressing percent	Fat thickness, in.	Rib eye area, in.^{2}	Kidney, heart, and pelvic fat, %	Calculated yield grade, units	Marbling score, units[a]	Percent choice
October steers								
Average	723	62.68	.40	12.36	2.34	2.75	4.79	39.86
Range	531-915	57.18-67.85	.08-.90	9.20-16.90	1.00-3.50	.88-4.50	3.00-7.50	
Standard deviation	70	2.12	.14	1.33	.52	.59	.56	
Range (5 head)	558-872	60.15-65.03	.20-.58	10.2-14.18	1.8-3.0	1.81-3.43	4.14-5.98	0-100
January steers								
Average	740	61.90	.35	13.04	2.11	2.45	4.79	48.73
Range	585-908	56.51-65.98	.10-.80	9.80-18.70	1.00-3.50	.75-4.34	3.00-6.10	
Standard deviation	71	1.89	.13	1.65	.49	.62	.49	
Range (5 head)	652-868	59.77-63.99	.22-.52	11.12-16.16	1.5-2.8	1.53-3.11	4.14-5.42	0-100
January heifers								
Average	652	61.30	.39	12.27	2.35	2.49	4.90	50.25
Range	478-806	56.49-68.39	.10-.75	9.70-15.60	1.50-3.50	1.05-3.73	3.00-6.70	
Standard deviation	62	1.90	.13	1.21	.56	.58	.56	
Range (5 head)	561-725	59.66-63.15	.26-.54	10.74-14.26	1.7-2.9	1.94-3.18	4.35-5.64	0-100

[a]4.00 = Slight°, 5.00 = Small°.

Table 4. Feeding period costs[a]

Item	October steers	January steers	January heifers
Feed	274.88	193.93	167.08
Yardage	30.90	20.53	18.13
Veterinary	14.29	6.18	6.16
Interest[b]	8.04	3.67	2.84
Trucking[c]	7.60	7.88	7.00
Marketing	1.22	1.22	1.22
Death loss	10.85	.00	.00
Total	347.77	233.40	202.43
Feed cost of gain[d], $/cwt	48.47	46.01	47.93
Total costs of gain[d], $/cwt	61.48	55.55	58.39
Break-even sale price, $/cwt	78.73	73.32	74.28

[a]Average dollars per head.
[b]Interest on feed, yardage, and veterinary expenses only.
[c]Trucking to packing plant only.
[d]Pay weight basis.

Table 5. Profitability of retained ownership steers and heifers

Item	October steers	January steers	January heifers
Initial pay weight, lb	584	768	710
Price, $/cwt	95.92	84.19	83.07
Initial value, $	560.17	646.58	589.80
Hot carcass wt, lb	723	740	652
Carcass price, $/cwt	113.60	102.28	106.84
Sale value, $	821.33	756.87	696.60
Profit, $/head[a]	-86.61	-123.11	-95.63
Annual return on investment, %	-27.26	-50.73	-48.51

[a]Excludes calf interest and trucking to the feedlot.

using numerous sale barn reports for the last 3 weeks in October and regressing price on pay weight (Figure 1). The same technique was used for predicting the January prices (Figures 2 and 3). Equations predicting price are displayed in Table 6. No attempt was made to adjust the initial prices for breed type, frame size, initial condition, or location.

All cattle were sold on a grade and yield basis. Table 7 displays the steer carcass prices that were obtained for the cattle. A seasonal decline in the base choice price and a widening of the choice-select spread was observed. A greater number of the October steers were sold at the earlier marketing dates, resulting in a higher price being paid for these cattle as compared with the January steers or heifers. Likewise, over half of the heifers were sold prior to June, while 84% of the January steers were sold after June, resulting in a greater price for the January heifers than the January steers.

Profits, excluding calf interest and trucking to the lot, were -\$86.61, -\$123.11, and -\$95.63 per head for the October steers, January steers and January heifers, respectively. The variability in profitability between individual cattle and between groups of five head was tremendous (Table 8). The poorest profitability group of five cattle among the October calves lost \$173.03 per head. The most profitable group of five cattle lost \$27.67 per head. Annual return on investment for all of the groups of five ranged from -64.79 to -9.82%.

Another way to express retained ownership profitability is to use slaughter value and feedlot costs to back calculate the value of the calves when they entered the feedlot. October steers, January steers, and January heifers were worth \$821.33, \$756.87, and \$696.60 per head at slaughter, respectively. Total feeding costs were \$347.77, \$233.40, and \$202.43 per head for the October steers, January steers, and January heifers, respectively. Therefore, the calves were worth \$473.56, \$523.47, and \$494.17 at feedlot arrival for the October steers, January steers, and January heifers, respectively. Average pay weights on the calves were 584, 768, and 710 lb for the October steers, January steers, and January heifers, respectively. Thus, October steers were worth \$81.09 per cwt, January steers were worth \$68.16 per cwt, and January heifers were worth \$70.00 per cwt. These calf values represent no interest charge on the calf and no feedlot profit. If one assumes calf interest at 9.5%, breakeven calf values are \$76.72, \$65.73, and \$67.79 per cwt.

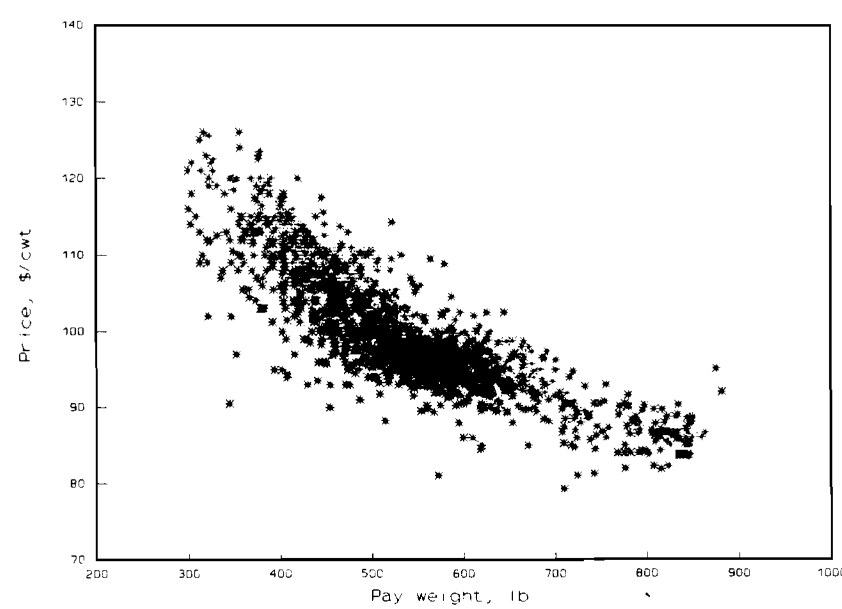

Figure 1. Relationship between price and pay weight of steers for late October 1993.

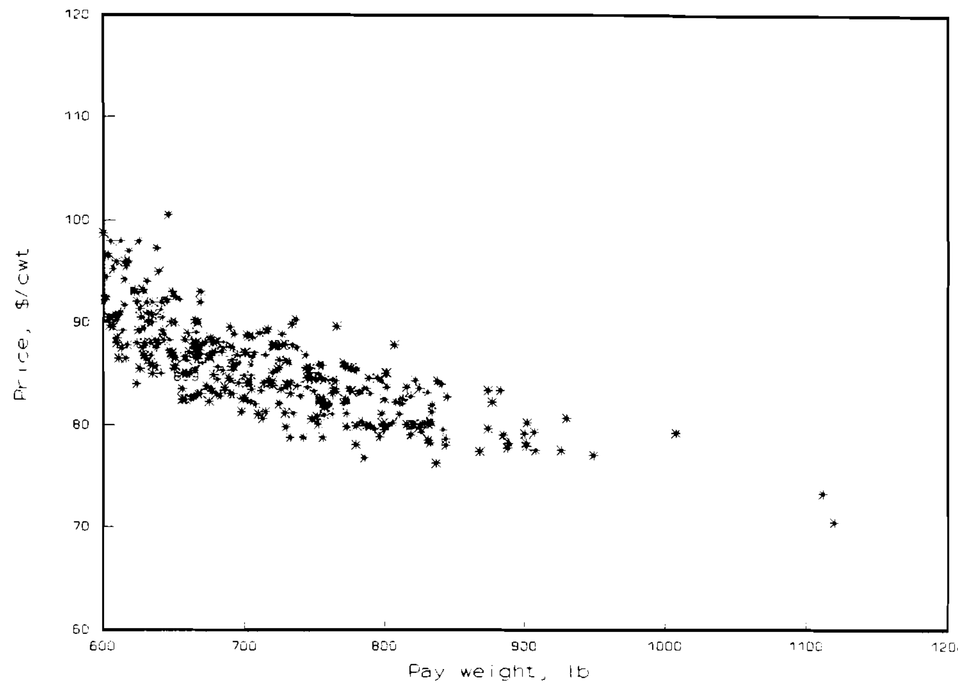

Figure 2. Relationship between price and pay weight of steers for late January 1994.

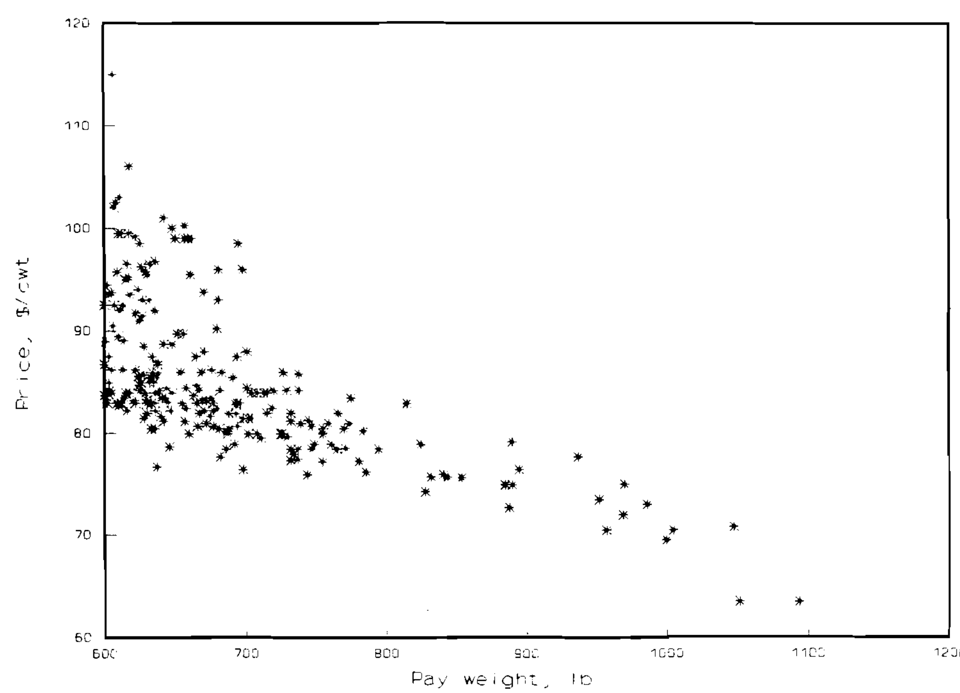

Figure 3. Relationship between price and pay weight of heifers for late January 1994.

Table 6. Equations predicting initial price

Cattle	n	Equation[a]	R^2	Sy.x
October steers	1887	$160.6476 - .16455 \times lb + .000091 \times lb^2$	.7326	3.83
January steers	345	$181.9377 - .22128 \times lb + .000119 \times lb^2$	.6138	2.82
January heifers	297	$152.4253 - .14451 \times lb + .000064 \times lb^2$	.4904	4.54

[a]Weight = pay weight in lb.

Table 7. Market dates of the cattle and carcass prices paid for cattle

	Number of cattle sold			Base		
Market date	October steers	January steers	January heifers	choice price[a]	Select discount[a]	Heifer discount[a]
April 6	89			122.00	3.00	
April 20	119	9	6	124.00	3.00	1
May 17	104	23	45	113.00	5.00	0
June 7	69	74	23	107.00	7.00	1
June 14	17	25		106.00	6.00	
July 6	16	65	15	100.00	6.00	1

[a]$ per cwt carcass.

Table 8. Variation in profitability

	Profit, $/head	Annual return, %	Initial calf value, $/cwt
October steers			
Average	-86.61	-27.26	81.09
Range	-255.51-28.35	-73.51-9.64	50.67-103.62
Standard deviation	57.03	15.37	9.99
Range (5 head)	-173.03 - -27.67	-45.52 - -9.82	66.07-92.25
January steers			
Average	-119.88	-50.73	68.16
Range	-252.91 - -25.82	-93.96 - -10.31	52.99-78.70
Standard deviation	41.63	14.29	5.09
Range (5 head)	-172.70 - -62.24	-64.79 - -31.58	63.55-74.56
January heifers			
Average	-92.55	-48.51	70.00
Range	-195.68-41.13	-82.00-28.73	54.68-83.32
Standard deviation	43.53	19.04	5.88
Range (5 head)	-143.10 - -36.80	-62.59 - -21.95	62.31-76.54

Tables 9, 10, and 11 show the value of select variables for low, middle, and high profitability groups for the October steers, January steers, and January heifers, respectively. Average daily gain, days on feed, and percentage of choice appear to be important indicators of profitability. Higher gaining cattle that went to market earlier lost less money than poor gaining cattle that were marketed later in the year.

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Table 9. Value of select variables for low, middle, and high profit groups of October placed calves

	Profit group		
Variable	Low 1/3	Mid 1/3	High 1/3
Profit, $/head	-153.64	-79.79	-29.56
Average daily gain, lb	2.56	2.71	2.98
Initial weight, lb	552	567	568
Finished weight, lb	1182	1142	1135
Dressing percent	63.03	62.16	62.83
Days fed	233	200	188
Cost of gain, $/cwt	61.88	61.60	60.96
Percentage choice	20.29	47.83	51.45

Table 10. Value of select variables for low, middle, and high profit groups of January placed steer calves

	Profit group		
Variable	Low 1/3	Mid 1/3	High 1/3
Profit, $/head	-164.57	-121.54	-73.51
Average daily gain, lb	3.21	3.31	3.56
Initial weight, lb	748	714	753
Finished weight, lb	1217	1184	1188
Dressing percent	61.53	61.94	62.22
Days fed	147	142	122
Cost of gain, $/cwt	56.64	54.18	55.84
Percentage choice	10.77	45.45	58.46

Table 11. Value of select variables for low, middle, and high profit groups of January placed heifer calves

	Profit group		
Variable	Low 1/3	Mid 1/3	High 1/3
Profit, $/head	-140.11	-91.63	-44.30
Average daily gain, lb	2.85	3.33	3.33
Initial weight, lb	656	669	726
Finished weight, lb	1050	1062	1078
Dressing percent	61.70	60.70	61.33
Days fed	141	119	105
Cost of gain, $/cwt	58.62	56.29	60.33
Percentage choice	36.67	46.67	72.41

Use of Futures and Options in a Retained Ownership Program

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CATTLE 94-19

Summary

Four alternative marketing strategies were evaluated for cattle placed in the South Dakota Retained Ownership Program on October 13, 1993. The strategies were 1) cash marketing only, 2) a futures hedge, 3) a put option, and 4) an options "fence." Each of these market alternatives were described and expected net prices were determined. The actual net prices from using each of these strategies were calculated for three different marketing periods. For steers marketed in April, the cash only alternative provided the highest net price. The options "fence" net price was only $.20/cwt to $.25/cwt lower than the cash price. However, for the steers marketed in June, the futures hedge provided the highest net price. There is not one "best" marketing strategy to follow. Each producer needs to evaluate their attitudes toward price risk and select the marketing strategy that "best" fits their goals and situation.

Key Words: Marketing Alternatives, Futures, Options

Introduction

South Dakota cow-calf producers have had the opportunity over the last four years to feed some of their calves through the South Dakota Retained Ownership Program. The primary goal of this program has been to provide educational opportunities to cow-calf producers. Producers could learn more about the cattle feeding and meat packing industries, learn how their cattle would perform in the feedlot, and what quality of carcass would be produced. In addition, each year some marketing exercises have been conducted in which various futures and options strategies were outlined for producers seeking risk protection if they retained ownership of their calves.

The first three years of the program have been profitable on average. In each of these years, the cash market moved higher in the spring than was anticipated in the fall by the futures market. As such, a strategy of only using the cash market was more profitable than using a futures hedge or buying a put option for price floor protection. However, 1994 was a different story. From mid April until late May prices declined sharply, from $75/cwt to $65/cwt. While some of the retained ownership cattle were marketed prior to this price break, the majority were marketed during or after the price decline. Cattle that were not marketed prior to the price decline generally were not profitable. Could futures or options have been used to offset some or all of these losses? The answer to that question is the focus of this article.

Materials and Methods

To correctly answer the above question, one first must evaluate the market situation when the cattle were placed on feed and determine what strategies could be used. Then, the actual market at the end of the feeding period is used to evaluate each of the marketing strategies.

Information on the futures and options markets for October 13, 1993, when the fall steers were placed on feed, is contained in Table 1. This information will be used to evaluate three marketing strategies: (1) a futures hedge, (2) buying a put option, and (3) establishing a "fence" by buying a put option and selling a call option. Each of these strategies will be discussed briefly and then they will be evaluated.

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Table 1. Market situation on October 13, 1993, when fall steers were placed on feed

	APR LC futures			JUN LC futures		
Futures price	$75.50			$73.00		
Options strike prices	Put	Premiums	Call	Put	Premiums	Call
$70	$0.37			$1.00		
$72	$0.77			$1.65		
$74	$1.35			$2.50		
$78	$3.35		$1.10			$0.45
$80			$0.57			

A futures hedge involves taking an opposite position (selling) on the futures market than that on the cash market (view feeding cattle as buying the cattle into a feeding process). This is accomplished for the cattle feeder by selling a Live Cattle futures contract for the month of, or the month following, the expected slaughter date. When cattle are sold at slaughter, the hedge is lifted by buying back the same contract that was sold.

With a futures hedge, price risk is eliminated, but there still is some basis risk. Basis is defined as the local cash price minus the futures price. With a futures hedge if the actual basis (cash price minus futures price at the time of cash sale) equals the expected basis (estimated when placing the hedge), then the net price will always be the futures price at the time of sale plus or minus the expected basis. This strategy protects a feeder against downward price movements but also prevents the feeder from participating in upward price moves.

Buying a put option is a strategy that allows a feeder to establish a price floor but still take advantage of higher prices, should they occur. Buying a put option is like buying insurance against lower prices. And like buying insurance, you must pay a premium to get this price protection--the higher the protection desired the higher the premium will be.

Sometimes the price floor on a put option may seem low compared to your break even. In addition, you may not want to spend the premium to establish this price floor. Another option strategy that can be employed is the use of a "fence." A fence is designed to establish both a minimum and maximum price and do it for little or net premium expense. This transaction is accomplished by buying a put for the price floor protection but selling a call option to capture that premium to offset the put premium. However, selling the call creates a ceiling on the maximum price you can receive.

Results and Discussion

Based on the information in Table 1, APR Live Cattle futures could have been sold for $75.50/cwt on October 13. If APR Live Cattle futures price increased to $77.00/cwt by April, then a loss of $1.50/cwt would be incurred when the contract is bought back. However, if cash prices at Sioux Falls were expected to be $1.00/cwt under the futures, then initially a feeder would have expected a price of $74.50/cwt ($75.50 - $1.00) for his cattle. If the actual price at Sioux Falls was $76.00 ($1.00 under $77.00) in April then the net price would be $74.50/cwt ($76.00 - $1.50 futures loss). However, if futures had declined to $73.00 and cash was $72.00, then the net price would still be $74.50/cwt ($72.00 + $2.50 futures profit). If in the last example cash price had declined to $71 (basis of -$2.00) then the net price would be $73.50 ($71.00 + $2.50 futures profit).

The put premiums for various levels of protection (strike prices) for the APR and JUN Live Cattle contracts are provided in Table 1. Looking at the $74.00/cwt strike price for the APR contract, the premium is $1.35/cwt.

Buying this put option would result in a minimum expected price of $71.65/cwt (74.00 - $1.35 premium - $1.00 basis). This is lower than the expected price with a futures hedge, but remember, this is only the minimum price. As cash prices rise, your net price will be the higher cash price minus the $1.35/cwt premium you paid out.

Using the information in Table 1, you could purchase a $74 put on APR Live Cattle for $1.35/cwt and sell a $78 call and receive a $1.10/cwt premium to establish an options fence. Your net cost of this transaction is $0.25 ($1.35 - $1.10). You now have created a minimum price of $72.75 ($74.00 - $1.00 basis - $0.25 net option premium) but have also established a maximum price of $76.75 ($78.00 -$1.00 - $0.25).

The expected outcome of each of the market alternatives is shown in Table 2 for both the APR and JUN Live Cattle contracts. A graphical representation of these alternatives is presented for the APR contract in Figure 1.

Table 2. Expected price for alternative marketing strategies for steers placed on feed on October 13, 1994

Alternative	Expected price	Expected minimum	Expected maximum
Cash market	???	None	None
APR futures hedge	$74.50	$74.50	$74.50
JUN futures hedge	$72.00	$72.00	$72.00
APR Put options			
$70		$68.63	
$72		$70.33	None
$74		$71.65	
$78		$73.65	
JUN Put options			
$70		$68.00	
$72		$69.35	None
$74		$70.50	
APR fence			
$72 Put/$80 Call		$70.80	$78.80
$74 Put/$78 Call		$72.75	$76.25
JUN fence			
$70 Put/$78 Call		$68.45	$76.65

Note: All futures and options alternatives are calculated with an expected basis of -$1.00/cwt (Local cash price will be $1.00 lower then the Live Cattle Futures.).

Expected Net Price for Alternative Marketing Strategies

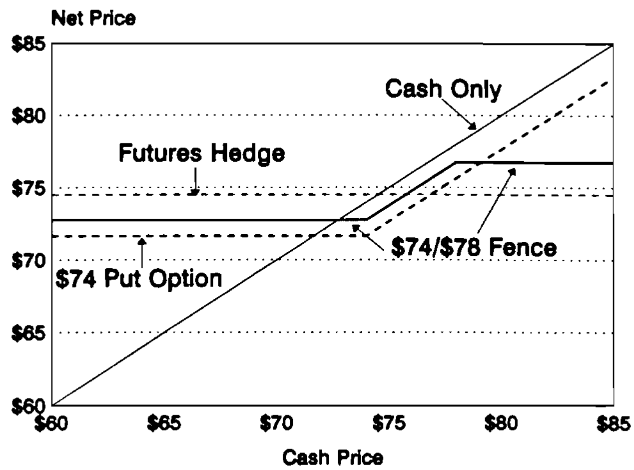

Figure 1. Graphical representation of expected outcomes for alternative marketing strategies.

Steers were marketed on several slaughter dates over a three month period. Three particular dates will be evaluated. The first steers sold were priced on March 30 and delivered on April 7. March 30 is also the last day of trading for the APR Live Cattle options. This date will be used to evaluate the market strategies for the steers slaughtered on April 7 and April 20. There was another set of steers sold on May 3 and slaughtered on May 12. May 3 will be used to evaluate the marketing strategies. Two groups of steers were slaughtered in June, one on June 8 and the other on June 14. The first group was sold on May 31. May 31 is also the last day of trading for the JUN Live Cattle option and will be used to evaluate the strategies.

On March 30, the APR Live Cattle futures contract could have been bought back (to close out the futures account) at $76.40/cwt. This would have resulted in a loss of $0.90/cwt (sold for $75.50 and bought for $76.40) for the futures hedge. Since the steers are sold on a grade and yield basis, each producer's cash price will be different. However, the average cash price was around $75.40/cwt for live weight. The net cash price, if a hedge had been placed, would be $74.50/cwt ($75.40 - $0.90 futures loss). This was the expected price since the actual basis was equal to the expected basis. The net prices for the alternative market strategies for the March 30 sale date are displayed in Table 3.

Table 3. Net price with alterative marketing strategies for March 30, 1994

Alternative	Price or value	Futures/Options Gain/Loss	Net price
Cash	$75.40		$75.40
APR futures hedge	$76.40	-$0.90	$74.50
APR Put options			
$70	$0.00	-$0.37	$75.03
$72	$0.00	-$0.77	$74.77
$74	$0.00	-$1.35	$74.05
$78	$1.60	-$1.75	$73.65
APR option fence			
$72 Put/$80 Call	$0.00	-$0.20	$75.20
$74 Put/$78 Call	$0.00	-$0.25	$75.15

With the exception of the $78 strike price, all of the put options expired with zero value because the market was higher than the strike price. The $78 option had a value of $1.60/cwt and could have been sold to capture the premium. The net price for the put options is the cash price of $75.40 less the put option premium that was initially paid out. However, for the $78 put, $1.60 of the original $3.35 premium is recovered, so the net premium is $1.75/cwt.

Since the actual futures price is within the boundaries established by both option fences, none of the options have any value and are allowed to expire. The net price is the cash price less the net option premium of $0.20 or $0.25 originally paid to establish the fence.

For the March 30 date, using the cash market is the most profitable alternative followed by the two option fence strategies and then the lower priced put options. However, less than $2.00/cwt separates the highest net price from the lowest net price for this date.

By early May the cash market had started to lose ground and by the end of May prices were considerably lower. How do the market alternatives compare during these time periods? On May 3, JUN Live Cattle was trading at $69.30/cwt and the cash price was around $71.00/cwt. The basis at this time was a $1.70/cwt, rather than the expected -$1.00/cwt. All of the futures and options alternatives should have a net price that is higher than expected, because the basis strengthened by $2.70/cwt. The net price for the various alternatives are displayed in Table 4.

Table 4. Net price with alternative marketing strategies for May 3, 1994

Alternative	Price or value	Futures/Options Gain/Loss	Net price
Cash	$71.00		$71.00
JUN futures hedge	$69.30	$3.70	$74.30
JUN Put options			
$70	$1.50	$0.50	$71.50
$72	$2.75	$1.10	$72.10
$74	$4.75	$2.25	$73.25
JUN options fence			
$70 Put/$78 Call	$1.50	$0.95	$71.95

The JUN futures contract is bought back at a gain of $3.70/cwt ($73.00 sale less a $69.30 purchase). This gain is added to the cash price of $71.00/cwt to get the net price of $74.30. Since the futures market is lower than all of the Put option strikes considered, they all have an intrinsic value (intrinsic value is the strike price minus the futures price). In addition, since there is still almost a month of trading, these options also have a time value. This value will decrease as the options near expiration and, in general, the more volatile a market the higher the time value will be. All of the put options are sold to capture the premium value. The cost of the original Put premiums are subtracted from the Put premiums earned from the sale of the Puts to obtain the net options gain or loss. In this case, there was a net gain on all of the Put options. This gain was added to the cash price to obtain the net price. The Put option for the fence is also sold and the net gain determined.

For this time period the ranking of the strategies from highest net price to lowest net price is almost the reverse of the March 30 time period. The straight futures hedge results in the highest price and the cash only alternative is the lowest price. The option strategies are between cash and futures in terms of net price. There is a difference of $3.30/cwt from the highest to lowest net price. This is not an extremely large difference, but it may represent the difference of earning a modest profit or incurring a slight loss on the cattle.

By May 31, the @#$&% market had gone to &#$% ... Well, you probably know where it went. JUN Live Cattle futures were at $66.30 and cash was around $65.50/cwt. The net prices for the various alternatives are shown in Table 5. Since this is the last day for JUN options to be traded, they do not have any time value, but all of them have intrinsic value. With the market even lower than on May 3, the cash alternative is even less attractive than the other alternatives.

Table 5. Net price with alternative marketing strategies for May 31, 1994

Alternative	Price or value	Futures/Options Gain/Loss	Net price
Cash	$65.50		$65.50
JUN Futures Hedge	$66.30	$6.70	$72.20
JUN Put Options			
$70	$3.70	$2.70	$68.20
$72	$5.70	$4.05	$69.55
$74	$7.70	$5.20	$70.70
JUN Options Fence			
$70 Put/$78 Call	$3.70	$3.15	$68.65

From this analysis, several general conclusions can be made concerning the alternative marketing strategies. When the market moves higher than expected by the futures traders, a cash marketing strategy will result in the highest net price. This was generally the case for the retained ownership project for 1991-1993. If prices when you sell are near where they were expected to be based on the futures price, then generally cash marketing only will still result in the highest net price. However, there will probably not be much difference between the cash price and the net price from an options fence strategy. This was the case for the first sale of 1994. If the market moves lower then was expected, then the futures hedge will result in the highest net price. This was the case for the latter sales this year. Another observation is that the options strategies will never be the "best" strategies in terms of highest net price, but generally they will not miss the highest net price by very much (the most they will miss the highest net price by is the initial amount of the option premium).

In conclusion, there is not one "best" marketing strategy. The best strategy for individual producers depends upon the amount of risk they are willing to bear, their costs of production, and obviously the actual market conditions. It is hoped that this article has provided additional insight into some of the alternative pricing strategies that are available.

For those producers who entered cattle into the project in the winter, the results of the alternatives would be very similar to the JUN results for the October steers. The initial market conditions on January 19 were very similar to the October 13 conditions. The market was, in fact, $0.90/cwt higher. As a result, the futures and options positions would be a little more favorable compared to the cash only alternative.

Predicting the Value of Feeder Cattle Placed into an Accelerated Finishing Program Under Dynamic Market Conditions

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CATTLE 94-20

Summary

Data from 769 steer calves that were fed as part of the South Dakota Retained Ownership Demonstration program were used for this study. At feedlot placement, variables that included initial weight, hip height, fat thickness, age, sire breed, and dam breed were recorded on each calf. Calves that were creep fed, vaccinated, and weaned prior to feedlot arrival were identified. These initial variables accounted for only 17.16% of the variation in calf value. When using multiple regression techniques to predict calf value, including year, average daily gain, dressing percentage, and quality grade improved R^2 to .8275. Initial variables accounted for only 8.22% of the variation in gain, 14.28% of the variation in dressing percentage, and 16.36% of the variation in percentage choice. Initial variables are of limited value in predicting feeder calf value under dynamic market conditions.

Key Words: Value Based Marketing, Feeder Calf Value

Introduction

Research at the retail level has demonstrated that modern consumers are demanding leaner, more uniform quality cuts of beef. Unfortunately, there is evidence suggesting that consumers are not always obtaining what they demand in the market place. The National Beef Quality Audit--1991 has identified excess fat and lack of product uniformity as two important problems facing the beef industry. These problems are in large part due to a marketing system that places the same value on excess fat as edible lean. To combat quality and cutability problems, the Value Based Marketing Task Force suggested that the beef industry move toward a value based marketing system.

Value based marketing would transmit consumer demand for quality and leanness throughout the entire production and marketing system. Under value based marketing, the value of feeder cattle would presumably be determined by consumer preferences and feedlot production efficiency. The ultimate objective is to reward producers for superior feeder cattle and to discriminate against inferior feeder cattle.

Data from the South Dakota Retained Ownership Demonstration Program clearly show that feedlot performance and carcass characteristics for cattle are extremely variable. Therefore, the actual value of feeder cattle is also highly variable. If meaningful price discrimination is to occur at the feeder calf level, the ability to predict value is a necessity. The objective of this research was to predict the actual value of feeder calves as calculated from feedlot performance and carcass merit under dynamic market conditions.

Materials and Methods

The data used in this research were obtained from 769 steer calves that were fed as part of the South Dakota Retained Ownership Demonstration Program. At feedlot placement, initial weight, hip height, and fat thickness[3] were recorded. Calf owners were surveyed to

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[3]Determined by ultrasound.

determine age, sire breed, and dam breed on each calf. It was also determined which calves were creep fed, vaccinated, and weaned prior to feedlot arrival.

Feedlot costs for each steer were subtracted from the value of the steer at slaughter. Cattle were sold on a grade and yield basis as they reached about .40 in. fat over the 12th rib. Prices and appropriate discounts were negotiated with the buyer in a competitive setting. The remaining value was assumed to equal calf value:

Calf value = slaughter value - feedlot costs

Calf value was divided by pay weight at feedlot placement. Calf value per cwt was regressed on the initial variables using forward selection regression procedures as outlined by SAS. The full model evaluated was:

\$/cwt = a (PYWT) + b (YEAR1) + c (YEAR2) + d (FAT) + e (HPHT) + f (AGE) + g (CREEP) + h (VACC) + i (WEAN) + j (ANGUS) + k (CHAR) + l (GELB) + m (HERE) + n (LIM) + o (RED) + p (SALERS) + q (SIMM) + r (INTER) + s (HIGH) + error

where PYWT = pay weight at feedlot placement, YEAR1 = 1 for cattle marketed in 1991 and 0 for cattle marketed in 1992 or 1993, YEAR2 = 1 for cattle marketed in 1992 and 0 for cattle marketed in 1991 or 1993, FAT = initial fat thickness over the 12th rib, HPHT = hip height, AGE = calf age at feedlot placement, CREEP = 1 if calves were creep fed and 0 if they weren't, VACC = 1 if calves were vaccinated for more than one feedlot pathogen prior to feedlot arrival and 0 if they were not, ANGUS = 1 if the calf was by an Angus sire and 0 if it was not, CHAR = 1 if the calf was by a Charolais sire and 0 if it was not, GELB = 1 if the calf was by a Gelbvieh sire and 0 if it was not, HERE = 1 if the calf was by a Hereford or Polled Hereford sire and 0 if it was not, LIM = 1 if the calf was by a Limousin sire and 0 if it was not, RED = 1 if the calf was by a Red Angus sire and 0 if it was not, SALERS = 1 if the calf was by a Salers sire and 0 if it was not, SIMM = 1 if the calf was by a Simmental sire and 0 if it was not, INTER = 1 if the calf was out of a cow of intermediate milk production potential and 0 if the calf was out of a low or high milk potential cow, HIGH = 1 if calf was out of a high milk production potential cow and 0 if calf was out of a low or intermediate milk potential cow.

Cow breeds were categorized into low, intermediate, or high milk production groups. Breeds qualifying as low milk production breeds were Hereford, Devon, Limousin, Charolais, and Chianina. High milk production breeds included Holstein, Jersey, Brown Swiss, Gelbvieh, Simmental, Red Poll, South Devon, Tarentaise, Maine-Anjou, Salers, and Angus. Intermediate milk production breeds were crosses of high x low.

Results and Discussion

Table 1 shows the prices received and the quality grade, yield grade 4, and carcass weight discounts that were received for the cattle at slaughter for each marketing date. Table 2 displays sale value, feedlot costs, and initial value of feeder calves. The average carcass weight was 724.1 lb and sold for an average of \$124.64 per cwt. Thus, sale value of the cattle at slaughter averaged \$903.23. Sixty-seven percent of the carcasses were worth between \$806.32 and \$1,000.14. Feedlot costs averaged \$295.80 per head. Initial value of the calves (sale value - feedlot costs) averaged \$607.43 per head. Average pay weight at feedlot placement was 589 lb. Initial value of the calves was \$103.65 per cwt pay weight. The standard deviation was \$10.22, indicating that 67% of the calves were worth between \$92.91 and \$113.35 per cwt.

Hip height and initial fat thickness (measured with ultrasound) were also determined on each steer as it was entered into the Retained Ownership Program (Table 3). Cattle owners also provided the age, breed of sire, and breed of dam for each calf. Questionnaires were completed to indicate which calves were creep fed, weaned and bunk broke, or vaccinated prior to feedlot arrival.

Fifty different breeds or combinations of breeds were indicated by the owners as the breed of sire or dam. To reduce this number to a more manageable figure for the analysis, eight different sire breeds (Angus, 164 head; Charolais, 132 head; Gelbvieh, 65 head;

Table 1. Sale price and discounts[a]

Market date	Choice price	Select discount	Yield grade 4 discount	Light carcass discount[b]	Heavy carcass discount[c]
1991					
4/10	130	5	10	20	20
5/2	129	7	10	20	20
5/8	128	8	10	20	20
5/9	128	8	10	20	20
6/20	119	8	10	20	20
1992					
3/31	125	2	12	20	20
4/14	126	2	12	20[d]	20
4/23	122	3	10	20[d]	20
5/19	125	6	11	20	20
1993					
3/23	134	2	12	20	0
4/1	135	3	12	20[d]	20
5/5	134	5	12	20	20
5/25	134	10	12	20	20
6/10	126	10	12	20	20
6/24	126	8	12	20	20

[a]$ per cwt.
[b]Applied to carcasses less than 550 lb.
[c]Applied to carcasses over 950 lb.
[d]A $2 per cwt discount applied to 550 to 599 lb carcasses.

Table 2. Sale value, feedlot costs, and initial value of feeder calves that were fed as part of the Retained Ownership Demonstration

Item	Mean	Standard deviation	Minimum	Maximum
Sale value, $/head	903.23	96.91	528.96	1,291.76
Feedlot costs, $/head	295.80	38.39	203.36	409.58
Initial value, $/head	607.43	79.88	293.12	923.66
Initial pay weight, lb	588.90	77.19	360.00	878.00
Initial value, $/cwt	103.13	10.22	70.46	139.03

Table 3. Initial hip height, initial fat thickness, and initial age of retained ownership calves

Variable	Mean	Standard deviation	Minimum	Maximum
Hip height, in.	44.70	1.91	39.50	51.50
Fat thickness, in.	.09	.05	.00	.28
Age, days	207	21	145	293

Hereford, 77 head; Limousin, 29 head; Red Angus, 35 head; Salers, 40 head; and Simmental, 87 head) were compared to 118 head of miscellaneous breeds categorized as other. Dam breeds were categorized into high, low, and intermediate (high x low) milk production potential categories. In the analysis, the high and intermediate categories were compared to the low category.

Regression statistics describing premiums and discounts associated with each of the variables known at feedlot placement are shown in Table 4. Pay weight was the first variable to enter the model and explained 12.55% of the variation in feeder calf value. The regression coefficient was -$6.05 change in the value per cwt for each additional cwt of pay weight. Year 2 and year 1 were the next variables to enter the regression, explaining an additional 14.01 and 2.27% of the variation in value, respectively. Calves in year 2 were $11.79 per cwt less valuable and calves in year 1 were $4.83 per cwt less valuable than calves in year 3. This was due to a higher slaughter market in year 3 than in the previous 2 years.

Whether a calf was sired by a Hereford bull was the next factor to enter the model and accounted for an additional 2.27% of the variation. Hereford sired calves were worth $3.46 per cwt less than calves sired by the miscellaneous breeds of sire categorized as other. Lower value of Hereford calves was probably due to their poor dressing percentage (62.6%) and quality grades (23.7% choice) as compared with the other cattle in this study. Average percentage choice and dressing percentage for all cattle were 44.0 and 63.7, respectively.

Angus sired calves accounted for an additional .54% of the variation and were worth $1.89 per cwt more than calves sired by the

Table 4. Regression statistics predicting fall calf value from initial variables

Variable	Coefficient[a]	Standard error[a]	Partial R^2	Probability[b]
Intercept	148.28	3.09		.0001
Pay weight, cwt	-6.05	.48	.1255	.0001
Year 2	-11.79	1.45	.1401	.0001
Year 1	-4.83	1.09	.0227	.0001
Hereford	-3.46	1.13	.0227	.0001
Vaccinated	-2.18	.90	.0067	.0104
Angus	1.87	.83	.0054	.0207
Simmental	-1.92	1.01	.0031	.0771
High milk	2.19	.89	.0033	.0706
Intermediate milk	1.41	.87	.0023	.1248
Initial fat, inches	-16.74	10.45	.0025	.1097

[a]$ per cwt.
[b]Probability that the regression coefficient is equal to 0.

miscellaneous breeds of sire categorized as other. This advantage probably represents differences in quality grade as over 66% of the Angus sired calves graded choice.

Discounts observed for Simmental sired calves ($1.92 per cwt) explained .31% of the variation and were most likely due to quality grade problems as well. Only 29.4% of the Simmental calves graded choice or higher.

Premiums associated with intermediate ($1.41/cwt) and high ($2.19/cwt) milk potential as compared to the low group accounted for .23 and .33% of the variation and may be due to quality grade. Forty-eight percent of the intermediate calves and 45% of the high calves graded choice compared with 36.2% of the low milk potential cattle.

The final variable entering the model was initial fat thickness, which explained an additional .25% of the variation. For each .1 in. of fat cover, the calves were worth $1.67 per cwt less.

A discount of $2.18 per cwt was observed for calves that were vaccinated prior to feedlot arrival (partial R^2 = .0067). All calves were vaccinated when they arrived and the appropriate boosters were given in 2 to 3 weeks. Thus, calves that were vaccinated prior to feedlot arrival received three and many received even four vaccinations for some of the feedlot pathogens. Perhaps this rigorous vaccination schedule negatively impacted performance. Prefeedlot arrival vaccinations were administered at the ranch of origin by the cattle owners. The degree of quality control exercised by each owner is unknown. Feedyard pulls were not affected by vaccination program. Percentage choice, average daily gain, and dressing percentage were 43.9 vs 47.4, 3.00 vs 3.05, and 63.66 vs 63.87 for the vaccinated and nonvaccinated calves, respectively.

Only 17.16% of the variation in calf value in the fall can be explained by variables known at feedlot placement. Years 1 and 2 account for an additional 16.28% of the variation and probably reflect variation due to the strength of the slaughter cattle market each spring as well as differences in feed costs and cattle performance from year to year. Additional information is needed to accurately predict value.

Table 5 shows the regression statistics predicting fall calf value when various carcass and performance traits are included. Average daily gain entered the model first and accounted for 14.30% of the variation in feeder calf value. For each .1 lb improvement in daily gain, the feeder calf was worth an additional $1.37 per cwt.

Table 5. Regression statistics predicting fall calf value from feedlot performance and carcass characteristics

Variable	Coefficient[a]	Standard error[a]	Partial R^2	Probability[b]
Intercept	-50.33	5.67		.0001
Average daily gain, lb	13.71	.44	.1430	.0001
Pay weight, cwt	-8.43	.22	.1673	.0001
Year 2	-13.55	.46	.1787	.0001
Dressing percentage	2.64	.09	.2047	.0001
Quality grade	5.93	.32	.0873	.0001
Year 1	-6.38	.46	.0465	.0001

[a]$ per cwt.
[b]Probability that the regression coefficient is equal to 0.

Initial pay weight entered the model second and explained 16.73% of the variation in calf value. This figure is similar to the partial R^2 (.1255) that was observed when fall value was predicted from the information available at feedlot placement. Each additional cwt of pay weight reduced calf value by $8.43 per cwt. This discount is similar to the $6.05 discount displayed in Table 4.

Calves placed in year 2 were worth $13.55 less per cwt than calves placed in the feedlot in year 3 and $7.17 per cwt less than calves placed in year 1. Partial R^2 was .1787 and .0465 for year 2 and year 1, respectively.

Dressing percentage accounted for an additional 20.47% of the variation. For each additional unit of dressing percentage, value was increased by $2.64 per cwt. Dressing percentage is defined as the yield of carcass per unit live weight. It is influenced by fill, fat, and muscle. In this study, differences in fill and fat were minimized. Therefore, dressing percentage may reflect differences in muscle.

Quality grade explained an additional 8.73% of the variation in value. If a carcass graded choice or greater, the feeder steer was worth an additional $5.93 per cwt as compared with cattle grading select or lower.

Mean and variation observed for average daily gain, dressing percentage, and marbling score are presented in Table 6. Variation observed for these traits was tremendous. Nearly 17% of the calves gained less than 2.64 lb per head daily. Nearly 17% of the calves had less than a 61.77% yield. Quality grades for 56% of the calves were high select or poorer. Conversely, some of the calves exhibited outstanding performance. Nearly 17% of the calves gained more than 3.38 lb daily. Nearly 17% of the calves had greater than a 65.69% yield. Forty-four percent of the calves graded low choice or higher.

Total R^2 of the model predicting calf value from initial variables and year (Table 4) was .3344. Including daily gain, dressing percentage, and quality grade in this model improves R^2 to .8275. Additional information is needed at feedlot placement to account for the variation in gain, dressing percentage, and quality grade.

Initial variables do a poor job of predicting gain, dressing percentage, and percentage choice. Initial variables accounted for only 8.22% of the variation in gain (Table 7). Only 14.28% of the variation in dressing percentage was explained by initial variables (Table 8). Initial variables only accounted for 16.36% of the variation in percentage choice (Table 9).

The data from the retained ownership study clearly show that performance and the carcass traits of quality grade and dressing percentage are needed to adequately predict feeder calf value. The information collected on calves consigned to the retained ownership study further demonstrate that the initial variables of weight, height, fat thickness, prefeedlot arrival management, and breed type are of limited value in predicting the quality of feeder cattle placed in an accelerated finishing program under dynamic market conditions. Additional analyses are needed to determine if the same relationships and conclusions drawn from this research hold true under stable market conditions. In order for value based marketing to have the appropriate impact on cow-calf producers, reliable predictors of feeder calf performance, quality grade, and dressing percentage are needed.

Table 6. Average daily gain, dressing percentage, and marbling score of retained ownership calves

Variable	Mean	Standard deviation	Minimum	Maximum
Average daily gain, lb	3.01	.37	1.54	4.22
Dressing percentage	63.73	1.96	57.39	70.43
Marbling score, units[a]	4.79	.59	3.00	8.00

[a]4.00 = slight°, 5.00 = small°.

Table 7. Regression statistics predicting daily gain from initial variables

Variable	Coefficient[a]	Standard error[a]	Partial R^2	Probability[b]
Intercept	1.40	.36		.0001
Year 2	.14	.03	.0186	.0004
Initial height, inches	.03	.01	.0305	.0001
High milk	.12	.04	.0126	.0027
Angus	.07	.03	.0066	.0292
Vaccination	-.08	.04	.0067	.0274
Limousin	-.11	.07	.0039	.0908
Intermediate milk	.06	.04	.0032	.1271

[a]Lb per head daily.
[b]Probability that the regression coefficient is equal to 0.

Table 8. Regression statistics predicting dressing percentage from initial variables

Variable	Coefficient[a]	Standard error[a]	Partial R^2	Probability[b]
Intercept	60.76	.66		.0001
Hereford	-1.03	.23	.0406	.0001
Limousin	1.38	.35	.0112	.0049
Pay weight, cwt	.39	.10	.0092	.0102
Year 1	1.27	.21	.0099	.0069
Year 2	1.26	.20	.0161	.0005
Simmental	-.72	.22	.0123	.0023
Weaned	-.41	.15	.0129	.0017
Salers	.70	.30	.0072	.0183
Intermediate milk	-.29	.14	.0051	.0462

[a]Percentage of finish weight.
[b]Probability that the regression coefficient is equal to 0.

Table 9. Regression statistics predicting percentage choice quality grade from initial variables

Variable	Coefficient[a]	Standard error[a]	Partial R^2	Probability
Intercept	-49.32	18.84		.0090
Age	.49	.09	.0820	.0001
Angus	15.84	5.09	.0247	.0001
Year 2	-13.41	3.64	.0220	.0001
Red Angus	23.50	8.70	.0173	.0002
Hereford	-16.63	6.17	.0052	.0427
Gelbvieh	-13.82	6.68	.0026	.1500
Salers	-16.53	7.90	.0032	.1091
Simmental	-10.63	5.94	.0036	.0922
Creep fed	-5.79	3.78	.0029	.1260

[a]Percentage choice quality grade. Data entered as 100 = choice or higher nand 0 = select or lower.

[b]Probability that the regression coefficient is equal to 0.

South Dakota Beef Herd Profitability 1986-1993

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CATTLE 94-21

Summary

The average profitability of beef cow herds evaluated by the South Dakota Farm Business Management group has ranged from $201 profit in 1987 to $104 profit per cow in 1993. Average total costs per cow in a pasture drylot have increased from $180 in 1986 to $310 in 1993. Average total cow costs of range run have increased from $166 in 1986 to $302 in 1993.

High profit herds in both range run and pasture drylot had lower 8-year average total costs, $264/cow drylot high profit compared to $272 drylot average (-3%) and $252/cow range high profit compared to $264 range average (-4.5%). Yet high profit herds produced greater total income/cow: $489/cow Drylot High Profit to $401 Drylot Average (+22%); $451/cow Range Run High Profit to $392 Range Run Average (+15%).

Key Words: Cow-Calf Profitability, Cow Costs

Introduction

Beef is the number one agricultural product produced in South Dakota. The cow/calf enterprise is the backbone of the beef industry. Beef cow herds have been profitable over the last 8 years, but costs have been increasing. This has resulted in tighter profit margins. Beef cow/calf producers must be especially aware of their costs. This study evaluates the change in income, expenses, production, and performance levels of the beef cow herds summarized in the South Dakota Farm Business Management[3] annual reports. The cow/calf enterprises were separated into range run cow herds typical of western South Dakota and pasture/drylot cow herds, typical of eastern South Dakota. High profit groups were compared to the average to determine what could lead to greater profits/cow.

Materials and Methods

Eight years of cow/calf enterprise income and expenses data from farms and ranches in South Dakota were reviewed. High profit cow/calf enterprises on ranches were separated and compared to the average. Herd size, weaning weights, and percentage of weaned calves were compared. Total income per cow, total costs per cow, total feed, pasture costs, and allocated overhead costs for machinery and equipment were included in the review. Ranches were reviewed as separated in the South Dakota Farm Business Management Summaries into Range Run Average Profit Group (RA), Range Run High Profit Group (RHP), Pasture/Drylot Average Group (DA), and Pasture/Drylot High Profit Group (DHP). Designations were according to how cows were wintered, in drylot or range settings, during the winter months.

Results and Discussion

This study suggests that high profit cow herds are operated by ranchers who can produce heavier weaned calves (+4% RHP and +7.3% DHP weaning weights) on lower total costs. Feed costs which account for an average of 68% of the high profit group's total cost are the largest cow/calf cost. Average drylot and range run cow/calf producers spent similar percentages over the 8-year period. Average drylot/pasture total feed costs were 72.9% and range run was

[1]Area Farm Management.
[2]Former Farm Business Management Instructor.
[3]In cooperation with the Office of Adult Vocational-Technical Education.

66.9% of total costs. Maintaining animal performance without increasing overall feed costs is key to higher profits. High profit range run producers had 6.4% lower total feed costs and 9.8% lower nonpasture feed costs than average range run herds (Table 1). High profit drylot herds also had 9.7% lower total feed costs and 11.2% lower nonpasture feed costs (Table 1).

Table 1. Average to High Profit cow/calf herd comparisons, 1986-1993

	Average herds	High Profit herds	High Profit percentage change
	Pasture/drylot, Eastern		
Number of beef cows, head	93	85	-8.6
Percentage of calves weaned	90.6	90.7	0
Avg weaning wt, lb	496	532	+7.3
Gross cow income, $	401	489	+22
Total cost/cow, $	272	264	-3
Profit/cow, $	**129**	**225**	**+74**
Total feed costs/cow, $	196	177	-9.7
Pasture costs/cow, $	79	73	-7.6
Nonpasture feed costs/cow, $	117	104	-11.2
Allocated machinery/equipment costs, $	557	624	+12.7
	Range Run, Western		
Number of beef cows (head)	188	204	+8.5
Percentage of calves weaned	91.3	92.3	+1
Avg weaning wt, lb	497	517	+4
Gross cow income, $	392	451	+15
Total cost/cow, $	264	252	-4.5
Profit/cow, $	**128**	**199**	**+55**
Total feed costs/cow, $	172	161	-6.4
Pasture costs/cow, $	90	87	-3.3
Nonpasture feed costs/cow, $	82	74	-9.8
Allocated machinery/equipment costs	74	68	-8.1

The average profitability of beef cow herds has ranged from $201 profit in 1987 to $104 profit per cow in 1993 (Table 2). Average total costs per cow in a pasture drylot have increased from $180 in 1986 to $310 in 1993. Average total cow costs of range run have increased from $166 in 1986 to $302 in 1993.

Allocated machinery and equipment costs took the largest increase from 1986 to 1993. Costs increased in every category. These costs include equipment/machinery repair, fuel, building repair, utilities, interest, labor, depreciation on equipment, machinery, and buildings. The author recognizes that, when

Table 2. Cow/calf profitability 1986-93

	Year							
	1986	1987	1988	1989	1990	1991	1992	1993
	Pasture drylot average (DA)							
Gross income/cow, $	263	377	420	414	461	414	427	434
Total cost/cow, $	180	191	287	311	310	304	284	310
Profit/cow, $	**83**	**186**	133	**103**	**151**	**110**	**143**	**124**
	Range run average (RA)							
Gross income/cow, $	261	370	394	440	425	421	416	406
Total cost/cow, $	166	169	292	291	270	304	319	302
Profit/cow, $	**95**	**201**	**102**	**149**	**155**	**117**	**97**	**104**

Allocated Machinery/Equipment Costs

	1986	1993	8-yr. avg.
Range Run Avg.	$15.69	$73.25	$74.46
Range Run High Profit	11.64	98.00	67.82
Pasture Drylot Avg.	21.82	63.31	55.05
P/D High Profit	25.10	66.78	61.89

profits are available, repairs and capital improvements will and should be made, but 300 to 400% plus increases in these costs may not be justified. Producers should become aware of their individual costs on machinery, buildings, and equipment. These expenditures are taking a larger part of the potential profit.

In conclusion, high profit producers are able to produce larger calves at average or below costs. Feed costs are approximately two-thirds of all costs. Cow/calf producers need to watch carefully machinery, building and equipment costs if they are to remain profitable.

The faculty members of the **Animal and Range Sciences Department** are always ready to answer your questions. Our Brookings phone number is (605) 688-5166. Staff members in Rapid City (RC) may be reached at (605) 394-2236. Please feel free to give any one of us a call.

FACULTY

	SPECIALTY	RESPONSIBILITY
BIRKELO, Carl P.	Ruminant Nutrition	Research, Teaching
BOGGS, Donald L.	Beef Cattle Nutrition and Management	Extension
COSTELLO, William J.	Meat Science	Teaching, Research
GARTNER, F. Robert (RC)	Range Science	Research, Teaching
GEE, Dan H.	Evaluation/Marketing	Teaching
HAMILTON, C. Ross	Swine Nutrition	Research, Teaching
HELD, Jeffrey E.	Sheep Nutrition and Production and Management	Extension
INSLEY, Larry W.	Beef Cattle Management and Nutrition/Horse Production	Extension, Teaching
JOHNSON, James R. (RC)	Range Science	Extension, Research
JOHNSON, Patricia S.	Range Science	Research, Teaching
KNUTSON, Mary K.	Livestock Judging Team Coach	Teaching
KRONBERG, Scott	Range Science	Research, Teaching
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MARSHALL, Donald M.	Animal Breeding	Research, Teaching
MCFARLAND, Douglas C.	Monogastric Nutrition and Muscle Biology	Research, Teaching
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PRITCHARD, Robbi H.	Ruminant Nutrition	Research, Teaching
PRUITT, Richard J.	Cow-Calf Management	Teaching, Research
ROMANS, John R.	Meat Science	Research, Teaching
SLYTER, A. Lowell	Reproductive Physiology/Sheep Production and Management	Research, Teaching
THALER, Robert C.	Swine Nutrition	Extension
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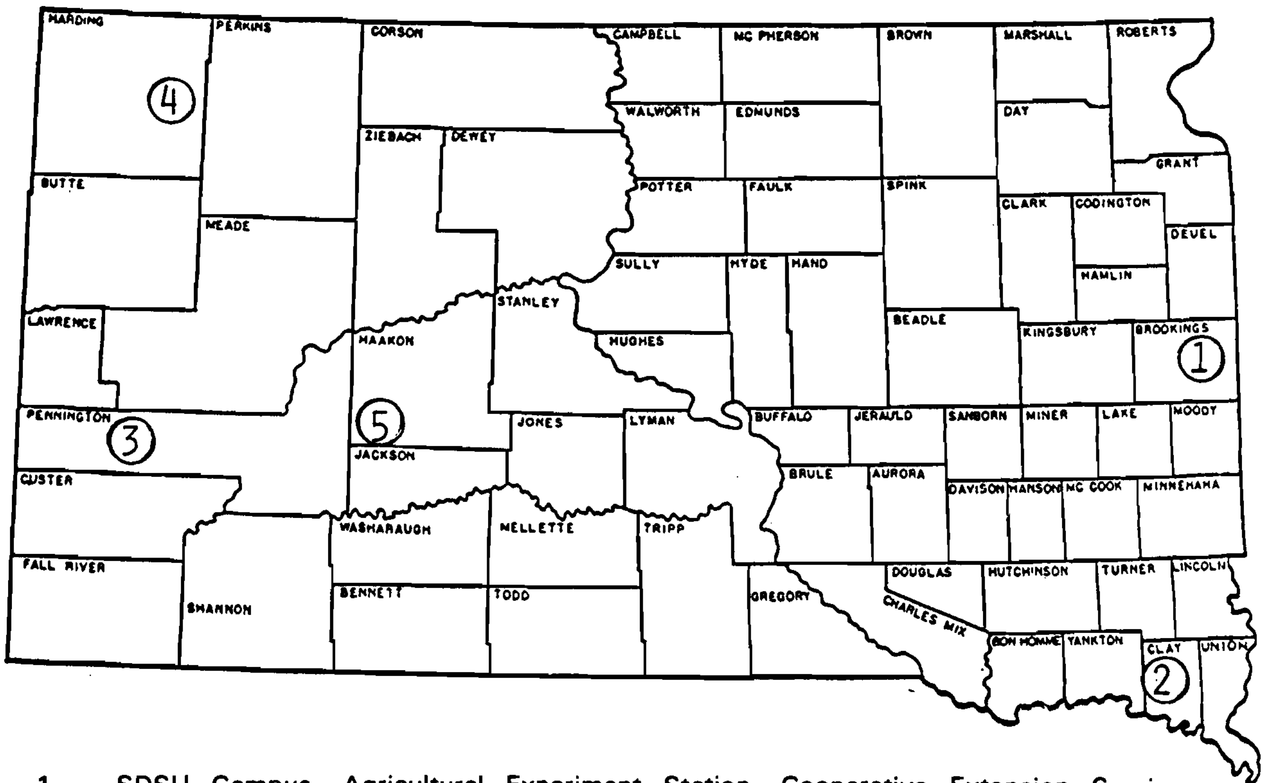

1. SDSU Campus, Agricultural Experiment Station, Cooperative Extension Service, Brookings.

2. Southeast South Dakota Research Farm, Beresford
   Beef cattle nutrition * Swine nutrition and management.

3. West River Agricultural Research and Extension Center, Rapid City
   Professional research and extension staff in Animal and Range Sciences, Plant Science, Economics, 4-H, and Extension Administration.

4. Antelope Range Livestock Station, Buffalo
   Beef cattle breeding * Range beef herd management * Sheep nutrition, management, and breeding.

5. Range and Livestock Research Station, Philip
   Range beef nutrition * Herd management * Range management.

These research and extension units are geographically located in South Dakota to help solve problems, bring the results of livestock and range research to the user, enhance the statewide teaching effectiveness of the Animal and Range Sciences Department staff, and maintain a close and productive relationship with South Dakota producers and our agri-business community.

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