1990

1990 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

Department of Animal and Range Sciences

1990

Agricultural Experiment Station

South Dakota

Cooperative Extension Service

Beef Report

South Dakota State University, Brookings

Animal and Range Sciences Department

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SDSU
South Dakota State University
Box 2170
Brookings, SD 57007-0392

Department of Animal and
Range Sciences
College of Agriculture and
Biological Sciences
Phone (605) 688-5165

September 1990

Dear Beef Producers:

It doesn't seem possible it is time for another SDSU Beef Report. During the past year, consistently high beef prices have been experienced by all segments of the industry. Despite continued dry conditions in some parts of South Dakota, the overall outlook is positive. Beef demand appears to be good, feed prices will be favorable this fall and all segments of the beef industry are able to realize a profit.

However, there are threats on the horizon. Animal welfare, food safety and environmental concerns will be the "buzz" words of the 90's. The National Cattlemen's Association Task Force, addressing concentration and integration, issued their report this past year. To some, a surprising conclusion of the task force was that a major threat to the profitability of beef cattle is the high cost of production. The Department of Animal and Range Sciences at South Dakota State University has research and extension programs that are designed to address this very important area.

The Beef Report contains reports on nutrition research of interest to both cow/calf producers as well as cattle feeders. Cow/calf nutrition work emphasizes cow condition, winter feeding and rebreeding performance of the cow herd. Feedlot research has been addressing the use of by-product feeds and feedlot management to reduce the fat on the carcass. Beef cattle breeding research is designed to look at cow type and efficiency as well as breeding programs that will enhance profitability in western South Dakota. Reproductive physiology research continues to look at the mechanisms that control reproduction and ways that reproductive efficiency can be enhanced.

The second set of very successful Bull Clinics was concluded this past spring. John Wagner, in conjunction with University of Minnesota staff, put together a very educational cattle feeders seminar held in both Aberdeen and Marshall, MN. The extension staff are in the planning process for a set of clinics this coming year that will address heifer development and cow management. In addition to these activities, the beef specialists continue to participate in numerous local meetings and are always available to field questions.

It is our hope that the information contained in this Beef Report is beneficial to you. If you need further information contact the authors - they will be happy to visit with you. We are also interested in what you think, so keep in touch. We want to know what type of researchable questions you have and the type of extension programming that interests you.

Sincerely,

Jim Males

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

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COOPERATIVE EXTENSION SERVICE

South Dakota State University
Box 2170
Brookings, SD 57007-0392

Department of Animal and
Range Sciences
College of Agriculture and
Biological Sciences
Phone: (605) 688-5165

September 1990

Dear Beef Cattle Industry Friends:

Thank you for examining our 1990 Beef Report. This report summarizes beef cattle research conducted at South Dakota State University during the past year.

We have moved our publication date from December to September. This enables us to distribute this report at field days and meetings scheduled for fall. Hopefully, this will provide you with information in a more timely manner.

The results of the studies summarized in this report have several levels of application. Some studies have immediate application in your farming, feeding, ranching or business activities. Other studies examine more basic biological principles concerning beef production. These studies strive for new knowledge that may have application in the future.

In this year's report, we have added a marketing section. An article concerning feeding cattle beyond the time that they are ready for slaughter and an article examining retained ownership over the past five years are printed in this section. We hope these studies are of interest to you.

Thank you for your continuing support of extension, research and teaching in the Animal and Range Sciences Department. Please do not hesitate to call if we can be of service to you.

Sincerely,

John J. Wagner

John J. Wagner, Ph.D.
Extension Ruminant Nutrition Specialist

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INTERPRETING EXPERIMENTAL RESULTS

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

CATTLE 90-1

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.

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[1]Associate Professor.

RESPONSE OF YEARLING CATTLE TO LIMIT-FED FINISHING DIETS IN DIFFERENT SEASONAL ENVIRONMENTS

C. P. Birkelo[1] and D. R. Sorenson[2]
Department of Animal and Range Sciences

CATTLE 90-2

Summary

Two trials were conducted to evaluate limit-feeding of finishing diets to yearling steers in different seasonal environments. In Trial 1, 72 yearling steers were fed (1) ad libitum or (2) 93% of ad libitum (restricted) from July through early November. Trial 2 was conducted from January through early May with a similar group of steers. Weather data collected at the feedlot indicated that the weather during Trial 1 was similar to the 30-year average (Trial 1 average air temperature = 62 °F), but the weather during Trial 2 was 10 °F warmer than typical (average air temperature = 37 °F). In both trials, dry matter intakes were lower for restricted than controls as intended ($P<.001$), but average daily gains did not differ ($P>.10$). This resulted in numerically improved feed/gain but only approached significance in Trial 1 ($P=.14$). Carcass characteristics were not affected by treatment ($P>.10$) with the exception of dressing percent in Trial 1, but this difference was not found in Trial 2. Limit-feeding of finishing rations to yearling steers tended to improve feed/gain in warm summer as well as moderate winter-spring environments.

(Key Words: Yearling Steers, Limit-feeding, Environment.)

Introduction

It has been widely considered in the cattle feeding industry that feed efficiency is maximized in finishing cattle by increasing feed intake which maximizes rate of gain and "dilutes" maintenance energy requirements (i.e., the greater the energy intake, the smaller the percentage required for maintenance). Decreased digestibility that also results from higher feed intake is more than offset. In the last several years, university research from Oklahoma and California has shown that slight restriction of feed intake (90 to 95% of ad libitum) may in some cases improve feed efficiency without appreciably decreasing rate of gain. This, in addition to practical benefits such as improved bunk management and reduced feed wastage, could make limit-feeding of finishing diets a viable management option once questions such as how to determine the degree of restriction in commercial feeding conditions and the appropriate nutrient and feed additive levels have been answered.

However, South Dakota, Minnesota and Iowa research has shown that responses to limit-feeding are not consistent, and the reasons are unknown. The inconsistencies may be due in part to variations in environment. A reduction in dry matter intake not only reduces energy intake but also the heat produced as a consequence of consumption, digestion and metabolism. Reduced heat production may increase the lower critical temperature (the temperature below which an animal may be stressed by cold) by 6 to 13 °F, potentially decreasing or even negating the improvements in efficiency.

The objective of this study was to determine whether limit-feeding would be effective in yearling cattle fed during seasons having substantially different environmental conditions.

Materials and Methods

In Trial 1, a group of 199 crossbred, yearling steers (predominantly Charolais, Simmental and Limousin) were vaccinated (IBR, BVD, BRSV, Lepto, 7-way clostridial), treated with invermectin, implanted with Synovex-S, ear tagged and weighed shortly after arrival at the feedlot. Seventy-two head were selected from these, blocked by weight and randomly assigned to two treatments with four pens per treatment, 9 head per pen. The treatments were (1) ad libitum (cattle had unlimited access to feed) and (2) restricted. The amount of feed offered to treatment 2 was adjusted daily and restricted to 93% of the previous 7-day average for the corresponding control pen within weight block. This approach greatly reduced day-to-day variation in intake for the restricted group. The restriction was begun once the cattle were started on their finishing diets. Step-up diets were fed ad libitum. The finishing diets were formulated such that absolute

[1]Assistant Professor.
[2]Manager, Southeast South Dakota Experiment Farm, Beresford.

intakes of protein, calcium, phosphorus, potassium, supplemental trace minerals, vitamin A and feed additives were the same across treatments (Table 1). The intention was to restrict only dry matter and energy intake. The steers were weighed on and off test after a 16-hour shrink off feed and water. The procedures of Trial 1 were repeated in Trial 2 with 72 steers of similar breeding selected from a group of 172 head.

The data from Trials 1 and 2 were statistically analyzed separately as a randomized block design because of the confounding between season and source of cattle.

The weather instruments were mounted approximately 6 feet above the ground in an area unprotected by windbreaks, trees or buildings. The feedlot was located approximately 600 feet north of the weather instruments and protected on the west and north by a shelter belt and each pen contained a windbreak. The pens were also bedded with straw during Trial 2.

TABLE 1. STEP-UP AND FINISHING DIETS FED TO CONTROL AND RESTRICTED CATTLE

	Diet					
Ingredient	1	2	3	4	5[a]	5[b]
	%					
Rolled corn	53.7	58.8	66.3	73.8	80.8	80.0
Oat hulls				7.5	8.0	8.0
Molasses	4.0	4.0	4.0	4.0	4.0	4.0
Alfalfa	37.9	30.0	22.5	7.5		
Supplement	4.4	7.2	7.2	7.2	7.2	8.0
Analysis (dry matter basis)						
Dry matter, %						
Crude protein, %	13.0	14.2	13.6	12.1	11.5	12.3
Net energy, Mcal/cwt						
Maintenance	82.8	85.5	88.7	90.5	93.4	93.0
Gain	53.8	56.3	59.0	59.3	61.8	61.4
Calcium, %	.87	.91	.81	.61	.50	.54
Phosphorus, %	.55	.34	.35	.35	.35	.38
Potassium, %	1.25	1.17	1.07	.89	.80	.86
Vitamin A, IU/lb DM	3295	2119	2119	2119	2119	2283
Monensin, g/T DM	12.4	30.5	30.5	30.5	30.5	32.9
Tylosin, g/T DM	11.2	7.6	7.6	7.6	7.6	8.2

[a] Control.
[b] Restricted.

Results and Discussion

Weather data collected during Trials 1 and 2 are presented in Table 2. Weather during Trial 1, conducted from July through early November, 1989, was almost identical to the 30-year average for the area. However, weather during Trial 2, conducted from January through early May, 1990, was approximately 10 °F warmer than average. The average windchill temperature during Trial 2 based on the weather data was 13 °F and was as low as 4 °F during January and February. The pens were somewhat protected from direct wind, however, so that windchill temperatures to which the cattle were exposed were likely higher.

Performance data for Trial 1 (Table 3) indicated no differences in initial or final weights or average daily gain (ADG). Dry matter intake (DMI) was significantly lower ($P<.001$) for the restricted steers, as intended, and averaged 93.3% of the controls for the entire feeding period which included the step-up rations that were fed ad libitum. Because DMI was lower but ADG was unchanged, the feed/gain (F/G) ratio was numerically lower and approached statistical significance ($P=.14$).

The results of Trial 2 reflect a similar response to limit-feeding. Initial and final weights and ADG were similar across treatments, while restricted DMI averaged

TABLE 2. WEATHER DATA FOR TRIALS 1 AND 2

Item	Trial 1 7-13-89 to 11-8-89	Trial 2 1-11-90 to 5-8-90
Avg daily high temperature, °F	75	49
Avg daily low temperature, °F	49	25
Avg hourly temperature, °F	62	37
Avg relative humidity, %	67	62
Avg wind speed, mph	6.8	8.5

[a] Data were collected at the feedlot using weather instrumentation mounted approximately 6 feet above the ground and unprotected by windbreaks, trees or buildings.

TABLE 3. PERFORMANCE DATA FOR YEARLING STEERS FED DURING DIFFERENT SEASONS

	Trial 1			Trial 2		
Item	Ad libitum	Restricted	SE	Ad libitum	Restricted	SE
No. steers	36	36		36	36	
Days on feed	118	118		117	117	
Initial wt, lb	823	817	4.4	851	851	4.2
Final wt, lb	1259	1247	13.5	1219	1225	12.6
Daily gain, lb	3.70	3.64	.10	3.14	3.20	.10
Dry matter intake, lb	22.23	20.73[a]	.15	21.92	20.81[a]	.07
Feed/gain	6.03	5.71	.14	7.00	6.52	.29

[a] Treatment effect within trial significant (P<.001).

94.95% of controls (P<.001). As in Trial 1, overall restriction was higher than 93% because of DMI while on the step-up rations. As a result of lower DMI and similar ADG, F/G was numerically lower but not significantly different (P=.28).

No differences in carcass data were found due to treatment in either trial (Table 4) with one exception. Dressing percent was lower (P<.10) for the restricted steers in Trial 1. This is contrary to what one would expect if restriction reduced gut fill. The steers were shrunk 16 hours prior to initial and final weighing to reduce this potential effect on dressing percent. This difference was not found in Trial 2.

It appears from these two trials that a small restriction in DMI can result in similar ADG and may thereby improve F/G in yearling steers. This seems true even in the moderate winter-spring conditions present in Trial 2. Determining if limit-feeding will work under more normal (adverse) conditions will require additional study, but these results suggest that limit-feeding, at the very least, could be a viable management option for cattle fed during the spring, summer or fall in South Dakota.

TABLE 4. CARCASS DATA FOR YEARLING STEERS FED DURING DIFFERENT SEASONS

Item	Trial 1			Trial 2		
	Ad libitum	Restricted	SE	Ad libitum	Restricted	SE
Carcass wt, lb	785	769	9.2	753	759	9.7
Dressing percent	62.39	61.71[a]	.263	61.99	61.93	.267
Fat thickness, in.	.47	.46	.027	.46	.46	.023
Rib eye area, in.^{2}	13.37	13.13	.228	13.23	13.14	.195
Yield grade	2.86	2.83	.116	2.73	2.74	.105
Marbling score[b]	11.11	11.36	.661	13.20	12.72	.725

[a] Treatment effect significant ($P<.10$).
[b] 10 = high select; 11 = low choice.

ANHYDROUS AMMONIA OR LIQUID SUPPLEMENT TREATMENT OF WHEAT STRAW: DEMONSTRATION RESULTS

T. B. Goehring[1], R. H. Pritchard[2], T. Derr[3] and J. Thelen[4]
Department of Animal and Range Sciences

CATTLE 90-3

Summary

The effect of anhydrous ammonia or liquid supplement treatment of wheat straw was evaluated by field demonstration in response to the drought of 1989. Ammoniation of wheat straw increased estimated TDN content by 7.8 percentage points and crude protein by 7 percentage points in comparison with untreated straw. Adding a liquid protein supplement to wheat straw increased estimated TDN content by 1.5 percentage points and crude protein by .6 percentage points. Ammoniation increased the quality of wheat straw to a level comparable to prairie hay. Based on nutrient analysis, the ammoniation procedure was more effective in improving the quality of wheat straw than addition of liquid supplement.

(Key Words: Wheat Straw, Anhydrous Ammonia, Liquid Supplement.)

Introduction

The droughts common to South Dakota can seriously reduce the winter feed supply. When the hay supply is limited, cow-calf producers oftentimes use wheat straw as part of the cow diet even though wheat straw is low in energy and crude protein.

Numerous research trials conducted nationwide have evaluated methods of chemically treating wheat straw and other crop residues to improve feeding value. Results indicate treatment with anhydrous ammonia consistently improved the feeding value of crop residues. Anhydrous ammonia was also the most cost effective and readily available material evaluated. Although treatment of wheat straw with anhydrous ammonia is not a difficult procedure, it does require labor and materials. Pouring a liquid supplement over wheat straw in an attempt to improve quality has received some attention as a simpler method for increasing forage crude protein.

The drought of 1989 provided an opportunity to demonstrate handling procedures and compare the effect of anhydrous ammonia or liquid supplement treatment on crude protein and TDN content of wheat straw.

Materials and Methods

An ammoniation demonstration was conducted in cooperation with Bill Bielmaier, Wall, SD, in August of 1989. After wheat harvest, the straw was baled into 800- to 850-lb round bales and hauled to a stack yard. Straw bales were stacked into a three-bale pyramid, 13 bales long. A total of four stacks was constructed. Each stack was covered with a 40 x 100 foot, 8-mm plastic cover and the edges were sealed with 8 to 12 inches of dirt. A 1 1/2 inch plastic pipe was run under the dirt edge from the outside of the stack into the center. Anhydrous ammonia was released into the stack via the plastic pipe. Anhydrous ammonia was applied at the rate of 3% or 60 lb per ton of straw.

On the day ammonia was applied to the covered stacks, 19 additional bales of wheat straw were individually sprayed with approximately 4 gallons of a liquid protein supplement[5] (LPS). Guaranteed analysis of the supplement indicated not less than 15% crude protein, with .0% equivalent protein from nonprotein nitrogen. Each bale was tipped on end for application of the LPS and placed back on its side 20 to 30 minutes later.

All LPS-treated bales were core sampled before and 2 to 3 hours after application. Core samples from ammoniated straw bales were obtained before and 82 days after treatment. Samples were analyzed for dry matter, crude protein, acid detergent fiber (ADF), neutral

[1]Assistant Professor.
[2]Associate Professor.
[3]Pennington County Agricultural Agent.
[4]Former Pennington County Agricultural Agent.
[5]Loomix, P. O. Box 490, Arroyo Grande, CA, 93420.

detergent fiber (NDF), in vitro dry matter disappearance (IVDMD) and gas production. The IVDMD was calculated after a 48-hour digestion in an artificial rumen. Gas production was calculated by measuring the volume of water displaced after 20 hours of fermentation.

The TDN content of feeds can be estimated by various means. In this demonstration, TDN was estimated from both ADF (% TDN = 96.35 - [1.15 * % ADF]) and IVDMD (% TDN = 16.7 + [.74 * % IVDMD]) values.

Results and Discussion

Crude protein and fiber values are shown in Table 1. Crude protein content prior to treatment was extremely low. LPS treatment increased the crude protein content of wheat straw by .6 percentage point to an average of 3.5%. Ammoniation increased the crude protein content to 9.9%.

Anhydrous ammonia reacts with the water molecules present in the straw to form ammonium hydroxide. This compound in turn aids in breaking lignin-cellulose bonds, thus reducing the amount of indigestible fiber. As shown in Table 1, addition of anhydrous ammonia reduced NDF and ADF content to a greater extent than addition of LPS.

LPS treatment caused a small increase in IVDMD, while anhydrous ammonia treatment increased IVDMD by 34% (Table 2). Ammonia treatment also caused higher 20-hour gas production which may indicate a higher rate of fermentation. Higher rates and extent of dry matter disappearance could be expected to allow greater daily digestible dry matter intake by beef cows. This is a critical aspect of meeting cow energy requirements.

The estimated TDN content varied with method of calculation (Table 2). The ADF method, used by many analytical laboratories, does not work well with wheat straw. The ADF-based calculation overestimated the TDN content of untreated and LPS-treated straws. Based on IVDMD-generated TDN values, LPS increased TDN content of wheat straw by 3.5%, while ammoniation increased TDN content by 19.7%.

Both treatments changed the nutrient analysis of wheat straw but by two different mechanisms. The increase in quality due to LPS addition represents a dilution of the supplement over the straw. Composition of the wheat straw itself was not changed. Conversely, the increase in quality through ammoniation represents a change in physical characteristics of the fiber component of the wheat straw. This change increases fiber fermentability. The modification of fiber fermentability is not accounted for in estimates of forage TDN content when the ADF equation is used.

Producers should be conservative when evaluating the protein content of ammoniated wheat straw. The increase in crude protein is through the addition of a nonprotein nitrogen source and should be considered only 50% utilizable.

Estimated cost of the different treatments, excluding labor and transportation charges for product, and cost benefit of additional TDN are presented in Table 3.

TABLE 1. COMPOSITION OF WHEAT STRAW SAMPLES[a]

Treatment	Dry matter	Crude protein	NDF[b]	ADF[c]
Ammoniation				
Pretreatment	94.7	2.8	77.6	46.7
Posttreatment	89.8	9.9	70.8	41.6
Liquid protein supplement				
Pretreatment	95.4	2.9	77.8	46.0
Posttreatment	95.2	3.5	75.7	42.2

[a] Percentage crude protein, NDF, ADF on a dry matter basis.
[b] Neutral detergent fiber.
[c] Acid detergent fiber.

TABLE 2. IN VITRO DRY MATTER DISAPPEARANCE, GAS PRODUCTION AND ESTIMATED TDN CONTENT OF WHEAT STRAW

Treatment	IVDMD[a], %	Gas production, ml/hour	TDN estimate ADF[b]	TDN estimate IVDMD[c]
Ammoniation				
Pretreatment	30.9[d]	9.2[d]	42.6	39.6[d]
Posttreatment	41.4[f]	12.7[e]	48.5	47.4[g]
Liquid protein supplement				
Pretreatment	33.3[e]	9.1[d]	43.5	41.3[e]
Posttreatment	35.2[g]	10.0[d]	47.8	42.8[f]
SEM	.55	.41		.41

[a] In vitro dry matter disappearance.
[b] TDN estimated from acid detergent fiber; not subjected to statistical analysis.
[c] TDN estimated from IVDMD.
[d,e,f,g] Means with unlike superscripts differ ($P<.05$).

TABLE 3. COST ANALYSIS FOR CHEMICALLY TREATED WHEAT STRAW[a]

Item	Treatment: Ammoniation	Treatment: Liquid protein supplement
Treatment costs, $/T	11.85	9.00
Cost/ton of TDN, $	91.62	94.81
Cost/% increase in TDN, $[b]	1.52	6.00

[a] Based on wheat straw costs of $30/T.
[b] For 1 ton wheat straw.

USE OF SUNFLOWER HULLS AS THE ROUGHAGE COMPONENT OF FINISHING DIETS FOR YEARLING STEERS

R. H. Pritchard[1] and M. A. Robbins[2]
Department of Animal and Range Sciences

CATTLE 90-4

Summary

Sunflower hulls were substituted for grass-alfalfa hay as the roughage component of finishing diets for yearling steers. Feed intake was lower when sunflower hulls were fed, resulting in reduced rate of gain and increased feed conversion. When diets were formulated to contain 12% NDF rather than 10% roughage, performance of steers fed either roughage source was similar. Sunflower hulls because of low cost can be used in finishing diets at 5% of dry matter intake without affecting production costs. Feeding higher levels of unprocessed sunflower hulls is discouraged.

(Key Words: Steers, Sunflower Hulls, Roughage, NDF.)

Introduction

The roughage source used in feedlot finishing diets represents a significant contribution to total diet costs. Roughage purchase cost/T is high during drought years. Cost per unit of energy or protein, storage losses and processing-handling costs of roughages are high relative to grains. Sunflower hulls (SFH) represent a low cost alternative roughage source. The raw product has a small enough particle size to accommodate mixing and feeding without further processing. Since the roughage component of high grain diets is poorly utilized as a nutrient source, the low nutritive value of SFH is of little concern. This experiment was designed to evaluate SFH as an alternative to mixed grass-alfalfa hay as the roughage for finishing steer diets.

Materials and Methods

Yearling crossbred steers, 128 head, initial weight 824 lb, were allotted to 16 pens of 8 head. Steers were fed a common receiving diet and were vaccinated for IBR, BVD, PI_3, RSV and 7-way clostridia a week before initiating this study. Initial and final weights were obtained following a 12-hour feed and water restriction. Final weights reported and gain calculations include a 4% pencil shrink. The steers were on test for 72 days. Test diets (Table 1) were offered at a maintenance intake level on day 1. Feed delivery was increased 10% every other day until feed refusals were evident. From that point, feed was offered to appetite.

Diets were formulated to contain either 10% roughage or 12% NDF for each roughage source (Table 1). Roughage composition values were mixed hay, 14.6%, crude protein, 57% NDF, 37% ADF and 13.7% ash; SFH 7.6% crude protein, 75% NDF, 60% ADF and 4.0% ash. The supplement was pelleted. Feed samples were obtained weekly to determine dry matter and NDF content.

Statistical analysis of data was completed using procedures appropriate for a 2 x 2 factorially arranged experiment. All data were analyzed on a pen mean basis using the general linear model procedure of SAS.

Results and Discussion

Roughage source affected average daily gains (3.31 vs 2.76 lb; $P<.0001$) daily dry matter intake (18.53 vs 16.89 lb per head; $P<.001$) and feed/gain (5.61 vs 6.16; $P<.01$) for hay and SFH diets, respectively. An interaction between roughage source and level existed for performance variables. This interaction could be attributed to the performance depression that occurred when diets contained 10% SFH (Table 2).

Lower feed intake can explain virtually all of the reduction in performance observed. It is beyond the scope of this experiment to determine if the lower intake of SFH diets was in response to poor palatability or other factors. The SFH used were not further processed. The hulls were brittle and had sharp edges that may have caused problems with prehension and mastication. The SFH were not sorted by steers, suggesting other factors may be involved. SFH are refractory and may have created a large ruminal indigestible fill component that might suppress feed intake.

[1]Associate Professor.
[2]Manager, Beef Cattle and Sheep Nutrition Unit.

TABLE 1. DIET FORMULATIONS[ab]

Roughage source	Mixed hay		Sunflower hulls	
Formulation	12% NDF	10% roughage	12% NDF	10% roughage
Whole shelled corn	26.65	25.72	27.43	25.60
High moisture corn	58.98	57.12	59.86	56.54
Hay	7.00	10.00		
Sunflower hulls			5.04	10.00
Molasses	2.00	2.00	2.00	2.00
Supplement				
Ground corn[c]	3.00	3.00	3.00	3.00
SBM, 44%[c]	.40	.40	.40	.40
Urea[c]	.46	.43	.62	.68
Calcium carbonate[c]	1.01	.93	1.15	1.16
Potassium chloride[c]	.25	.15	.25	.54
Trace mineralized salt[c]	.25	.25	.25	.25

[a] Percentage, dry matter basis.
[b] Diets provide 30 g/T lasalocid and 1,000 IU/lb vitamin A.
[c] Included as supplement.

TABLE 2. PERFORMANCE OF STEERS FED FINISHING DIETS THAT INCLUDED MIXED HAY OR SUNFLOWER HULLS

Roughage source	Mixed hay		Sunflower hulls		
Formulation	12% NDF	10% roughage	12% NDF	10% roughage	SEM
Initial weight, lb	826	826	820	823	1.9
Final weight, lb[abc]	1058	1071	1034	1006	3.8
ADG, lb[bc]	3.22	3.40	2.97	2.54	.05
DMI, lb/d[bc]	18.07	18.99	17.33	16.44	.20
F/G[bde]	5.62	5.59	5.83	6.50	.09
Feed cost/gain, cents/lb[f]	24.6	24.7	24.2	26.2	.37
Total cost/gain, cents/lb[f]	37.8	37.2	38.4	42.9	

[a] Includes a 4% pencil shrink.
[b] Roughage source effect (P<.01).
[c] Roughage source x level effect (P<.05).
[d] Roughage level effect (P<.10).
[e] Roughage source x level effect (P<.10).
[f] Includes feed, interest and yardage. Projected to constant final weight of 1071 lb.

Previous studies conducted in this feedlot indicated that 11 to 12% NDF may be optimum in finishing diets. There were no (P>.15) roughage level responses in this trial when considering main effects. Formulating for NDF would have restricted the use of SFH to 5% of the diet, avoiding the typical substitution of 10% roughage which resulted in unacceptable performance.

Optimum feedlot performance is a function of lowest production costs. Because of the lower cost of SFH feed cost per pound of gain was not higher when 5% SFH were fed. Feed cost/lb gain tended (P<.20) to be lower with diets formulated for 12% NDF than diets with 10% roughage.

Total feedlot cost of gain was calculated projecting a 1071-lb final weight for each group. Cattle purchase price accrued a 12% interest charge and daily yardage was set at 20 cents per head. Total cost of gain tended to be higher for the 10% SFH diets. The other three diets provided for similar production costs and therefore profit potential.

These data indicate SFH may be an acceptable roughage substitute. In our situation, hay cost $85/T to feed while SFH cost $35/T to feed. If substitution of alternative feeds for typical roughages is being considered, diet formulations and productions costs must be included in the evaluation process.

ALTERNATE DAY SUPPLEMENTATION OF CORN STALK DIETS FOR RUMINANTS WITH HIGH OR LOW RUMINAL ESCAPE PROTEIN SUPPLEMENTS

R. M. Collins[1] and R. H. Pritchard[2]
Department of Animal and Range Sciences

CATTLE 90-5

Summary

Two experiments were conducted to determine the effects of feeding soybean meal (SBM) and corn gluten meal (CGM) based, isonitrogenous supplements at 24- or 48-hour intervals on corn stalk utilization. Exp. 1. Yearling rams were fed either protein supplement as 100 g daily or 200 g on alternate days. DMI was lower (P<.10) for the CGM than SBM based supplements. Protein source and interval of feeding did not affect (P>.10) digestible dry matter intake (DDMI) or disappearance of dry matter (DMD), but an interaction was observed (P<.05) between protein source and interval of feeding. Nitrogen retention was greater for CGM (P<.10) and 48-hour supplementation (P<.01). However, an interaction between protein source and interval of feeding occurred (P<.10) for N retention. Exp. 2. Angus and Hereford x Anugs steers (119 head; 620 ± 1.9 lb) allotted to 8-head pens were fed similar diets except supplements (46% crude protein) also provided 0 (0M) or 200 (200M) mg per head per day monensin. CGM supported higher (P<.05) ADG and gain/feed (G/F) than SBM, but a protein by monensin interaction occurred (P<.10) for ADG and G/F. There was an interval by monensin interaction for ADG (P<.10) and DMI (P<.05). An interaction between protein and interval occurred for plasma urea N on day 1 (P<.01) and day 2 (P<.10) of the sampling period. CGM was an effective isonitrogenous substitute for SBM based supplements in these applications. Supplementation at 48-hour intervals supported higher N utilization. High intermittent dosages of monensin appeared detrimental to calf performance.

(Key Words: Escape Protein, Ruminants, Corn Stalks, Supplementation.)

Introduction

The use of low quality forages as a primary feed resource is important in beef cattle production. However, nutrient deficiencies, particularly protein, in low quality forages limit effective utilization by the animal. A protein supplementation program is usually necessary to meet the ruminal and animal requirements. Protein supplementation on alternate days does not adversely affect dry matter intake and digestibility, daily gain and N retention. However, supplementation programs using high protein supplements may be over supplying protein above that which can be assimilated by rumen microorganisms. The use of high escape protein sources may reduce N loss associated with rumen degradable protein sources and improve daily gain and feed efficiency when low quality forages are fed.

Practical use of high escape protein supplements depends on palatability, animal performance and cost effectiveness. In recent years, monensin has been incorporated into range protein supplements. Monensin improves daily gain and feed efficiency but also reduces palatability.

This research was conducted to determine (1) the effect of protein source (soybean meal vs corn gluten meal) and interval (24 vs 48 hours) of supplementation of corn stalk diets on dry matter disappearance and N balance of lambs and (2) the effect of these supplement regimes with and without supplemental monensin on corn stalk utilization by growing steers.

Materials and Methods

Exp. 1. Twenty yearling Hampshire rams (128 ± 1.7 lb) were blocked by weight and randomly allotted to treatments in a N balance study. Treatments consisted of (1) soybean meal (SBM) fed daily (SBM24), (2) SBM fed on alternate days (SBM48), (3) corn gluten meal (CGM) fed daily (CGM24) and (4) CGM fed alternate days (CGM48). Supplements (Table 1) were top dressed on a basal diet of ground corn stalks. Diets were formulated to contain 8% crude protein. The 45% crude protein supplements were fed at 100 g/head daily (24 hours) or 200 g/head on alternate days (48 hours). Rams were housed under constant lighting

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[1]Graduate Assistant.
[2]Associate Professor.

TABLE 1. FORMULATION OF SOYBEAN MEAL AND CORN GLUTEN MEAL SUPPLEMENTS (EXP. 1)

Ingredients[a]	SBM[b]	CGM[b]
Corn gluten meal	--	66.70
Soybean meal	92.01	--
Dicalcium phosphate	3.37	3.37
Trace mineral salt[c]	3.37	3.37
Vitamins A, D, E premix[d]	.22	.22
Vegetable oil	.51	.51
Lasalocid[e]	.51	.51
Corn starch	--	25.31

[a] Percent, dry matter basis.
[b] Supplements differ only by interval of feeding (24 vs 48 hours).
[c] Contained 96% NaCl, .350% Zn, .28% Mn, .175% Fe, .035% Cu, .007% I and .007% Co.
[d] Contained 1,200,000 IU/lb vitamin A, 50,000 IU/lb vitamin D and 1,000 IU/lb vitamin E.
[e] Added as a coccidiostat.

and temperature (72 °F). Two rams had to be removed from the experiment because of problems unrelated to treatment.

Rams were adapted to diets for 23 days in individual slotted floor metabolism stalls and 3 days in elevated metabolism crates. Two consecutive 8-day periods followed in which urine and feces were collected, subsampled and frozen for later analysis. Feed refusals were weighed daily and refed. Orts were collected at the end of the 16-day period and frozen for later analysis. Corn stalks were fed at 85% of previously established ad libitum intake. All feed, refusals and fecal samples were analyzed for dry matter (DM), Kjeldahl N, ADF and NDF (Table 2). Urine samples were analyzed for Kjeldahl N.

Data were analyzed as a 2 x 2 factorial arrangement in a randomized complete block design using GLM procedures in SAS and least square means for unequal cell sizes. Main effects were protein source, interval of feeding and replication. Interactions were calculated with dry matter intake as a covariate.

Exp. 2. One hundred twenty Angus and Hereford x Angus steer calves (620 $\pm$ 1.9 lb) were utilized in a 56-day steer performance study from December 12, 1989, to February 6, 1990. Steers were stratified by weight and allotted to treatments (1) soybean meal (SBM) fed daily without monensin (SBM24-0M), (2) SBM fed daily with monensin (SBM24-200M), (3) SBM fed alternate days without monensin (SBM48-0M), (4) SBM fed alternate days with monensin (SBM48-200M), (5) corn gluten meal (CGM) fed daily without monensin (CGM24-0M),(6) CGM fed daily with monensin (CGM24-200M), (7) CGM fed alternate days without monensin (CGM48-0M) and (8) CGM fed alternate days with monensin (CGM48-200M). Diets were formulated to contain 10% crude protein but, because of low intakes during the adaptation period, were adjusted to 14.47% crude protein. The 46% crude protein supplements (Table 3) were fed at 24.2% of the diet and top dressed on a basal diet of ground corn stalks. During the period of feed refusals, average temperatures were below 0 °F. One steer was removed from the study after developing polio encephalomalacia. One pen was deleted from the data set because of low feed intakes.

Initial and final weights were obtained on 2 consecutive days. Blood samples were taken prior to feeding on day 34 (day 1) and 35 (day 2) for all steers. Supplementation at 48-hour intervals was offered on day 1. Plasma was separated and frozen for urea-N analysis. Feed samples were analyzed for Kjeldahl N, NDF and ADF (Table 4).

TABLE 2. COMPOSITION OF FEED INGREDIENTS (EXP. 1)

		Supplements	
Item[a]	Corn stalks	SBM	CGM
Dry matter	85.64	89.04	91.02
Crude protein	3.74	44.02	46.23
Neutral detergent fiber	69.47	14.42	12.78
Acid detergent fiber	47.12	8.26	8.40

[a]Expressed as percent dry matter, except dry matter.

TABLE 3. FORMULATION OF SOYBEAN MEAL AND CORN GLUTEN MEAL SUPPLEMENTS (EXP. 2)

Ingredients[a]	SBM[b]	CGM[b]
Corn gluten meal	--	68.49
Soybean meal	94.03	--
Cracked corn	--	25.55
Trace mineral salt[d]	2.52	2.52
Dicalcium phosphate	2.52	2.52
Animal fat	.92	.92

[a] Percent, dry matter basis.
[b] Supplements differ by frequency (24 vs 48 hours) and monensin (0 vs 200 mg per head per day).
[c] Contained 920 IU/lb vitamin A and 8.37 IU/lb vitamin E.
[d] Contained 96% NaCl, .350% Zn, .28% Mn, .175% Fe, .035% Cu, .007% I and .007% Co.

Data were analyzed as a 2 x 2 x 2 factorial arrangement in a completely random block design using GLM procedures in SAS with least square means utilized because of uneven cell sizes. Main effects were protein source, interval of feeding and monensin and the calculated interactions. Initial weight was used as a covariate.

Results and Discussion

Exp. 1. Apparent digestible dry matter intake (DDMI) and disappearance of DM (DMD) are shown in Table 5. SBM and CGM intake supplied 39.20 and 42.08 g per day crude protein (dry matter basis) and 78.40 and 84.16 g per alternate day crude protein (dry matter basis) for SBM24, CGM24, SBM48 and CGM48, respectively. DMI was affected ($P<.10$) by protein source, 1010 vs 875 g/day for SBM and CGM diets, respectively. Some individual animal acceptance problems with the CGM supplements may partially explain the lower DMI of CGM24 and CGM48 diets. DMD, DDMI and ND were not affected ($P>.10$) by protein source or interval of feeding. An interaction between protein source and interval of feeding occurred for DMD and DDMI ($P<.05$) and ND ($P<.10$). The

TABLE 4. COMPOSITION OF FEED INGREDIENTS (EXP. 2)

Item[a]	Corn stalks	Supplements SBM	Supplements CGM
Dry matter	78.40	89.28	90.30
Crude protein	2.96	41.94	48.36
Neutral detergent fiber	75.73	13.63	12.29
Acid detergent fiber	56.19	7.52	7.10

[a] Expressed as percent dry matter, except dry matter.

TABLE 5. EFFECT OF PROTEIN SOURCE AND INTERVAL OF FEEDING ON APPARENT DIGESTIBLE DRY MATTER INTAKE, DISAPPEARANCE OF DRY MATTER AND NITROGEN (EXP. 1)

Item	Treatments[a] SBM24	SBM48	CGM24	CGM48	SEM
No. of animals	4	4	5	5	
Dry matter intake[b]	1004	1017	833	917	80.70
Digestible dry matter intake, g/day[c]	577	534	535	564	15.31
Disappearance, %					
Dry matter[c]	62.05	57.36	57.60	60.59	1.59

[a] Least square means.
[b] Protein ($P<.10$).
[c] Protein x interval effect ($P<.05$).

poorer utilization of SBM48 and CGM24 may be attributable to relative rates of ruminal protein degradation and escape. SBM48 appears to be causing a N deficit on day 2, wehre CGM24 may be limiting daily N availability. Urinary N output was affected (P<.10) by protein source on day 1 and interval of feeding (P<.01) on day 2 of the supplementation periods. An interaction occurred (P<.10) between protein source and interval of feeding on day 1 and were 6.91, 7.34, 6.90 and 6.12 g/day N for SBM24, SBM48, CGM24 and CGM48, respectively. Protein source affected (P<.10) N retention. However, there was an interaction (P<.10) between protein source and interval of feeding (Table 6).

Exp. 2. Crude protein content of corn stalks was lower than tabular values (Table 4), partially explaining the need to increase the amount of supplemental protein fed. DMI for treatments were different (P<.10) due to interval of feeding (Table 7), but an interval by monensin interaction (P<.05) occurred. DMI (1.72% of body weight) was within expected values for low quality forages, indicative of a slower rate of passage and increased gut fill. There was a protein source effect (P<.05) on ADG (.55 vs 1.00 lb/day) and gain/feed (4.97 vs 9.50 lb/cwt) for SBM vs CGM, respectively. Interval affected (P<.10) DMI which were 11.18 vs 10.24 lb/day for 24 and 48 hours, respectively. Monensin supplementation did not affect (P>.10) steer performance. An interaction occurred (P<.10) between protein source and monensin for ADG and G/F (Table 7). CGM with or without monensin caused increased feed efficiency over SBM, but the addition of monensin to CGM was detrimental. The increased intestinal supply of dietary protein from CGM may be supporting improved amino acid uptake and utilization. An interaction occurred for interval of feeding and monensin for ADG (P<.10) and DMI (P<.05) [Table 7]. ADG and DMI were lower when monensin was fed at 48-hour but not 24-hour intervals. At 48-hour intervals, monensin was offered at 400 mg on the day supplements were fed. This suggests dose related ruminal inhibition. A protein source effect on plasma urea nitrogen (PUN) occurred (P<.01) for day 1 (11.73 vs 13.47) and day 2 (17.89 vs 12.98) of the sampling period for SBM and CGM, respectively. Also, an interval effect on PUN occurred for day 1 (13.96 vs 11.25; P<.01) and day 2 (16.08 vs 14.79; P<.10) for 24 or 48-hour intervals, respectively. However, an interaction occurred for protein and interval on day 1 (P<.01) and day 2 (P<.10) of the sampling period (Table 7). Feeding at 48 hours resulted in lower PUN concentrations on day 1, suggesting a greater loss of N from the body, whereas CGM fed at 48 hours between days 1 and 2 remained relatively constant. No differences in PUN concentration were observed due to monensin, although an interaction occurred (P<.05) between interval and monensin for day 1 (Table 7). This may be due to a protein sparing effect from the presence of monensin.

The low DMI in these studies are indicative of the high structural fiber content in corn stalks. These data suggest that CGM fed at 48-hour intervals supports improved N efficiency and disappearance of DM and N when compared to SBM fed at 48-hour intervals. CGM fed without monensin to steers supported higher feed efficiency and ADG. Regardless of the presence of monensin, CGM supported steer performance comparable to or better than that of SBM. The intermittent dosage of monensin in this study reduced DMI and ADG, which may be attributable to a reduction in palatability and inhibition of rumen microorganisms. The supplemental protein with monensin in this study provided 400 mg/head on alternate days in which reduced performance was observed. Further studies are needed to determine optimal dosage of monensin with alternate day supplemental protein regimens.

TABLE 6. EFFECT OF PROTEIN SOURCE AND INTERVAL OF FEEDING ON NITROGEN UTILIZATION (EXP. 1)

Item	Treatments[a]				SEM
	SBM24	SBM48	CGM24	CGM48	
No. of animals	4	4	5	5	
N digestion, %[b]	61.80	59.00	59.50	62.06	1.42
Nitrogen balance, g/day					
N intake	11.96	12.68	11.46	12.18	.50
Fecal N	4.84	5.50	4.37	4.58	.49
Urine N[c]	6.75	6.20	6.64	5.26	.37
N retained[bcd]	.37	.97	.45	2.34	.38
N retained/N intake, %[bcd]	2.96	7.38	3.62	19.32	3.25

[a] Least square means.
[b] Protein by interval effect (P<.10).
[c] Interval effect (P<.05).
[d] Protein effect (P<.10).
[e] Interval effect (P<.01).

TABLE 7. EFFECT OF TREATMENT ON STEER PERFORMANCE AND PLASMA UREA NITROGEN (EXP. 2)[a]

Item	SBM				CGM				
	24-0M	24-200M	48-0M	48-200M	24-0M	24-200M	48-0M	48-200M	SEM
Dry matter intake, lb/day[bc]	9.73	12.66	11.77	9.27	11.64	10.68	11.19	8.72	.81
Average daily gain, lb/day[def]	.02	.97	.78	.43	1.35	.94	1.11	.59	.23
Gain/feed, lb/cwt[de]	.25	7.86	6.92	4.86	12.17	8.72	10.13	6.98	.02
Plasma urea nitrogen, mg/dl									
Day 1[cghi]	15.58	14.44	8.11	8.80	13.16	12.66	12.73	15.37	1.11
Day 2[ghj]	17.65	18.17	17.61	18.14	14.97	13.51	11.96	11.46	1.30

[a] Least square means.
[b] Interval effect (P<.05).
[c] Interval by monensin interaction (P<.05).
[d] Protein effect (P<.05).
[e] Protein by monensin interaction (P<.10).
[f] Interval by monensin interaction (P<.10).
[g] Protein effect (P<.01).
[h] Interval effect (P<.01).
[i] Protein by interval interaction (P<.01).
[j] Protein by interval interaction (P<.10).

EVALUATION OF CONTROLLED RELEASE CHROMIC OXIDE BOLUSES AND ALKALINE HYDROGEN PEROXIDE LIGNIN AS MARKERS TO DETERMINE INTAKE OF COWS FED MATURE PRAIRIE HAY

P. A. Momont[1], R. J. Pruitt[2], R. J. Emerick[3] and R. H. Pritchard[2]
Departments of Animal and Range Sciences and Chemistry

CATTLE 90-6

Summary

A digestion trial involving 8 mature cows fed mature prairie hay ad libitum was conducted to determine the validity of controlled release chromic oxide (Cr) and alkaline hydrogen peroxide lignin (APL) as markers for prediction of forage intake by the fecal output (FO)/indigestibility ratio technique. Seven days after oral administration of Cr boluses, total FO was collected daily, weighed and sampled. Rectal fecal grab samples were collected at 10:00 a.m. each day and at 4-hour intervals on day 4 of collections. Mean fecal Cr output based on total fecal collections was 1,662 mg Cr/day compared to a manufacturer's suggested value of 1,505 mg Cr/day. Based on forage and fecal APL levels, mean fecal APL recovery was 95.9%. Increasing the number of days that grab samples were composited raised R^2 values between actual FO and dry matter digestibility (DMD) and those predicted using fecal Cr and APL concentration (R^2 = .56, .70, .77, .79 and .82; .27, .55, .61, .67 and .70 for 1- to 5-day composites for FO and DMD, respectively). With samples composited over the entire 5-day collection period, predicted FO, (DMD) and dry matter intake (DMI) were similar (paired t-test) to actual values. Fecal grab samples and total fecal collection samples, composited over 5 days, provided a similar relationship (R^2 = .71) between actual and predicted DMI. Fecal Cr and APL concentrations were not affected by sampling time of day. Results from this study indicate that grab samples collected once daily and composited over 5 consecutive days can be used to predict FO when controlled release chromic oxide boluses are used. While accuracy of DMD estimations was not as high as that of FO, APL was nearly 100% recoverable and resulted in reliable predictions of DMD and DMI.

(Key Words: Markers, Chromic Oxide, Alkaline Hydrogen Peroxide Lignin, Intake, Digestibility.)

Introduction

Effective research procedures to determine forage digestibility and intake of grazing animals would contribute greatly to understanding the effects of management and supplementation practices on animal performance. To estimate dry matter intake (DMI), the following equation can be used: DMI = Fecal output (FO)/(1-digestibility). More precise estimations of FO and DMD have been made with recently developed internal (alkaline hydrogen peroxide lignin, APL) and external (controlled release chromic oxide, Cr) marker procedures. The objectives of this study were to evaluate APL and Cr for estimating FO, DMD and DMI of cows consuming mature prairie hay.

Materials and Methods

Eight mature cows (mean weight = 1,389 lb ± 34) fed mature prairie hay ad libitum were maintained in individual pens for a 5-day DMI measurement and fecal collection period. On day 7 of a 14-day intake stabilizing period preceding fecal collections, controlled release chromic oxide (Cr) boluses (Captec Chrome, NuFarm Industries, Aukland, New Zealand) were orally administered. Boluses were designed to release 1,505 mg Cr/day (Manufacturer's test completion date = 12/12/88, batch #81122-8). Prairie hay was fed twice daily at a level approximately 10% above ad libitum intake. Composition of the mature prairie hay is listed in Table 1. Individual orts were weighed and refed each day. Final orts were weighed and sampled at the end of the trial. Total fecal collections were accomplished by scraping concrete floors of each pen a minimum of four times a day. Daily total FO was weighed, mixed and sampled. Rectal fecal grab samples were taken at 10 a.m. each day and at 4-hour intervals on day 4 of collections. All fecal samples were weighed and frozen (-30 °C) for later analytical

[1]Graduate Assistant.
[2]Associate Professor.
[3]Professor.

TABLE 1. CHEMICAL AND SPECIES COMPOSITION OF PRAIRIE HAY CONSUMED BY COWS[a]

Item	Percent
Dry matter	84.1
Crude protein	5.8
Neutral detergent fiber	70.2
Acid detergent fiber	39.0
Alkaline hydrogen peroxide lignin	1.57
Calcium	.40
Phosphorus	.11
Sulfur	.10
Western wheatgrass (*Agropyron smithii*)[b]	65.0 ± 10.0
Japanese brome (*Bromus japonicus*)[b]	35.0 ± 11.0
Unidentified forage[b]	2.0 ± 3.0

[a] Percent dry matter basis.
[b] Mean and SD from 15 samples.

procedures. Feed, final orts, and fecal samples were oven dried at 60 °C and ground (1-mm screen). Fecal Cr concentrations were determined by a microdigestion-oxidation procedure and flame atomic absorption spectrophotometry. Prairie hay and fecal APL concentrations were analyzed by an alkaline peroxide predigestion followed by standard lignin procedures. Equations used in the process of estimating DMI are listed in Table 2.

Predicted minus actual values (FO, DMD and DMI) were generated as dependent variables. Coefficients of determination (R^2) were determined by regressing predicted over actual FO, DMD and DMI values using General Linear Model procedures of the Statistical Analysis System. These regressions were conducted by progressively compositing data from collection days 1 to 5 for fecal grab samples and total fecal collection samples. Predicted and actual values

TABLE 2. EQUATIONS USED WITH MARKER PROCEDURES IN PROCESS OF DRY MATTER INTAKE ESTIMATIONS[a]

$$\text{Cr excretion rate, mg/day} = (\text{mg Cr/g fecal DM}) \times (\text{g fecal DM output/day})$$

$$\text{Percent APL recovery} = \frac{(\text{percent fecal APL}) \times (\text{g fecal DM/day})}{(\text{percent dietary APL})^{b} \times (\text{g DMI/day})}$$

$$\text{Predicted fecal DM output g/day} = \frac{(\text{mean Cr excretion rate, mg/day})^{c}}{(\text{mg Cr/g fecal DM})}$$

$$\text{Predicted DM indigestibility} = \frac{(\text{percent dietary APL})}{(\text{percent fecal APL})}$$

$$\text{Predicted DMI} = \frac{(\text{predicted fecal DM output, g/day})}{(\text{predicted DM indigestibility})}$$

[a] Cr = Cr_2O_3, APL = alkaline peroxide lignin.
[b] Mean dietary APL = 1.57%.
[c] Mean excretion rate = 1,662 mg Cr/day.

were also compared using Means procedure with the paired t-test option (SAS, 1985). Fecal APL and Cr concentrations were regressed over sampling time of day (quartic to linear responses were tested). Sampling time was also used as a discrete independent variable to generate least squares means. Mean separation was accomplished using the Least Significant Difference procedure.

Results and Discussion

Mean Cr excretion rate from cows was 1,662 mg Cr/d ± 63 with a range from 1487 to 2,020 mg Cr/day. Manufacturer's reported release rate for this allotment of boluses was 1,505 mg Cr/day. Mean APL fecal recovery from cows was 95.9% ± 3.2 ranging from 81 to 106%.

No diurnal variation of fecal Cr or APL excretion was detected (Figure 1). Based on polynomial regression, sampling time of day did not affect (P>.69, quartic to linear responses tested) fecal Cr or APL concentrations. Mean fecal Cr concentration for the eight cows on day 4 was 42.2 µg/g and fecal Cr concentration at each 4-hour interval was not affected by sampling time of day (P=.97). Mean fecal APL concentration was 4.9% ± .24 and fecal APL did not differ over sampling time (P=.94).

Accuracy of predicting FO, DMD and DMI was improved by increasing the number of days that samples were collected and composited (Figures 2 and 3). The R^2 values represent the percent of the variation associated with actual FO, DMD or DMI that can be accounted for by their respective predicted values. Increases in R^2 values between predicted and actual FO, DMD and DMI diminished with additional sampling days.

Predicted FO from Cr concentrations were closely related to actual FO. Using 5-day composited samples, high R^2 values for both fecal grab samples and samples from total collections were determined (.82 and .85, respectively). Lower R^2 values between actual DMD and DMD predicted from APL concentrations (R^2 = .70 and .65., for 5-day fecal grab and subsamples) resulted in reduced accuracy of DMI estimations (R^2 = .71 and .71 for grab and total collection samples). Predicted minus actual FO, DMD and DMI values were not different from zero (Table 3).

These results indicate that grab samples collected once daily on 5 consecutive days can be composited and used with high accuracy to predict FO when controlled release Cr boluses are used. This technique has the potential to reduce animal handling time, stress and disruption of animal grazing patterns compared to twice daily administration of Cr gelatin capsules. While mean recovery of APL in the feces was nearly 100%, accuracy of digestibility estimates using APL as an internal marker was not as high and influenced predictions of DMI.

TABLE 3. RELATIONSHIPS BETWEEN ACTUAL AND PREDICTED FECAL OUTPUT, APPARENT DRY MATTER DIGESTIBILITY AND DRY MATTER INTAKE

Item	Actual	Predicted	Difference[a]	Probability[b]
Fecal grab samples				
FO, lb	9.3	9.6	.3 ± .4	.49
DMD, %	58.9	56.5	-2.4 ± 1.8	.21
DMI, lb	22.7	22.0	-.6 ± .9	.49
Daily fecal subsamples				
FO, lb	10.0	9.9	-.03 ± .07	.94
DMD, %	56.0	55.5	-.5 ± 2.2	.85
DMI, lb	22.7	22.3	-.3 ± .7	.63

[a] Predicted minus actual and SEM.
[b] Probability that mean difference is different from zero.

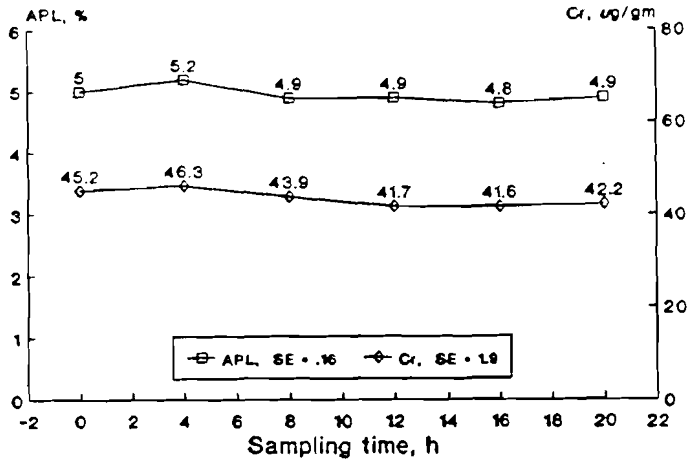

Figure 1. Effect of sampling time on fecal chromic oxide and alkaline hydrogen peroxide lignin concentrations.

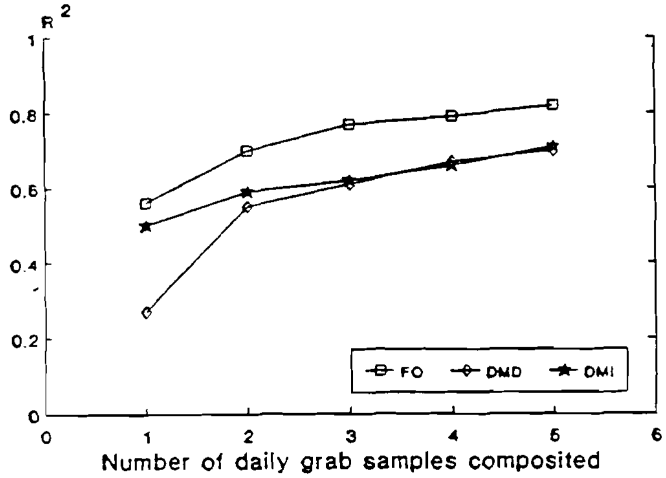

Figure 2. Effect of number of daily fecal grab samples composited on accuracy of FO, DMD and DMI predictions.

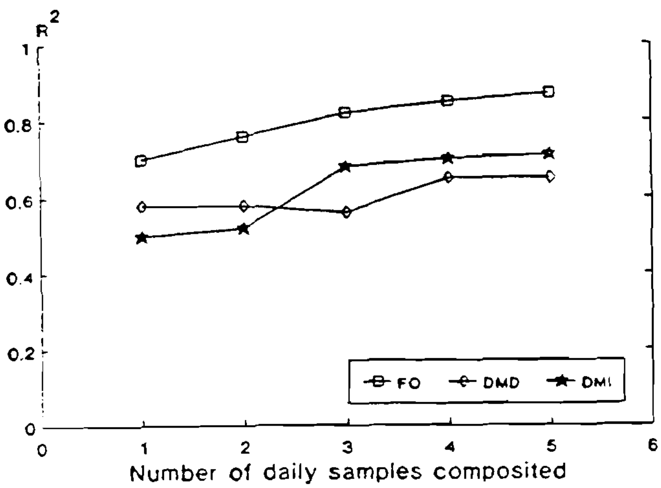

Figure 3. Effect of number of daily fecal samples composited from total collections on FO, DMD and DMI predictions.

HYDROLYZED FEATHER MEAL SUPPLEMENTATION FOR LACTATING RANGE COWS

P. A. Momont[1], R. J. Pruitt[2] and T. Weber[3]
Department of Animal and Range Sciences

CATTLE 90-7

Summary

A 2-year study involving 178 cow/calf pairs was conducted to evaluate hydrolyzed feather meal[4] as a protein supplement for cows grazing native range during early lactation. Calving season occurred from mid-March until late April. Within a week after calving, cows were fed either a soybean meal or feather meal-corn supplement that provided approximately .83 lb crude protein per cow daily. Cow weight and condition score changes from calving until early May and percentage of cows cycling early in the breeding season (early June) were similar between supplement groups. Calf average daily gains from birth until May were not affected by supplement fed to cows. In this study, supplementing lactating cows with hydrolyzed feather meal resulted in similar performance, regardless of cow age, as supplementing with soybean meal.

(Key Words: Supplementation, Hydrolyzed Feather Meal, Range Cows, Protein, Lactation.)

Introduction

Research indicates that methionine, a sulfur-containing amino acid, is one of the first limiting amino acids for milk production and animal growth. Supplementing lactating cows with a protein source that provided this limiting amino acid to the small intestine may increase milk levels, weight gains and improve reproductive performance. Hydrolyzed feather meal is 85 to 95% crude protein and high in the sulfur-containing amino acids methionine and cystine. Feather meal is also relatively undegraded (70% rumen escape) in the rumen and it could be expected that a greater percentage of those amino acids would be presented intact to the small intestine where they could be absorbed and used for milk synthesis. The objective of this study was to evaluate hydrolyzed feather meal as a protein supplement for beef cows grazing native range during early lactation.

Materials and Methods

One hundred seventy-eight cow/calf pairs wintered on native range at the SDSU Range and Livestock Research Station near Cottonwood were fed either a soybean meal or hydrolyzed feather meal-corn supplement (Table 1) during early lactation.

TABLE 1. SUPPLEMENTS FED LACTATING COWS[a]

Ingredient	Soybean meal	Feather meal
Soybean meal	93.0	--
Corn	--	48.0
Hydrolyzed feather meal	--	39.0
Liquid molasses	5.0	5.0
Sodium sulfate	1.0	--
Sodium bentonite	1.0	5.0
Potassium chloride	--	2.5
Dicalcium phosphate	--	.5

[a] Percent, as fed basis.

Supplements were formulated to provide .83 lb crude protein per cow daily and were balanced for energy, calcium, phosphorus, potassium and sulfur. Actual nutrient composition of supplements as determined by laboratory analysis are reported in Table 2. Equal amounts of prairie grass hay were fed to cows on each treatment when weather prevented grazing. Simmental x Angus cows calved from mid-March to late April. Calves were sired by Simmental and Angus bulls. During the second year, thirty-five 2- and 3-year-old cows were included in the study. Within a week after calving, cows were weighed (after overnight feed and water removal), condition scored (1-9, 1 = severely emaciated) and allotted by calving date and within cow

[1]Graduate Assistant.
[2]Associate Professor.
[3]Superintendent, Range and Livestock Research Station, Philip.
[4]Thanks to Central Bi-Products, Redwood Falls, MN, for donating the hydrolyzed feather meal.

TABLE 2. POUNDS OF NUTRIENTS PROVIDED LACTATING COWS[a]

	Supplement	
Item	Soybean meal	Feather meal
Crude protein	.77	.82
Calcium	.0069	.0077
Phosphorus	.0104	.0075
Potassium	.0413	.0361
Sulfur	.0106	.0160
Methionine + cystine	.0258	.0571
Mcal ME[b]	2.37	2.40

[a] Lb per head daily.
[b] Calculated values.

age to supplemental treatments. Pasture groups were rotated every 10 to 15 days over the treatment period. In early May, shrunk weights on two consecutive days and cow condition scores were recorded. Calves were weighed within 24 hours of birth, in early May and at weaning in late October. For the first year, two blood samples taken 8 days apart from cows in early June were used to determine cyclic activity. Cows with greater than 1.0 ng progesterone per ml of serum (determined by radioimmunoassay) in either sample were considered to be cycling. Estrus was determined by visual observation during the second year. Pregnancy was determined by rectal palpation in late October.

Data were analyzed by least squares procedures using General Linear Model procedure of the Statistical Analysis System. For the second year, treatment, cow age, calf sex and treatment x cow age were included as independent variables in each model with calving date as a covariate. Data for mature cows was then combined over the two year study and analyzed separately, with cow age and supplemental treatment x cow age variables excluded from the model.

Results and Discussion

Hydrolyzed feather meal supplemented cows had similar early lactation weight and condition score changes compared to cows supplemented with soybean meal (Tables 3 and 4). No differences in the percentage of cows cycling early in the breeding season or pregnant in late October were observed for the different supplement groups. Hydrolyzed feather meal did not appear to affect milk production of mature cows as indicated by calf weight gains during early lactation or adjusted calf weaning weights in late October. During the second year when 2- and 3-year-old cows were included in the experiment, supplemental treatment x cow age interactions were not significant for cow or calf weight changes. Although weight gains from birth to early May tended to be higher ($P=.14$) for calves of 2- and 3-year-old cows fed hydrolyzed feather meal, this trend was observed with a limited number of animals.

Potential benefits in increased cow and/or calf weight gains or cow reproductive performance by feeding a bypass protein high in sulfur containing amino acids were not observed in this study.

TABLE 3. EFFECTS OF SUPPLEMENTATION ON MATURE COW PERFORMANCE

Item	Supplement: Soybean meal	Supplement: Feather meal
No. of cows	72	71
Cow weight following calving, lb	1186	1180
Cow condition score at calving	6.1	6.0
Calf birth weight, lb	90	89
Cow weight change, lb		
Calving - early May	-40	-39
Cow condition score, early May	5.5	5.4
Percent cows cycling,		
early June	88.1	86.0
Percent cows pregnant, Fall[a]	91.9	91.1
Calf weight change, lb/day		
Birth - early May	2.37	2.44
Calf weaning weight[ab]	627	621

[a] Data from first year only.
[b] Weight adjusted for sex and age of calf.

TABLE 4. EFFECTS OF SUPPLEMENTATION ON 2- AND 3-YEAR-OLD COW PERFORMANCE

Item	Supplement: Soybean meal	Supplement: Feather meal
No. of cows	17	18
Cow weight following calving, lb	1002	966
Calf birth weight, lb	80	78
Cow weight change, lb		
Calving - early May	-13	-27
Percent cows cycling,		
early June	72.4	74.3
Calf weight change, lb/day		
Birth - early May	1.67	2.00

WHOLE PLANT FABA BEAN SILAGE AS A COMPONENT OF GROWING STEER DIETS

J. J. Wagner[1], H. Nantoume[2], R. Hanson[3] and D. R. Sorenson[4]
Department of Animal and Range Sciences and
Southeast Experiment Farm

CATTLE 90-8

Summary

Whole plant faba bean silage was compared to corn-alfalfa silage as a roughage source in 30% roughage growing steer diets. When the proportion of faba bean silage was increased from 0 to 10, 20 and 30%, respectively, daily feed intake, average daily gain and feed conversion of the steers were 18.32, 18.38, 18.23, 19.13 lb per head; 3.66, 3.42, 3.39, 3.57 lb per head; and 5.01, 5.38, 5.37 and 5.36, respectively. Substitution of faba bean silage for corn-alfalfa silage in a 30% forage diet had no significant (P<.05) effect on feed intake, weight gain and feed efficiency for growing steers.

(Key Words: Steers, Faba Beans, Drought Corn Silage, Feedlot.)

Introduction

Faba beans are a cool season, frost resistant, annual legume adapted to short growing seasons. Faba bean production is new in South Dakota and the extent of adaptation is not well known. Experimental plantings have been grown at the Southeast South Dakota Experiment Farm near Beresford.

The plant grows erect and possesses excellent stalk strength which facilitates harvest as silage. Under optimum conditions, the plant may reach 6 to 8 feet in height and yield 4 tons of high protein dry matter per acre. The yield potentials and the high protein content of the crop suggest that the whole plant could be an economical feed when used as a silage.

The objective of this research was to determine the nutritive value of whole plant faba bean silage compared with corn-alfalfa silage for growing steers.

Materials and Methods

Feeding Trial. Approximately 15 acres of faba beans were planted on April 14, 1988, at the Southeast South Dakota Experiment Farm near Beresford. The crop was cut July 13, 1988, at the stage of pod formation, wilted to approximately 30% dry matter, chopped and ensiled.

Because of drought, alfalfa hay production at the farm was limited. In addition, several acres of corn were extremely stressed due to heat and started to dry in the field. Therefore, another silage was made from 80% immature corn plant and 20% alfalfa hay on an as is basis. Chopped alfalfa hay (15% moisture) was added to the chopped corn to obtain the proper moisture (approximately 65%) for silage making. Both silages were stored using Ag Bag[5] plastic bags. Samples of ensiled forages were obtained on August 10, 1988, for chemical analysis.

Sixty-four, fall-born, crossbred steer calves were shipped to the Southeast Farm from northeastern Oklahoma in mid-July. The calves were fed a standard receiving diet (50% dry rolled corn, 50% ground grass hay) for 21 days. On August 9, feed and water were withheld overnight (16 hours) and the steers were weighed and randomly allotted to eight pens.

Ad libitum amounts of each of the four diets (Table 1) were fed to two pens of steers per diet. The whole plant faba bean silage available was sufficient only to feed the steers for 46 days from August 10 to September 15. Upon completion of the trial, steers were withheld from feed and water overnight (16 hours) and weighed.

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[1]Assistant Professor.
[2]Former Graduate Student.
[3]Former Herdsman, Southeast South Dakota Experiment Farm, Beresford.
[4]Manager, Southeast South Dakota Experiment Farm, Beresford.
[5]Alberta Ag Industry, Agripac, West Lock Alberta, Canada.

TABLE 1. DIETS USED TO FEED STEERS

Item	Level of faba bean silage			
	0	10%	20%	30%
Ingredient[a]				
Corn-alfalfa silage	30.00	20.00	10.00	0
Faba bean silage	0	10.00	20.00	30.00
Corn grain	67.15	67.19	67.23	67.27
Hi-Cal mineral[b]	2.84	2.11	1.37	.64
Supplement[c]	.01	.71	.40	2.09
Composition[ad]				
Dry matter[e]	57.20	57.15	57.17	57.15
Crude protein	12.00	12.00	12.00	12.00
Neutral detergent fiber	21.34	21.08	20.81	20.54
Calcium	1.26	1.05	.84	.64
Phosphorus	.43	.41	.39	.36
Potassium	1.01	1.13	1.25	1.38

[a] Percentage of dry matter.
[b] Product of Zip Feeds, Inc., Sioux Falls, SD. Contains 30% Ca, 5% P, 5% NaCl, .001% Co and 50,000 IU/lb vitamin A.
[c] Product of Zip Feeds, Inc., Sioux Falls, SD. Contains 32% crude protein, 3.5% Ca, 1% P, .0268% Zn and 50,000 IU/lb vitamin A.
[d] Calculated composition.
[e] Percentage of as-fed.

Data were analyzed according to analysis of variance procedures as a completely randomized design. Treatment means were compared by orthogonal contrasts. Linear, quadratic and cubic effects of treatment were tested.

Results and Discussion

The chemical analyses of both silages fed during the trial are shown in Table 2. The high crude protein content of the corn-alfalfa silage reflects the immaturity of the corn and the excellent quality of alfalfa used to make the silage. Mixing alfalfa hay with the silage was necessary to obtain the proper moisture content for the ensiling process. However, an added benefit appears to be a boost in crude protein content.

Performance of steers is shown in Table 3. Substitution of faba bean silage for corn-alfalfa silage had no effect on daily dry matter intake, average daily gain or feed conversion. Steers consumed about 18.5 lb dry matter daily, gained at 3.51 lb per head daily and required 5.27 lb dry matter per pound of gain.

Production of corn-alfalfa silage appears to be an acceptable strategy to salvage a drought stressed corn crop early prior to significant dry matter losses in the field. Faba bean silage appears to be a useful forage for growing calves. The decision to use faba beans should be based on agronomic or economic factors rather than cattle performance.

TABLE 2. CHEMICAL COMPOSITION OF FABA BEAN AND CORN-ALFALFA SILAGES FED TO STEERS[a]

Item	Faba bean silage	Corn-alfalfa silage
Dry matter[b]	31.58	32.65
Crude protein	15.10	17.60
Acid detergent fiber	34.60	38.90
Neutral detergent fiber	48.30	49.90
Calcium	1.11	1.14
Phosphorus	.37	.28
Magnesium	.56	.25
Potassium	3.60	2.52

[a] Percentage of dry matter.
[b] Percentage, as-fed basis.

TABLE 3. PERFORMANCE OF STEERS AS INFLUENCED BY LEVEL OF FABA BEAN SILAGE

	Level of faba bean silage, %			
Item	0	10	20	30
Initial wt, lb	668	668	659	637
Average daily gain, lb/head	3.66	3.42	3.39	3.57
Daily DM[a] intake, lb/head	18.32	18.38	18.22	19.13
Feed/gain	5.01	5.38	5.37	5.36

[a] Dry matter.

INTERRELATIONSHIPS OF HEIFER MILK PRODUCTION AND OTHER BIOLOGICAL TRAITS WITH PRODUCTION EFFICIENCY TO WEANING

B. A. Freking[1] and D. M. Marshall[2]
Department of Animal and Range Sciences

CATTLE 90-9

Summary

Interrelationships among milk production, cow-calf feed efficiency and other biological traits were evaluated on first-calf females and their calves. Production efficiency was defined as cumulative feed metabolizable energy consumed by the dam-calf pair during the year divided by calf weaning weight. Results indicated that increased levels of milk production were associated with improved production efficiency to weaning as long as calves have the genetic potential to convert the extra milk into body weight gains. However, the incremental improvement in efficiency per unit of increased milk was less for each additional unit of milk.

(Key Words: Beef Cattle, Milk Production, Production Efficiency.)

Introduction

Biological efficiency of energy utilization by the cow-calf herd is of great economic importance due to the relatively low reproductive rate of the species. The importance of level of milk production as a component of efficiency has been much debated. Increasing levels of milk production may increase calf weaning weights but may also increase maintenance requirements of the lactating female, leading to increased feed energy needs. It has often been suggested that milk production potential should be matched with availability of feed resources under individual situations in order to maintain adequate body condition for acceptable reproductive performance. Relationships among efficiency of feed utilization, milk production and other biological traits are of interest. The objective of the present study was to evaluate these relationships to determine how milk production differences might affect efficiency of feed utilization of the cow-calf unit.

Materials and Methods

Data for this study were obtained from a comprehensive project designed to evaluate genetic aspects of efficiency of feed utilization by beef cattle. Records from 425 2-year-old heifers and their crossbred calves born in the years 1981 through 1988 were analyzed. Heifer breed types included crossbred Angus-Hereford, Simmental-Hereford and Tarentaise-Hereford produced in two-breed rotational crossbreeding systems, F1 Salers-Hereford and straightbred Hereford. Individuals in the same rotation varied in percentage Hereford and breed groups were formed based on percentage of Hereford breeding within each rotation for statistical analyses.

Pregnant females were placed in a drylot facility each October at an average age of 19 months. Individual feeding stalls allowed measurement of feed intake for a 1-year period through production of the heifer's first calf at weaning the following October. Heifers were placed in individual feeding stalls twice daily and provided access to predetermined quantities of pelleted hay, chopped hay and grain. Feed not consumed by a heifer was periodically weighed and discarded. Feeding levels were adjusted individually at 28-day intervals based on weight change during the period, stage of production and level of milk production. Diets were adjusted to provide gains assumed to be desirable for typical replacement heifer development and reproductive performance. Feed intakes were expressed as the total cumulative metabolizable energy (ME) consumed for the 1-year period.

Calves were allowed access to their dams for nursing during the two daily periods that cows were in the individual feeding stalls. At other times, calves were maintained separately from cows to eliminate cross-nursing. It is possible that such a procedure might restrict total milk intake, although relative differences in milk production potential between cows are expected to be expressed. Calves were allowed overnight access to a high-roughage creep feed intended to replace forage the calf would have consumed under conventional pasture conditions.

[1]Former Graduate Assistant.
[2]Associate Professor.

Milk production of individual heifers was estimated after an overnight separation (approximately 14 hours) of the calf and dam using weigh-suckle-weigh procedures. Estimated milk production was evaluated on four to six different dates each year and is expressed as the average of those measurements. Cow weight is based on an average of weights obtained at 28-day intervals during the 1-year drylot period. Cow hip height, an average of measurements obtained at first calving and also at weaning, was used as an estimate of skeletal size. The ratios of weight to height at these two time points were used as estimates of body condition. Production efficiency is defined as the cumulative feed energy intake of the dam-calf unit during the 1-year test period divided by calf weaning weight. Thus, the lower the value, the more efficient a cow-calf pair.

Least-squares analyses provided development of response surface equations in which production efficiency was the dependent variable. The linear and quadratic effects of milk production were included simultaneously as predictors of efficiency in each of three surface response models, along with the linear effect of either dam weight, dam height or cumulative dam ME intake. The statistical models used for surface fitting and for residual correlation also accounted for the effects of breed groups, year to year variation, calf sex, age of calf at weaning and estimated dam body condition at calving and at weaning.

Results and Discussion

Residual correlations among traits of interest, adjusted for the previously mentioned effects, are presented in Table 1. The adjustment for breed group, for example, was expected to give results similar to those that would be obtained by computing correlation coefficients separately for each breed group and then computing an average of the coefficients. Desirable correlations with efficiency were detected ($P<.05$) for average milk production and calf weaning weight. These values indicate that, among cows within a given breed group, cow-calf pairs with higher levels of milk production and(or) increased calf weaning weight utilized less feed energy per unit of calf weaning weight on average. Significant positive correlations ($P<.05$) with average milk production were found for dam ME intake and calf weaning weight, indicating that higher milk-producing dams, on average, tended to produce heavier calves at weaning but at higher feed energy levels of the dam. Dam size (weight or height) did not appear to be related to production efficiency to weaning, although dam size was correlated with dam ME intake.

TABLE 1. PHENOTYPIC CORRELATION COEFFICIENTS AMONG TRAITS OF INTEREST[a]

Traits[b]	AVGWT	AVGHT	COWME	CREEP	WWT	EFF
AVGM	.01	.04	.43	-.09	.58	-.50
AVGWT		.82	.42	.13	.20	-.03
AVGHT			.47	.09	.19	.01
COWME				.04	.51	-.09
CREEP					.26	-.18
WWT						-.86

[a] Correlation coefficients less than -.11 or greater than .11 were significant ($P<.05$).
[b] AVGM = milk yield, AVGWT = dam weight, AVGHT = dam height, COWME = cumulative ME intake of dam, CREEP = calf creep ME intake, WWT = calf weaning weight and EFF = (COWME + CREEP)/WWT.

Equations presented in Table 2 were used to develop the response surface graphs presented in Figures 1 through 3. Predictive value (R^2) of the equations presented are inclusive of variables which were not allowed to deviate from their respective means (i.e., effects of year, breed group, sex, calf age, cow condition).

Figure 1 illustrates relationships of production efficiency with milk production and dam weight, while Figure 2 includes production efficiency, milk production and dam hip height. These graphs indicate that, at any given heifer body size, increasing levels of milk production (within the range evaluated) resulted in improved efficiency of feed utilization. However, the improvement in production efficiency per additional unit of milk becomes less at higher levels of milk production. This decreasing rate of improvement in efficiency may depend on the relationship of milk production potential with dam maintenance requirements and may also depend to some extent on the genetic ability of the calf to consume and utilize the extra milk. Efficiency did not vary significantly over the range of dam body weight or height at a given level of milk production. This indicates that both inefficient and efficient dams existed within any size group included in the study.

Figure 3 illustrates the relationship of production efficiency with milk production and dam intake. As mentioned previously, heifers were provided access to limited amounts of feed and in most cases dam feed intake was not ad libitum. Those individuals that were able to produce a relatively large amount of milk compared to feed energy intake were the most efficient, as would be expected considering the positive correlation between milk yield and calf weaning weight. The fact that efficiency tends to improve with decreased dam intake according to the regression analysis (Table 2 and Figure 3) seems to contradict the correlation between efficiency and dam intake (r = -.09) at first glance. However, it is important to keep in mind that milk production differences were accounted for in the regression analysis but not in the correlation analysis. The regression analysis suggests that efficiency tends to improve with decreased dam intake if milk production is held constant. However, it seems unlikely that milk can be held constant as dam intake decreases if body condition is to be maintained at a constant level. This last statement is supported by the correlation between dam intake and milk production (r = .43).

The results of this study indicate that increased levels of milk production (within the range observed in the study) tended to be associated with improved production efficiency to weaning in first-calf dams. However, the incremental improvement in efficiency per unit of increased milk was less for each additional unit of milk. Although an increase in energy requirements of the dam can be expected with increased milk production potential, the additional increase in calf weaning weight appeared to offset this as long as the calf had sufficient genetic growth potential to convert the higher levels of milk into body weight gain. Future research is planned to evaluate similar relationships between efficiency and milk production among older cows. Some research has indicated that increased milk production in the cow is sometimes unfavorably related to postweaning feed efficiency of the calf. Evaluation of the relationship between milk production and subsequent postweaning calf performance for the animals involved in the present study is planned for a future paper. Finally, it should be recognized that a comprehensive evaluation of the association between milk production and production efficiency should take reproductive performance into account. For example, cows which sacrifice body condition while maintaining relatively high levels of milk production might have relatively desirable feed to calf weight ratios for the current calf crop but perhaps at the expense of subsequent reproductive performance. While the effects of reproductive performance per se on efficiency were not considered in the present study, estimates of dam body condition (weight/height ratios) were taken into account in the statistical analysis.

TABLE 2. EQUATIONS USED TO DETERMINE RESPONSE SURFACE OF PRODUCTION EFFICIENCY TO MILK PRODUCTION AND OTHER TRAITS[ab]

Equation	R^2
EFF = 20.8097 - .5825 (AVGM - 7.75) + .0236 (AVGM - 7.75)^2 - .0014 (AVGWT - 982.21)	.83
EFF = 20.8115 - .5839 (AVGM - 7.75) + .0234 (AVGM - 7.75)^2 + .0409 (AVGHT - 50.24)	.83
EFF = 20.8881 - .6530 (AVGM - 7.75) + .0202 (AVGM - 7.75)^2 + .0007 (COWME - 8725.13)	.83

[a] Traits defined in Table 1.
[b] R^2 values are for equations inclusive of variables not allowed to deviate from their means (i.e., year, breed group, calf sex, cow condition, weaning age).

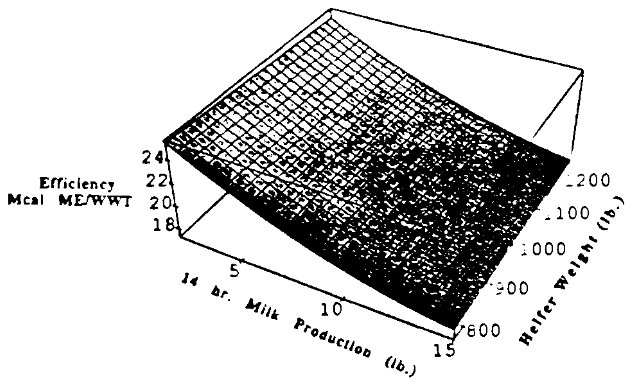

Figure 1. Response surface of production efficiency to average 14-hour milk production and average heifer body weight.

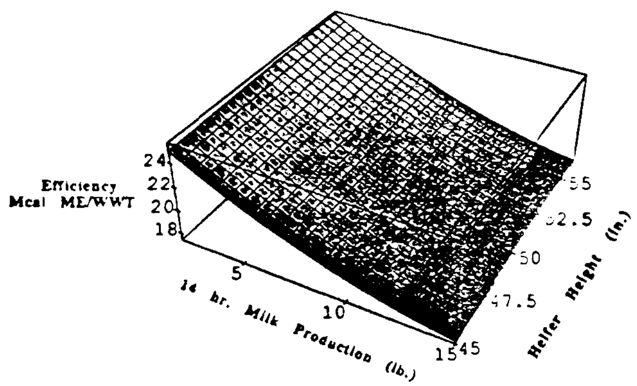

Figure 2. Response surface of production efficiency to average 14-hour production and average heifer height.

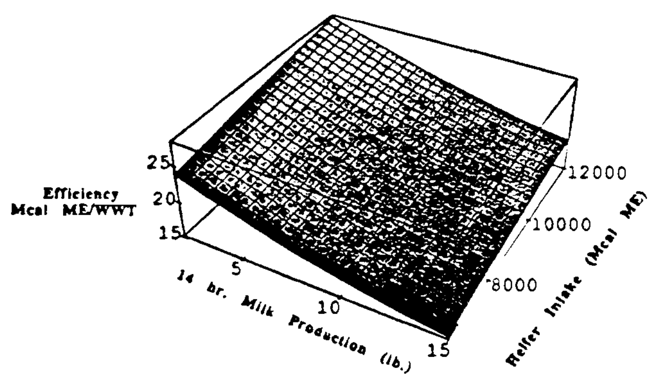

Figure 3. Response surface of production efficiency to average 14-hour milk production and cumulative heifer intake.

COMBINATIONS OF SYNOVEX[1] AND FINAPLIX[2] FOR YEARLING STEERS

J. J. Wagner[3], R. H. Pritchard[4], J. U. Thomson[4] and M. J. Goetz[5]
Departments of Animal and Range Sciences and Veterinary Science

CATTLE 90-10

Summary

One hundred twenty-three yearling black baldy steers were fed in one pen for 123 days at a commercial feedlot near Kimball, South Dakota. On day 1 in the feedlot, 53 steers were implanted with Synovex-S, 53 steers were implanted with the combination of Synovex-S and Finaplix-S and 17 steers received no implant. On day 60 in the feedlot, 18 of the Synovex-S steers and 18 of the combination steers were reimplanted using Synovex-S. Also on day 60, 18 of the Synovex-S steers and 18 of the combination steers were reimplanted using the combination of Synovex-S and Finaplix-S. The remaining steers were not reimplanted. Average daily gain, carcass weight, rib fat thickness, rib eye area and numerical yield grade were increased ($P<.05$) while marbling score and the percentage of cattle grading Choice were reduced ($P<.10$) for implanted steers as compared with nonimplanted steers. Steers implanted on day 1 with the combination gained faster ($P<.0246$) and exhibited larger ($P<.0168$) rib eyes than steers implanted on day 1 with only Synovex-S. Reimplanting on day 60 did not significantly improve average daily gain above day 1 implanting only. Percentage of implants found in acceptable position with no infection or encapsulation 2 wk postimplanting was 85.31 for Synovex-S and 60.23 for Finaplix-S.

(Key Words: Steer, Estradiol, Trenbalone Acetate, Feedlot, Carcass.)

Introduction

Finaplix is the newest implant available for use in feedlot cattle. The active ingredient in Finaplix is trenbelone acetate. When used as the sole implant for cattle, Finaplix administration results in similar or slightly lower improvements in performance as does implanting with estrogenic implants such as Ralgro and Synovex.

Using Finaplix in combination with an estrogenic implant has resulted in tremendous improvements in performance of feedlot cattle as compared with using an estrogenic implant alone and has become a common practice in the commercial cattle feeding industry. However, several reports have indicated that the percentage cattle grading Choice is reduced when the combination of Finaplix and an estrogenic implant are used. Depending upon when and how the cattle are sold, reduced propensity to grade Choice would have serious economic consequences for cattle feeders.

The objectives of this trial were to measure differences in average daily gain and carcass characteristics between cattle implanted with the combination of Finaplix plus Synovex versus cattle implanted with Synovex.

Materials and Methods

One hundred twenty-three yearling, black baldy steers (784 lb) were transported from the Range and Livestock Research Station located near Philip, SD, to R and L Feedyard, Kimball, SD. Upon arrival at the feedlot (8:00 pm) cattle were allowed overnight access to long-stem grass hay without water. The following morning (8:00 am), cattle were weighed, injected with seven-way clostridial bacterin and vaccinated for IBR and PI_3.

Cattle were stratified according to the last weight taken at Cottonwood (8 days preshipment) and randomly assigned to seven treatment groups (Figure 1). On day 1, 53 steers were implanted with Synovex-S, 53 steers were implanted with the combination of Finaplix-S and Synovex-S and 17 steers received no implant. On day 60, 18 of the steers previously implanted with Synovex-S and 18 of the steers previously implanted with the combination of

[1]Product of Syntex Animal Health, Palo Alto, California.
[2]Product of Hoescht Roussel, Sommerville, New Jersey.
[3]Assistant Professor.
[4]Associate Professor.
[5]Graduate Assistant.

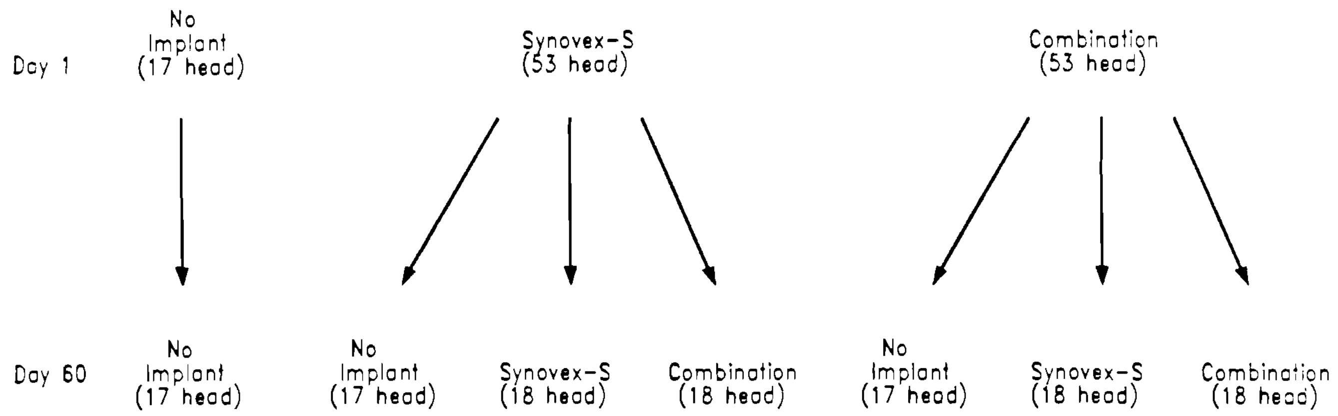

Figure 1. Implant treatment regimens used for steers.

Finaplix-S and Synovex-S were reimplanted with Synovex-S. Eighteen of the steers previously implanted with Synovex-S and 18 of the steers previously implanted with the combination of Finaplix-S and Synovex-S were reimplanted with the combination of Finaplix-S and Synovex-S. The remaining steers were not reimplanted.

Fourteen days postimplanting all cattle were run through the headgate and ears were palpated to determine the effectiveness of implant administration. A score of 0 to 5 was assigned to each implant site. A score of 0 meant that the implant was in place, in proper alignment and that there was no drainage or encapsulation present. A score of 1 meant that the implant was damaged in some way either crushed or out of proper alignment. Implant sites that scored a 2 showed signs of encapsulation as evidenced by a solid swelling with no drainage. Implant sites that scored a 3 were infected and exhibited drainage or a crusted exudate. A score of 4 meant that the implant site was infected and that the implant had been expelled. A score of 5 represented the situation where the implant was missing and no evidence of infection was observed.

Diets fed to steers are shown in Table 1. Steers were adjusted to the finishing diet by feeding diet 1 for 10 days and diet 2 for 7 days. All cattle were slaughtered on the same day after 123 days on feed. Cattle were weighed full at 60 days. A pencil shrink of 4% was applied to these weights prior to computing average daily gain for the first and second half of the trial. Final weight used to compute performance data was calculated by dividing hot carcass weight by the dressing percentage (62%) of the entire group.

Carcass data were collected 24 hours postslaughter. The USDA grader called marbling scores and estimated the percentage kidney, heart and pelvic fat. Rib fat was measured with a steel probe and rib eye area was estimated using a grid. Cattle were not regraded. The first marbling score called by the grader was used in the analysis.

Data were analyzed according to analysis of variance procedures for a completely randomized design. Differences in percentage Choice carcasses in each treatment were tested by Chi square analysis procedures. Means were separated using orthogonal comparisons. Comparisons of interest for the average daily gain and carcass data were (1) no implant versus implant; 2) Synovex-S on day 1 versus the combination on day 1; (3) reimplant versus no reimplant; (4) reimplant with Synovex-S versus reimplant with the combination; (5) Synovex-S on day 1, Synovex-S on day 60 versus the combination on day 1, Synovex-S on day 60; and (6) Synovex-S on day 1, Synovex-S on day 60 versus the combination on day 1, the combination on day 60. The comparison of interest for the implant site data was Synovex-S versus Finaplix-S.

Results and Discussion

Average performance of the pen of cattle was outstanding. Feed consumption for the pen averaged 28.60 lb of dry matter per head daily. Average daily gain was 4.39 lb per head. Feed conversion averaged 6.51 lb of dry matter per pound of gain. Percentage of the steers grading Choice or better was 71.54.

TABLE 1. COMPOSITION OF DIETS FED TO STEERS

Item	Diet 1	Diet 2	Diet Finish
Ingredient[a]			
High moisture corn	29.09	48.14	66.75
Corn silage	67.90	48.15	38.62
Supplement[b]	2.67	3.37	4.29
Mineral supplement[c]	.17	.17	.17
Limestone		.17	.17
Nutrient analysis[d]			
Dry matter, %	47.69	58.66	69.49
Crude protein, %	12.10	12.27	12.52
Calcium, %	.54	.59	.55
Phosphorus, %	.35	.36	.37
NEm, Mcal/cwt	83.69	89.93	94.86
NEg, Mcal/cwt	53.94	59.02	62.37

[a] Percentage as fed.
[b] Sup-R-Lix, Purina Mills, Inc., St. Louis, MO.
[c] Dry matter basis.

Weight and average daily gain of the cattle are displayed in Table 2. Implanted steers gained more (P<.0001) weight per day than nonimplanted steers during the first 60 days on feed (4.64 vs 3.74 lb per head). Differences in average daily gain for Synovex-S implanted cattle and cattle implanted with the combination were not significant.

During the last 63 days on feed, implanted cattle gained significantly (P<.0031) faster than nonimplanted cattle (4.25 vs 3.73 lb per head daily). Cattle that were reimplanted gained more (P<.0059) weight daily than cattle that received one implant (4.38 vs 4.00 lb per head). Cattle implanted on day 1 and day 60 with the combination gained weight more (P<.0102) rapidly than cattle implanted on day 1 and day 60 with Synovex-S (4.72 vs 4.14 lb per head daily). Cattle implanted with the combination on day 1 gained more (P<.0049) rapidly the final 63 days than cattle implanted with Synovex-S on day 1 (4.44 vs 4.06 lb per head daily). The reason for this carryover response is not apparent.

Average daily gain for the entire feeding period was significantly (P<.0001) greater for implanted steers than for nonimplanted steers (4.44 vs 3.73 lb per head daily). Steers implanted on day 1 with the combination of Finaplix-S and Synovex-S gained significantly (P<.0246) faster than steers implanted with Synovex-S (4.60 vs 4.32 lb per head daily). Steers reimplanted with the combination gained more (P<.0236) rapidly than steers reimplanted with Synovex-S (4.59 vs 4.33 lb per head daily). However, over both reimplant regimens, reimplanting did not significantly improve average daily gain (4.46 vs 4.40 lb per head). Steers implanted twice with the combination gained significantly more weight than steers implanted twice with Synovex-S (4.74 vs 4.20 lb per head daily).

Carcass characteristics are shown in Table 3. Carcass weight (P<.003, 827 vs 779 lb), carcass rib fat (P<.0007, .60 vs .44 inches), rib eye area (P<.0117, 12.96 vs 12.28 in.^{2}) and numerical yield grade (P<.0338; 3.47 vs 3.10 units) were all significantly increased, while marbling score (P<.0802, 5.15 vs 5.29 units) and the percentage of cattle grading Choice (P<.10, 68.87 vs 88.24%) were reduced by implanting. Implanting on day 1 with the combination increased (P<.0168) rib eye area as compared to implanting with only Synovex-S (13.20 vs 12.72 in.^{2}). Implanting on day 60 with the combination increased (P<.0291) rib eye area as compared to implanting with Synovex-S (13.35 vs 12.82 in.^{2}). Implanting twice with the combination increased rib eye area as compared to implanting twice with Synovex-S (13.67 vs 12.47 in.^{2}).

Table 4 displays the implant site score information. Eighty-five percent of the Synovex-S implants were administered properly compared with only 60% of the Finaplix-S implants. The same experienced operator administered both implants. However, all Synovex-S implants were placed in the right ear with the SX-10[1] implanting gun with a retractable needle while all Finaplix-S implants were placed in the left ear with the implanting device

TABLE 2. WEIGHT AND AVERAGE DAILY GAIN OF STEERS

Item	Treatment[a]							SEM
	NI	S	SS	SC	C	CS	CC	
Number of steers	17	17	18	18	17	18	18	
Initial wt, lb	793	801	785	770	795	775	773	
Wt at day 60, lb	1060	1140	1083	1096	1125	1087	1104	
Final wt, lb[b]	1257	1342	1306	1322	1346	1329	1363	
Avg daily gain, lb[cd]	3.74	4.89	4.25	4.70	4.75	4.47	4.77	.17
Avg daily gain, lb (day 1-60)[ce]	3.73	3.85	4.14	4.20	4.14	4.45	4.72	.16
Avg daily gain, lb (day 1-123)[f]	3.73	4.35	4.20	4.44	4.44	4.46	4.74	.12

[a] NI = no implant, S = Synovex-S day 1, SS = Synovex-S day 1 and Synovex-S day 60, SC = Synovex-S day 1 and the combination of Synovex-S and Finaplix-S day 60, C = Combination on day 1, CS = Combination day 1 and Synovex-S day 60, CC = combination day 1 and combination day 60.

[b] Calculated from hot carcass weight divided by .62 (standard dressing percent).

[c] Weight on day 60 was shrunk by 4% to compute average daily gain.

[d] No implant vs others (P<.0001).

[e] No implant vs others (P<.0031).
S, SS and SC vs C, CS and CC (P<.0049).
S and C vs SS, SC, CS and CC (P<.0059).
SS vs CC (P<.0102).

[f] No implant vs others (P<.0001).
S, SS and SC vs C, CS and CC (P<.0246).
SS and CS vs SC and CC (P<.0236).
SS vs CC (P<.0011).

TABLE 3. CARCASS CHARACTERISTICS OF STEERS

Item	Treatment[a]							
	NI	S	SS	SC	C	CS	CC	SEM
Hot carcass wt, lb[b]	779	832	810	819	834	824	845	14.47
Fat thickness, inches[c]	.44	.64	.58	.59	.59	.58	.59	.04
Rib eye area, in.^{2}[d]	12.28	12.68	12.47	13.02	12.78	13.16	13.67	.24
Marbling score, units[ef]	5.29	5.19	5.13	5.26	5.13	5.21	4.96	.08
Kidney, heart and pelvic fat, %	2.41	2.47	2.44	2.56	2.38	2.42	2.44	.07
Yield grade, units[g]	3.10	3.70	3.51	3.42	3.54	3.36	3.31	
Percentage Choice[h]	88.24	76.47	66.67	72.22	64.71	88.89	44.44	

[a] NI = no implant, S = Synovex-S day 1, SS = Synovex-S day 1 and Synovex-S day 60, SC = Synovex-S day 1 and the combination of Synovex-S and Finaplix-S day 60, C = Combination on day 1, CS = Combination day 1 and Synovex-S day 60, CC = combination day 1 and combination day 60.

[b] No implant vs others (P<.0030), SS vs CC (P<.0860).

[c] No implant vs others (P<.0007).

[d] No implant vs others (P<.0117).
S, SS and SC vs C, CS and CC (P<.0168).
S and C vs SS, SC, CS and CC (P<.0985).
SS and CS vs SC and CC (P<.0291).
SS vs CS (P<.0454).
SS vs CC (P<.0006).

[e] 4.00 = slight°, 5.00 = small°.

[f] No implant vs others (P<.0802).

[g] No implant vs others (P<.0338).

[h] Control vs others (P<.1000).
SS and CS vs SC and CC (P<.0770).

TABLE 4. IMPLANT SITE SCORE

Score[a]	Implant: Synovex-S	Implant: Finaplix-S
0	85.31[b]	60.23
1	3.39	2.27
2	6.78	15.91
3	1.13	4.55
4	1.69	7.95
5	1.69	9.09

[a] 0 = acceptable, in proper alignment, no drainage or encapsulation present; 1 = crushed or out of proper alignment; 2 = encapsulated, solid swelling with no drainage; 3 = infected, drainage or crusted exudate; 4 = implant site had been infected and implant expelled; 5 = implant missing and no evidence of infection.

[b] Chi square = 26.92, 4 d.f., $P<.005$.

designed for Finaplix. The retractable needle has been associated with fewer implanting problems. In addition, administering implants in the left ear may have been awkward for this particular operator. Implanter needles were not wiped with disinfectant between individual cattle. Wiping the needle clean between cattle has been shown to lower the incidence of infection. The Finaplix-S used in this study contained lactose in the carrier. This may provide a suitable media for bacteria, increasing infections if proper sanitation is not exercised.

Using the combination of Finaplix-S and Synovex-S for feedlot steers will likely improve average daily gain, feed efficiency and carcass muscling. However, quality grade may be reduced and carcass weight may be increased if the combination is used aggressively. Discounts for heavy carcasses, the price spread between Choice and Select carcasses and how the cattle are marketed need to be considered when deciding whether or not to use the combination for feedlot steers.

EFFECTS OF ESTRADIOL-TRENBALONE ACETATE IMPLANT COMBINATIONS ON FEEDLOT PERFORMANCE AND CARCASS TRAITS OF TWO STEER TYPES

R. H. Pritchard[1], D. H. Gee[2] and M. A. Robbins[3]
Department of Animal and Range Sciences

CATTLE 90-11

Summary

Hereford x Angus (HA) and predominantly Gelbvieh cross (Gx) steer calves either received no implant (control) or were implanted initially and again at 77 days on feed with a combination of estradiol and trenbalone acetate based implants. Calves were started on feed in December weighing 677 lb and fed for 146 to 167 days. Fed for a common period of time, implanting steers increased (P<.05) ADG, dry matter intake, final weight, carcass weight, rib fat thickness and yield grade. Implanting reduced (P<.01) marbling scores. Gx steers were heavier and grew more rapidly than HA steers. There were no interactions between breed type and implant treatments for any variables measured. The action of implants to depress marbling scores is not overcome by increasing steer weight and condition to levels similar to nonimplanted controls.

(Key Words: Steer, Estradiol, Trenbalone Acetate, Feedlot, Carcass.)

Introduction

Cattle feeders recently began using a combination of estradiol (Synovex-S[4]) plus trenbalone acetate (Finaplix-S[5]) based implants to improve performance of finishing cattle. The combination can be expected to improve rate of gain, reduce fatness at a common weight and improve feed efficiency. There is evidence that this implant combination may cause lower marbling scores in carcasses of implanted steers. Current speculation is that, if implanted steers were taken to heavier weights and concomitantly to greater fatness, the depression in marbling scores would be overcome.

Since these implants increase rate of gain, implanted steers fed for similar periods of time as nonimplanted steers should be heavier. The additional weight gained may be adequate to produce desirable carcasses. The increase in market weight would be appropriate for small framed cattle but may be detrimental for large framed steers where heavy carcasses could result in discounts. This experiment was conducted to determine the effects of cattle type and estradiol plus trenbalone acetate (TBA) implant combinations on feedlot performance and carcass traits of steer calves.

Materials and Methods

Hereford-Angus (HA) and predominantly Gelbvieh cross (Gx) steer calves were purchased at weaning. Steers were shipped to the Brookings research feedlot, processed and fed a corn silage based receiving diet. The receiving period was continued for 60 days to allow cattle to overcome shipping stress and to normalize body condition across breed types. Thirty-eight steers were selected from each breed group and allotted to control or implant treatments. Control steers received no implant. The implant group received estradiol and TBA based implants initially and were reimplanted after 77 days. Initial weights were taken after a 12-hour fast on two consecutive days. A single final weight was obtained following a 12-hour fast. There were 19 steers in each breed type x implant group. During the initial 56 days on feed, steers were penned in these 19-head groups. After 56 days, steers were sorted into 9- and 10-head pens. The finishing diet (Table 1) was fed beginning on the day the first implants were administered.

Pens were closed out when steers reached an acceptable market weight and condition. One pen each of control and implanted HA were slaughtered after 146 days on feed. The remaining HA were slaughtered after 153 days. All Gx steers were slaughtered after 167 days on feed.

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[1]Associate Professor.
[2]Professor.
[3]Manager, Beef Cattle and Sheep Nutrition Unit.
[4]Syntex Corporation, Des Moines, IA.
[5]Hoescht Roussel, Sommerville, NJ.

TABLE 1. FINISHING DIET FORMULATION AND COMPOSITION[ab]

Item	Amount
Corn silage, %	10.00
High moisture ear corn, %	30.00
Whole shelled corn, %	52.77
SBM, %	5.54
Trace mineralized salt, %	.25
Limestone, %	1.03
Dicalcium phosphate, %	.16
Potassium chloride, %	.25
Crude protein, %	11.2
NEm, Mcal/cwt	91.4
NEg, Mcal/cwt	60.2

[a] Dry matter basis.
[b] Diet provided 25 grams/T Rumensin and 1,000 IU per lb vitamin A.

There was no pen replication during the initial 56 days on feed. Therefore, intake and feed conversions during this period were not suited to statistical analysis. Data collected after 56 days were analyzed as appropriate for a 2 x 2 factorial arrangement of treatments. These data were evaluated on a pen mean basis. Cumulative ADG and carcass data were tested using individual steer data in the analysis of variance.

Results and Discussion

Cumulative ADG was greater for implanted ($P<.001$) and for Gx ($P<.05$) steers. After the initial 56 days on feed, there was no breed type effect ($P>.10$) on ADG. The gain response to implants ($P<.01$) persisted throughout the study. As a result of gain responses, Gx and implanted steers were heavier ($P<.05$) than HA and nonimplanted steers at each weigh date (Table 2).

Implants caused increased feed intakes ($P<.05$) and Gx steers tended ($P<.10$) to consume more feed than HA. There was a trend ($P<.15$) toward improved feed conversion by implanted steers that probably would be realized if there was greater pen replication. Days on feed were similar for implant groups within breed type. Implanting increased ($P<.01$) final weight of HA steers by 116 lb and Gx steers by 90 lb.

Carcass weights were heavier ($P<.001$) for Gx and implanted steers. Overall dressing percentage (59.0 $\pm$ .38%) was low probably due to fill when final weights were taken.

The HA steers were taken to a typical feedlot endpoint with an overall yield grade of 3.3. It was not practical to feed the Gx steers to this fatness because carcass weight would have been excessively heavy. Larger framed cattle provide the opportunity to market steers producing trimmer carcasses of an adequate weight. It was decided that the Gx steers should be marketed with .4 inch rib fat which is predominantly yield grade 2.

Implants tended ($P<.10$) to increase rib eye area and increased ($P<.05$) rib fat thickness (Table 3). Consequently, the yield grade was higher for carcasses from implanted steers. Most information to date based on feeding to a constant final weight indicates that this implant program will increase rib eye area but reduce rib fat and yield grade.

Quality grades were higher for HA steers as would be expected because of the additional carcass fatness. Quality grades were lowered ($P<.001$) by implanting, even though implant group carcasses were heavier and fatter. Control carcasses graded 66% Choice, while implant group carcasses graded 50% Choice.

Reduced percentage Choice carcasses have been previously noted with estradiol plus TBA implant programs. This is most prevalent when reimplanting as was performed in this study. It has been proposed that, if implanted steers were fed to a similar fat endpoint, the depression in intramuscular fat deposits would diminish. The results of this study suggest that these implants affected intramuscular fat to a greater

TABLE 2. FEEDLOT PERFORMANCE BY BREED TYPE AND IMPLANT TREATMENT

Item	Hereford-Angus	Gelbvieh cross	Control	Implant	SEM
Cumulative					
Initial wt[a]	655	698	676	677	6.6
Final wt[ab]	1096	1209	1101	1204	11.7
ADG	2.95	3.06	2.68	3.33	
DMI	16.83	17.77	16.33	18.27	
F/G	5.71	5.81	6.09	5.49	
After 56 days					
56-day wt[ab]	828	885	833	881	6.7
ADG[b]	2.86	2.91	2.62	3.16	.07
DMI[b]	17.82	18.86	17.27	19.41	.52
F/G	6.26	6.50	6.61	6.15	.27

[a] Breed type effect (P<.01).
[b] Implant effect (P<.01).

TABLE 3. CARCASS TRAITS BY BREED TYPE AND IMPLANT TREATMENT

Item	Hereford-Angus	Gelbvieh cross	Control	Implant	SEM
Carcass wt, lb[ab]	645	715	650	710	10
Dressing percent	58.9	59.1	59.0	58.9	.38
Rib fat, in.[bc]	.60	.40	.47	.53	.03
Rib eye area, $in.^2$[bd]	10.85	12.58	11.54	11.89	.21
KPH, %	1.70	1.60	1.72	1.58	.11
Yield grade[bc]	3.33	2.50	2.79	3.04	.11
Quality grade[abe]	17.18	16.26	17.02	16.42	.17

[a] Implant effect (P<.06).
[b] Breed type effect (P<.01).
[c] Implant effect (P<.05).
[d] Implant effect (P<.10).
[e] 18 = Ch^o, 17 = Ch^-.

extent than subcutaneous fat deposition. When carcass data were adjusted to a constant rib fat thickness by covariate analysis, differences in carcass weight and quality grade due to implant persisted (Table 4).

These data indicate that using estradiol plus TBA based implants in a reimplant program dramatically improved feedlot performance and increased carcass weights of steers when days on feed are constant. The percentage Choice carcasses is reduced by implanting even when cattle are fed until they have .6 inch rib fat. Increases in carcass weight due to implanting would be beneficial in small framed cattle but may be detrimental in larger framed steers. In this study, the reduction in carcass value (low marbling score; Select Choice spread $9.00/cwt) due to implants reduced the overall economic advantage of implanting from $25.32 per head to $13.63 per head over control steers.

TABLE 4. LEAST SQUARES MEANS FOR CARCASS TRAITS ADJUSTED TO A CONSTANT RIB FAT THICKNESS

Item	Hereford-Angus	Gelbvieh cross	Control	Implant	SEM
Carcass wt[ab]	642	717	651	708	10
Rib eye area, $in.^2$ [b]	10.89	12.54	11.53	11.90	.21
KPH	1.69	1.61	1.72	1.58	.12
Yield grade[b]	3.04	2.78	2.88	2.95	.06
Quality grade[ab]	17.15	16.30	17.04	16.41	.18

[a] Implant effect (P<.01).
[b] Breed type effect (P<.01).

PREWEANING PROCESSING-ANTHELMINTIC TREATMENT AND POSTWEANING EFFECTS OF SULFAMETHAZINE BASED MEDICATIONS ON PERFORMANCE TRAITS AND OOCYST SHEDDING IN WEANED CALVES

R. H. Pritchard[1], J. U. Thomson[1] and M. A. Robbins[2]
Departments of Animal and Range Sciences and Veterinary Science

CATTLE 90-12

Summary

Two trials were conducted to evaluate antibiotic therapies for feeder calves originating in western South Dakota. In Trial 1, processing-anthelmintic treatment 28 days before weaning reduced ranch gains and provided no advantage in feedlot gains when calves were reprocessed. Processing included deworming, grubicide treatment, implanting and vaccination. Sulfamethazine medication caused transient improvements in feedlot performance during the feedlot receiving period in both trials. Supertherapeutic treatment with AS 700 offered no advantage in feedlot performance over therapeutic feeding in these calves. Sulfamethazine exposure suppressed coccidia oocyst shedding and appears to be an effective means of controlling coccidiosis and shipping fever complex for newly received calves.

(Key Words: Calves, Sulfamethazine, Coccidiosis, Shipping Stress, Parasites.)

Introduction

The initial 4 weeks in the feedlot represent a critical period for recently weaned feeder calves. Stresses due to weaning, shipping, parasite burden, vaccination, exposure to pathogens and reduced feed intake increase susceptibility to disease. Respiratory illness and coccidiosis represent the two most common problems when managing these calves. Calf receiving programs that minimize losses to these problems are critical to successful feeding. The efficacy of sulfa based medications such as AS 700[3] for controlling shipping fever has been established. These products may also suppress coccidiosis. Two feeding trials were conducted to determine if sulfamethazine medication would reduce disease and enhance performance of calves infected with coccidiosis.

Materials and Methods

Feeding trials were conducted in the fall of 1988 and 1989. Calves were obtained from the same ranch each year. It was previously established that many of these calves were infected with coccidia.

Trial 1. Crossbred steer and heifer calves (48 head each) were weighed on the ranch and allotted to receive preshipment processing or as controls. The treated calves were vaccinated against IBR, BVD, PI_3, Hemophilus somnus and a 7-way clostridia. Warbex[3], Levamisole[3] and Ralgro[4] implants were also administered at this time. All calves were then comingled for 28 days before weaning.

At weaning, 32 additional steers that had received the vaccination and parasite treatments were added as a second group for inclusion in postshipment treatments. All calves were weighed and half of the calves from each sex, vaccination and group received three Sulmet[3] boluses before being loaded on trucks and shipped 350 miles to the SDSU research feedlot near Brookings.

In the feedyard, calves stood overnight with access to long stemmed grass hay and water. The next morning all calves received the same vaccinations as were used on the ranch. Previously unimplanted calves received a Ralgro implant. Sulmet boluses (3) were again administered to those calves bolused preshipment. Calves were sorted into 8-head pens by vaccination and Sulmet treatment groups. Steer and heifer calves were mixed within pens. The feedlot receiving diet was based on corn silage (Table 1). AS 700 was fed at therapeutic levels to half of the calves and was balanced across previous treatments. AS 700 feeding was continued at a constant dosage for 27 days. Performance data on the ranch were based

[1]Associate Professor.
[2]Manager, Beef Cattle and Sheep Nutrition Unit.
[3]American Cyanamid, Wayne, NJ 07470.
[4]Pitman-Moore, Terre Haute, IN 47808.

TABLE 1. DIETS FED TO CALVES DURING FEEDLOT PERFORMANCE TEST[a]

Ingredient	R8840-R[bc], %	R8840-2[cd], %
Ground hay	10.00	--
Corn silage	80.54	88.04
Supplement		
Soybean meal, 44%	8.54	10.75
Trace mineralized salt[e]	.40	.40
Limestone	.31	.64
Dicalcium phosphate	.21	.17

[a] Percent dry matter basis.
[b] Fed 1 to 27 days after arrival. In Trial 1, diet was top-dressed with .5 lb/head/day ground corn that did or did not contain 9.08 g AS 700/lb. In Trial 2, medication top-dressed as 6.67% diet, DMB.
[c] Diets contained 1,000 IU per lb supplemental vitamin A.
[d] Diet provides 27 g/T monensin. Fed after initial 27 days.
[e] Contains NaCl >93%, Zn >.35%, Mn >.28%, Fe >.175%, Cu >.035%, I >.007%, Co >.007%.

on individual calf responses. Feedlot performance data were analyzed on a pen mean basis using procedures appropriate for a 2 x 2 x 2 factorial arrangement of treatments.

Trial 2. One hundred thirty-one steer calves were shipped directly from the ranch to the Brookings feedlot without any preshipment treatment. Receiving conditions and diet were the same as for Trial 1. All calves received similar vaccinations, but Ivomec[5] was used for anthelmintic treatment in this trial. Allotment was based upon a weight stratification providing 15 pens of 8 head. Eleven steers were randomly selected to be removed from the experiment to balance pen concentrations.

Premixes were prepared to contain (A) 0, (B) 1.98 or (C) 5.94 g/kg AS 700 (Table 2). These premixes were top-dressed at 6.67% of diet dry matter. If dry matter intake (DMI) during this period was 1.5%, body weight treatment B would provide therapeutic levels of AS 700. If DMI was .5%, body weight treatment C would provide therapeutic levels of AS 700. On day 11, premix C was discontinued and premix B was used in its place. Feeding premixes A and B was discontinued after 27 days. Performance data were analyzed on a pen mean basis by procedures appropriate for a completely random designed experiment.

In both studies, fecal samples were obtained from all steers twice weekly for the initial 4 weeks in the feedlot. Oocyst counts/gram fresh feces were determined and categorized as clean, 0 oocysts/g; low, 1 to 99 oocysts/g; moderate, 100 to 499 oocysts; and heavy, >499 oocysts/g. The frequency of occurrence in each infestation category was compared among treatments by Chi square analysis.

TABLE 2. TOPDRESS MEDICATION FORMULATION[a]

	Premix		
Item	A	B	C
Ground corn	136	133	128
AS 700	0	2.724	8.172
Vegetable oil	1.26	1.36	1.36
AS 700 concentration, g/kg	0	1.98	5.94

[a] Kg, as fed basis.

[5]MSD AgVet, Rahway, NJ 07065.

Results and Discussion

The on ranch processing depressed gains (2.30 vs 2.08 lb/day, P<.05) on the ranch in Trial 1. We have observed this response in previous trials on an inconsistent basis. In previous studies, a Ralgro implant 4 weeks preshipment improved gains. Other processing treatments were not confounded with anabolic implants in those studies.

Calves vaccinated on the ranch actually received this treatment twice. We took this approach since it is typical for a feedyard to vaccinate all incoming cattle regardless of reported medical history. During the period from 28 to 55 days after feedlot arrival, calves vaccinated preshipment had lower average daily gains (2.53 vs 2.29; P<.05) and higher feed conversions (5.57 vs 6.18; P<.05) than controls. After 83 days, this response had diminished. A similar response was noted when gains were calculated for the period of initial ranch processing through 83 days in the feedyard.

Dosing with Sulmet boluses depressed gains (3.24 vs 3.01; P<.05) during the initial 28 days in the feedlot (Table 3). Intake was not affected by bolusing. The reason for the lowered average daily gain (ADG) is unclear. Calves made up this difference by 55 days.

Feeding AS 700 improved ADG (2.98 vs 3.28; P<.05) during the initial 27 days on feed and increased DMI (13.73 vs 14.36; P<.05) during 28 to 55 days on feed. After 83 days on corn silage diets, these responses had disappeared.

Interactions occurred (P<.05) between bolusing and AS 700 for DMI from 28 to 55 days, where cattle receiving one medication treatment consumed more feed than those receiving no medication or those receiving both forms of medication (Table 3). ADG from 56 to 83 days responded similarly. These data suggest that in the absence of acute disease only one avenue of medication should be utilized.

TABLE 3. EFFECTS OF SULMET BOLUS AND AS 700 ON FEEDLOT PERFORMANCE OF FEEDER CALVES, TRIAL 1

Sulmet boluses	No		Yes	
AS 700	No	Yes	No	Yes
1 to 27 days				
ADG[ab]	3.07	3.41	2.88	3.15
DMI[c]	10.59	10.85	9.84	10.69
F/G	3.46	3.19	3.44	3.39
28 to 55 days				
ADG	2.39	2.39	2.43	2.41
DMI[ad]	13.37	14.82	14.09	13.90
F/G	5.62	6.24	5.84	5.81
56 to 83 days				
ADG[d]	4.15	4.60	4.79	4.28
DMI	14.54	16.39	14.88	14.55
F/G	3.52	3.58	3.11	3.41
1 to 83 days				
ADG	2.71	2.91	2.80	2.77
DMI[c]	11.11	12.08	11.18	11.32
F/G	4.10	4.15	4.00	4.10

[a] AS 700 effect (P<.05).
[b] Bolus effect (P<.10).
[c] AS 700 effect (P<.10).
[d] AS 700 x bolus effect (P<.05).

An interaction also existed between processing-anthelmintic and AS 700 treatments for feed conversion from 55 to 83 days and overall (Table 4). Feed conversion was higher when calves received preweaning vaccinations and AS 700 in the receiving period.

In Trial 2, intake was good, resulting in high medication intakes during the initial 10 days in the feedlot (Table 5). Feeding AS 700 increased (P<.10) steer weights at 27 days and DMI after the initial 27 days (Table 6). Most of the increase in gain occurred during the initial 13 days in the feedlot. Feed conversion was also improved due to AS 700 feeding over the 13- (P<.05) and 27-day (P<.10) periods. The high dosage of AS 700 depressed feed intake (P<.10) throughout the receiving period. Using this approach to medicating diets does not help and may hinder performance if calves take to feed readily.

In both studies sulfamethazine reduced the frequency of calves shedding moderate and high amounts of oocysts. Sulmet treatment reduced shedding (P<.05) at 2, 5, 9 and 12 days after feedlot arrival in Trial 1 (Table 7). AS 700 reduced oocyst shedding on days 5 (P<.05), 9 (P<.10), 12 (P<.10), 23 (P<.01) and 26 (P<.10). In Trial 2 (Table 8), oocyst shedding was suppressed uniformly throughout the collection period. Supertherapeutic medication enhanced this response over therapeutic medication levels. In both studies monensin was included in diets at 20 g/T after AS 700 was withdrawn and subsequent fecal samples contained minimal incidence of oocyst shedding.

No significant incidence of respiratory illness or acute coccidiosis occurred in either of these trials. AS 700 treatment at therapeutic levels tended to improve calf performance and suppressed oocyst shedding. The higher level of AS 700 feeding was not efficacious for improving performance but may provide greater protection against coccidiosis. Other research has shown advantages to supertherapeutic treatment. Level of feed intake may be an important consideration in selecting medication therapy.

In our receiving studies, calves have been in the marketing channels for less than 48 hours. The importance of a preweaning processing program may differ in groups of cattle exposed to a longer transition time from the ranch to the feedlot or other stresses.

TABLE 4. EFFECTS OF PREWEANING PROCESSING AND POSTWEANING SULMET BOLUS AND AS 700 ON FEEDLOT PERFORMANCE OF FEEDER CALVES, TRIAL 1

Preshipment vaccination	No		Yes	
AS 700	No	Yes	No	Yes
1 to 27 days				
ADG[a]	2.93	3.27	3.03	3.29
DMI[b]	10.29	10.54	10.13	11.00
F/G	3.55	3.23	3.35	3.35
28 to 55 days				
ADG[c]	2.57	2.48	2.25	2.32
DMI	13.76	14.33	13.70	14.39
F/G	5.35	5.79	6.11	6.26
56 to 83 days				
ADG[e]	4.24	4.64	4.71	4.24
DMI	14.59	14.97	14.83	15.97
F/G[e]	3.47	3.23	3.16	3.76
1 to 83 days				
ADG	2.74	2.91	2.77	2.77
DMI[b]	11.15	11.51	11.13	11.89
F/G[e]	4.07	3.96	4.03	4.29

[a] AS 700 effect (P<.05).
[b] AS 700 effect (P<.10).
[c] Vaccination effect (P<.10).
[d] Vaccination effect (P<.05).
[e] AS 700 x vaccination effect (P<.05).

TABLE 5. DAILY DRY MATTER INTAKE AND DRUG CONCENTRATION BY TREATMENT GROUP[a]

	A		B		C	
Day	Dry matter intake	Drug intake[b]	Dry matter intake[b]	Drug intake[b]	Dry matter intake	Drug intake[b]
1	3.78	--	3.78	297	3.78	887
2	4.48	--	4.48	351	3.78	887
3	5.76	--	5.76	451	5.24	1228
4	7.22	--	7.22	565	6.69	1569
5	8.38	--	8.38	657	7.86	1840
6	9.54	--	9.54	748	9.02	2114
7	10.71	--	10.71	948	10.19	2385
8	11.87	--	11.87	930	11.81	2660
9	12.51	--	12.51	980	12.51	2930
10	13.68	--	13.68	1072	13.44	3151

[a] Mean of five pens.
[b] Mg/head of chlortetracycline + sulfamethazine.

TABLE 6. FEEDLOT RECEIVING PERIOD PERFORMANCE OF STEER CALVES, TRIAL 2

Treatment	A	B	C	SEM
Steer weight				
Initial	527	528	529	3.2
Day 10	561	563	557	6.6
Day 13	567	578	579	5.4
Day 27[a]	619	631	629	4.2
Day 34[a]	622	633	630	3.9
Average daily gain				
Days 1-10	3.30	3.54	2.78	.496
Days 1-13[b]	3.03	3.86	3.85	.263
Days 14-27	3.74	3.77	3.53	.306
Days 1-27[b]	3.40	3.82	3.68	.103
Days 1-34[b]	2.78	3.10	2.95	.071
Dry matter intake				
Days 1-13[c]	10.09	10.31	9.81	.163
Days 14-27[a]	13.92	14.81	14.48	.281
Days 1-27[ac]	12.08	12.65	12.23	.160
Days 1-34	13.18	13.70	13.24	.183
Feed/gain				
Days 1-13[b]	3.40	2.67	2.66	.213
Days 14-27	3.81	3.94	4.29	.294
Days 1-27[a]	3.58	3.32	3.33	.103
Days 1-34[b]	4.76	4.43	4.49	.084

[a] A vs BC ($P<.10$).
[b] A vs BC ($P<.05$).
[c] B vs C ($P<.10$).

TABLE 7. CHI-SQUARE ANALYSIS OF OOCYST SHEDDING FREQUENCIES BY SULMET BOLUS AND AS 700 TREATMENTS, TRIAL 1

Sample date	Bolus AS 700	No No	No Yes	Yes No	Yes Yes	No	Yes	No	Yes
		Number of calves							
Initial	0	3	1	2	1	4	3	5	2
	1-99	6	6	8	10	12	18	14	16
	100-499	5	8	6	7	13	13	11	15
	>499	6	5	8	6	11	14	14	11
Day 0	0	8	8	11	6	16	17	19	14
	1-99	12	10	11	15	22	26	23	25
	100-499	6	9	2	6	15	8	8	15
	>499	3	3	7	4	6	11	10	7
Day 2[bd]	0	11	7	26	22	18	48	37	29
	1-99	10	17	3	10	27	13	13	27
	100-499	4	6	1	0	10	1	5	6
	>499	3	2	1	0	5	1	4	2
Day 5[bdf]	0	6	13	15	24	19	39	21	37
	1-99	12	10	13	7	22	20	25	17
	100-499	8	7	3	1	15	4	11	8
	>499	6	2	0	0	8	0	6	2
Day 9[de]	0	8	14	27	24	22	51	35	38
	1-99	14	11	5	5	25	10	19	16
	100-499	1	4	0	0	5	0	1	4
	>499	8	1	0	0	9	0	8	1
Day 12[ace]	0	17	23	24	26	40	50	41	49
	1-99	9	6	5	3	15	8	14	9
	100-499	5	1	1	0	6	1	6	1
	>499	0	0	0	0	0	0	0	0
Day 17	0	19	24	24	22	43	46	43	46
	1-99	7	4	3	6	11	9	10	10
	100-499	3	4	3	1	7	4	6	5
	>499	1	0	1	0	1	1	2	0
Day 19	0	19	26	21	21	45	42	40	47
	1-99	5	1	2	6	6	8	7	7
	100-499	4	3	5	2	7	7	9	5
	>499	1	0	4	1	1	5	5	1
Day 23[ag]	0	15	24	14	23	39	37	29	47
	1-99	10	3	10	5	13	15	20	8
	100-499	5	1	5	1	6	6	10	2
	>499	1	0	1	0	1	1	2	0

TABLE 7 CONTINUED

Sample date	Bolus / AS 700	No / No	No / Yes	Yes / No	Yes / Yes	No	Yes	No	Yes
		Number of calves							
Day 26[e]	0	20	27	19	23	47	42	39	50
	1-99	7	4	5	2	11	7	12	6
	100-499	2	0	4	1	2	5	6	1
	>499	1	0	3	2	1	5	4	2
Day 31	0	17	17	14	23	34	37	31	40
	1-99	11	10	13	5	21	18	24	15
	100-499	1	3	3	1	4	4	4	4
	>499	2	2	2	1	4	3	4	3
Day 87	0	25	32	32	29	57	61	57	61
	1-99	1	0	0	1	1	1	1	1
	100-499	0	0	0	0	0	0	0	0
	>499	1	0	0	0	1	0	1	0

[a] Heterogeneity among four treatment array (P<.05).
[b] Heterogeneity among four treatment array (P<.01).
[c] Heterogeneity among bolus treatments (P<.05).
[d] Heterogeneity among bolus treatments (P<.01).
[e] Heterogeneity among AS 700 treatments (P<.10).
[f] Heterogeneity among AS 700 treatments (P<.05).
[g] Heterogeneity among AS 700 treatments (P<.01).

TABLE 8. CHI-SQUARE ANALYSIS OF OOCYST SHEDDING FREQUENCIES BY AS 700 TREATMENT, TRIAL 2

Sample date	Oocyst counts/g feces	AS 700 treatment A	B	C
		Number of animals		
Initial	0	12	17	12
	1-99	8	4	10
	100-499	0	1	1
	>499	0	0	1
Day 0	0	11	6	8
	1-99	17	23	22
	100-499	9	5	6
	>499	2	1	4
Day 3[a]	0	6	7	14
	1-99	20	18	20
	100-499	9	6	6
	>499	5	6	0
Day 6[c]	0	13	13	29
	1-99	21	21	10
	100-499	5	4	1
	>499	1	0	0
Day 10[b]	0	18	24	34
	1-99	17	12	5
	100-499	3	2	0
	>499	1	1	0
Day 13[c]	0	18	24	34
	1-99	19	13	4
	100-499	2	1	0
	>499	0	1	0
Day 17[b]	0	23	19	33
	1-99	15	19	5
	100-499	1	0	1
	>499	0	0	0
Day 19[a]	0	28	25	35
	1-99	10	11	3
	100-499	1	2	0
	>499	0	1	0
Day 24	0	27	29	31
	1-99	5	6	7
	100-499	0	1	0
	>499	0	0	0

TABLE 8 CONTINUED

Sample date	Oocyst counts/g feces	AS 700 treatment A	B	C
		Number of animals		
Day 27[a]	0	26	31	31
	1-99	10	3	3
	100-499	1	0	0
	>499	0	0	0
Day 31[a]	0	27	37	34
	1-99	9	2	6
	100-499	0	0	0
	>499	0	0	0
Day 85	0	33	35	33
	1-99	4	2	7
	100-499	1	0	0
	>499	0	0	0

[a] Heterogeneity among three treatment array ($P<.10$).
[b] Heterogeneity among three treatment array ($P<.05$).
[c] Heterogeneity among three treatment array ($P<.01$).

FEED UTILIZATION BY STEERS WITH CHRONIC CRYPTOSPORIDIA INFECTION

R. H. Pritchard[1], J. U. Thomson[1], C. D. Mullaney[2], L. Goss[3] and T. Melius[3]
Departments of Animal and Range Sciences and Veterinary Science

CATTLE 90-13

Summary

The effect of chronic cryptosporidia infection on feed utilization by yearling steers was evaluated. Two control and two infected steers were fed a corn silage based diet. Infected steers had shown evidence of cryptosporidia infection over a 6-month period prior to determining feed digestibility. Digestibilities of dry matter (58.1 vs 54.0 ± 3.9%), NDF (51.7 vs 54.6 ± 2.5%), ADF (35.8 vs 34.8 ± 7.1%) and crude protein (45.0 vs 45.9 ± 5.3%) were unaffected (P>.10) by parasite infection for control and infected steers, respectively.

(Key Words: Steers, Digestibility, Cryptosporidia.)

Introduction

Cryptosporidia is becoming recognized as an important gastroenteric infection in beef and dairy cattle. Cryptosporidiosis can cause severe diarrhea in calves and leaves them susceptible to secondary respiratory infections. In cases of cryptosporidia bovis infection, we expect immunity to develop as in coccidiosis infection. We have found cryptosporidia mura in stools of calves received in the feedyard. In two studies, we have observed calves that chronically shed oocysts. Infected calves did not exhibit clinical symptoms of infection.

Generally, when cattle are chronically infected with cryptosporidia mura, the abomasum is enlarged and the pH abomasal chyme is elevated. This may affect the digestive process, especially protein digestion. This experiment was designed to determine if digestibility of components of a corn silage based diet were affected in chronically infected steers.

Materials and Methods

Two Angus steer calves were observed to chronically shed cryptosporidia over a 83-day fecal sampling period. These steers were matched by size with two steers not shedding oocysts. All steers originated from the same ranch. During the digestibility study, a stool sample indicated control steers were negative and infected steers were positive for cryptosporidia organisms.

When steers were 12 months old, they were adapted to a corn silage diet (Table 1) and individually housed in stalls in the Animal Science Complex. Steers were fed once daily. After ad libitum intake was stabilized, intake was held constant for measuring digestibility components.

Digestibility was estimated by including chromic oxide in the diet at 6,500 mg per head per day by topdressing a ground corn-Cr_2O_3 premix. Marker was fed for 10 days prior to and during fecal collections. Fecal grab samples were collected over a 3-day period beginning immediately prior to feeding and again 8, 16, 27, 35, 43, 54, 62 and 70 hours later. Feces were dried at 55 °C, ground through a 1-mm screen and composited for N, NDF, ADF and Cr analysis. Digestibility coefficients were estimated by ratio technique.

Results and Discussion

There were no differences in intake or dry matter, ADF, NDF or N digestibility. However, there were only two steers in each group. Only marked differences in digestibility could be detected in this situation.

Chronic cryptosporidia infection did not affect utilization of corn silage diet. No differences in animal appearance or performance were noted. While chronic cryptosporidia infection had no apparent detrimental effect on steer performance, infected individuals provide a continual source of the parasite. No therapy currently exists to control cryptosporidia. Dry matter intake was relatively low in this study. Performance of cattle in various production situations should be evaluated to help establish the economic importance of this type of parasitic infection.

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[1]Associate Professor.
[2]Medical Technician, Veterinary Science.
[3]Undergraduate Animal Science students.

TABLE 1. DIET FED DURING DIGESTIBILITY STUDY[a]

Item	%
Corn silage	90.58
Soybean meal, 44%	7.24
Trace mineralized salt	.24
Calcium carbonate	.38
Dicalcium phosphate	.10
Cr_2O_3 premix	1.46

[a] Percent, dry matter basis.

TABLE 2. FEED UTILIZATION BY CRYPTOSPORIDIA INFECTED AND NONINFECTED STEERS[a]

Item	Uninfected	Infected	SEM
Dry matter intake, lb	14.3	17.6	1.70
Digestibility			
Dry matter, %	58.06	54.00	3.9
ADF, %	35.75	34.80	7.1
NDF, %	51.70	54.60	2.5
Crude protein, %	44.95	45.85	5.3

[a] Dry matter basis.

THE ECONOMICS OF PLACING HEAVY STEERS BACK IN THE FEEDLOT

C. M. Pankonin[1] and R. H. Pritchard[2]
Department of Animal and Range Sciences

CATTLE 90-14

Summary

In the fall of 1989, 30 fed steers (1,069 lb) marketed through the Sioux Falls Stockyards were purchased by a feeder to go back on feed rather than to slaughter. The cattle were purchased for $70/cwt on a $63/cwt fed steer market. These steers were previously on trial at the SDSU research feedlot. Thirty-two contemporary steers were retained at SDSU for determining subsequent costs of production and economic risks of placing heavy cattle on feed. The fed steer and futures markets were tracked for the next 27 days. During this period, there was no potential for profit based on breakevens in relation to the cash market. The only potential for profit was seen near the close of the October futures contracts on days 17 through 27 of the feeding period. After 2 weeks back on feed, weight losses due to shrink were compensated for and steers regressed to average daily gains of 2.5 lb. A companion study holding similar frame size steers on feed an additional 29 days caused an increase ($P<.01$) in frequency of yield grade 4 from 0 to 17%.

Introduction

It is a common practice in the upper midwest to buy heavy (1,000 lb) feeders to be placed in short feeding programs. By doing this, a large economic risk is involved. The feeder must be aware of what is happening to cost of production, how well the cattle perform, at what point are cattle overfed and how this can affect carcass grade and yield.

The objective of this experiment was to determine the economic feasibility and changes in performance and carcass value when feeding heavy steers.

Materials and Methods

Mixed crossbred steers were previously utilized in a study to determine feedlot performance of cattle fed finishing diets that included hay or sunflower hulls. Upon completion of that experiment, 96 head were sold at the Sioux Falls Stockyards during the week of September 14, 1989. Thirty head of these steers weighing an average of 1,069 lb were purchased for $70/cwt to go back to the country. The fed steer market on that date was $63/cwt. It was then decided to retain 32 steers of similar weight to serve as a contemporary group at the SDSU research feedlot.

Costs of production (i.e., cost of gains and breakeven prices) were calculated using a $.20 per head per day yardage fee and an interest rate of 12%, charged only against the purchase price of the cattle. Ration costs were $80/ton. Interim average daily gains, dry matter intake and feed/gain were determined on a full weight basis. Cash and futures markets were tracked throughout the 27-day period. Breakeven calculations included a 4% shrink adjustment.

In a companion study, 170 Limousin x Angus steers of similar weights and frame size and managed similarly were used to determine potential carcass changes late in the feeding period. The Limousin cross steers were serially slaughtered after 82, 95 and 111 days on feed. Carcass data needed to determine yield and quality grades were collected.

Results and Discussion

During the previous 72-day feeding period, these steers gained 3.03 lb per day and consumed 17.71 lb dry matter daily with a feed/gain of 5.89. Table 1 illustrates what happens to performance once heavy cattle have been bought and placed back into a short feeding program. Initial and final weights were 1,069 and 1,211 lb, respectively. Cattle performed well during the first 2 weeks back on feed. However, these gains represent compensation for shrink incurred at the time of sale. A significant decrease in performance was noted thereafter.

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[1]Animal Science graduate.
[2]Associate Professor.

TABLE 1. PERFORMANCE OF HEAVY FEEDER STEERS

Item	Feeding period						
	Sept 14-Sept. 20	Sept. 21-Sept. 27	Sept. 28-Oct. 4	Oct. 5-Oct. 11	Oct. 12-Oct. 20	$\bar{x}$	SEM
ADG[a], lb	5.39[c]	5.00[c]	3.04[c]	2.68[c]	1.59[b]	3.54	.63
DMI[a], lb/day	22.82[d]	25.24[c]	26.13[c]	27.17[c]	25.58[a]	25.39	.69
F/G[a]	4.28[d]	5.37[d]	9.93[cd]	13.80[cd]	28.52[c]	12.38	6.25
Cost of gain[b], cents/lb	28.17[d]	32.85[cd]	59.0[cd]	80.5[cd]	83.3[c]	56.77	16.06

[a] Calculated on a full weight basis.
[b] Includes 4% shrink adjustment.
[c,d] Means within a row with uncommon superscripts differ ($P<.05$).

A feeder may allow cattle to remain on feed until a certain date to act upon a more favorable market. Caution should be taken in these situations to ensure that cattle do not become overly fat at that point and performance is not substantially reduced. The companion study of Limousin x Angus steers (Table 2) clearly shows how extra days on feed result in heavy carcasses as well as noting a significant increase in the percentage of yield grade 4 carcasses. Dockage as a result of overly fat or heavy carcasses may offset anticipated profits.

In this study, potential for profit could be seen if a futures contract was sold between October 10 and October 20, 1989 (Figure 1). During this time, October futures contract showed a profit, with the greatest gains occurring on October 18, 1989. Other than this short time during the feeder/ownership period, there was no potential for a positive return on the cattle on the cash or futures markets (Figure 2).

In a given situation, the producer may want to evaluate methods to lower costs of production. Each feeder is presented with a set of circumstances that affect his method of determining costs. For example, one feeder may not include a yardage feed (i.e., buildings are already paid for or depreciated out) or feed resources and costs may differ from one producer to the next. These and other alternatives may reduce costs of production to allow a feeder to realize a profit where someone else may not.

Rather than trying to sell cattle at maximum market price, an optimum market price is preferred. Sometimes producers may fail to realize that time on feed and variables such as average daily gains, feed efficiency and cost of gain that increase with time on feed dramatically influence figures used to determine a breakeven price. In order to project potential returns, purchase price, interest rates, fixed costs and feed costs as well as market price must be considered.

No matter how large or small, the effective feedlot operator should closely monitor levels of performance to maintain maximum efficiency in his operation, know the windows of acceptability in terms of carcass grade and yield and utilize marketing tools available.

TABLE 2. DAYS ON FEED IN RELATION TO CARCASS QUALITY

Item	Days on feed 82	95	111	SEM
No. of animals	64	43	63	
Initial wt, lb	904	903	902	5.3
Final wt, lb	1217^{a}	1227^{b}	1329^{c}	7.3
Carcass wt, lb	751^{a}	780^{b}	826^{c}	3.9
Rib fat, in.	$.51^{a}$	$.63^{b}$	$.66^{c}$	.023
Yield grade, %				
1	0	4	0	
2	52	47	25	
3	44	42	57	
4	4	7	17	

^{a,b,c} Means within a row with uncommon superscripts differ ($P<.05$).
^{d} Heterogeneity among days on feed ($P<.01$).

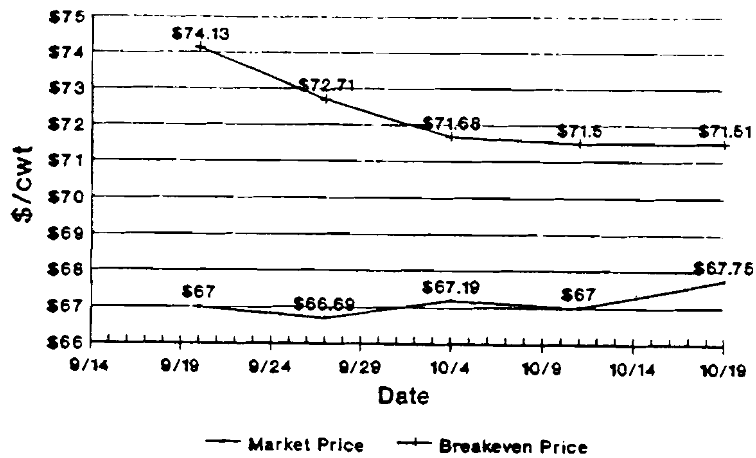


Figure 1. Breakeven in relation to market prices during feeding period.

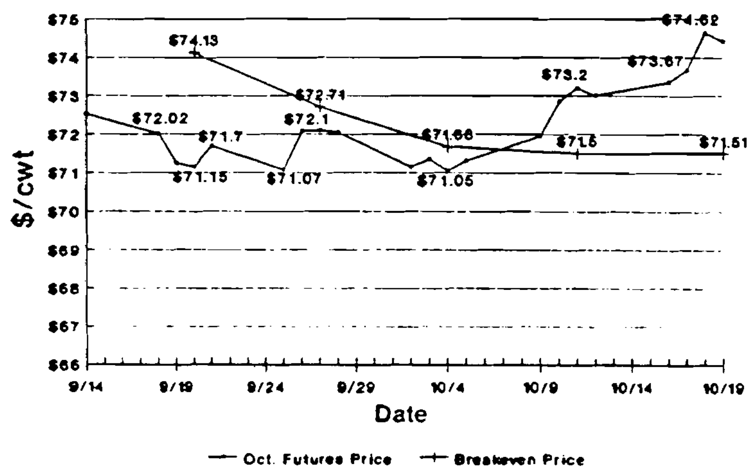


Figure 2. Breakeven in relation to October futures prices during feeding period.

A FIVE-YEAR CASE HISTORY OF RETAINED OWNERSHIP

D. M. Marshall[1] and J. J. Wagner[2]
Department of Animal and Range Sciences

CATTLE 90-15

Summary

A case history of retaining ownership of steer calves from weaning through slaughter was examined for calves born in 1985 through 1989. Calves were reared to weaning at the SDSU Antelope Range Livestock Station and following weaning were managed under a custom feedlot arrangement. Retaining ownership from weaning through slaughter resulted in profits of $1.83, $215.41, $162.75, $78.58 and $80.65 (excluding interest on calf) for the 1985 through 1989 calf crops, respectively. Cattle prices, feed costs and postweaning profitability tended to vary over years considerably more than cattle performance.

(Key Words: Beef, Retained Ownership, Feedlot.)

Introduction

Retained ownership may be defined as maintaining ownership of cattle beyond the traditional sale time. For cow-calf producers, retained ownership represents another marketing alternative where ownership of the calf crop is maintained beyond the traditional sale at weaning.

When examined over a period of several years, retained ownership of feeder calves through slaughter has been shown to consistently improve profitability of cow-calf operations. Kansas data showed that, when calves were sold at weaning, average net profit per cow was $4.89 from 1974 through 1988. Profit ranged from -$106.79 in 1974-75 to $115.00 in 1987-88. Average profitability for the feedlot phase of production of over 7,000 steers that were fed as part of the Kansas steer futurities was $49.57 per head. Producers selling calves at weaning would have experienced positive returns in six of the 14 years studied. Producers who retained ownership of steer calves through the feedlot phase of production experienced positive returns (cow-calf and postweaning production phases combined) in 10 of the 14 years studied.

Ownership has been retained through slaughter of a portion of calves born at the SDSU Antelope Range Livestock Station for the past five calf crops. While the primary purpose of retaining ownership was so that carcass information could be obtained as part of a breeding research project, the project also provides an actual case study of one particular type of retained ownership. The objective of this paper is to summarize our experiences over the past five years with retaining ownership of calves through slaughter in a custom feeding arrangement.

Materials and Methods

This study included data from two- and three-breed crossbred steers born primarily in March or April at the Antelope Range Livestock Station in northwest South Dakota. The calves were weaned at an average age of 7 months and transferred to a commercial custom feedlot about three weeks later. Half of the steers were retained each of the first 3 years and all steers were retained the last 2 years (Table 1).

The primary feedstuffs used at the feedlot were corn grain, corn silage and alfalfa hay. Energy levels were increased quite rapidly after entry of cattle into the feedlot. Steers were slaughtered the following May or June at commercial slaughter facilities and carcasses were graded after a minimum 24-hour chill. For calf birth years 1985 through 1988, all steers were slaughtered on the same day. Calves born in 1989 were slaughtered on two dates (4 weeks apart), and the figures presented in Table 1 represent averages over the two slaughter dates.

Calf price at weaning (Table 2) is the estimated price at which the calves could have been sold at weaning time if ownership had not been retained. Estimated value of calves at weaning is the estimated weaning price multiplied by the average weight of calves entering the feedlot. Performance and costs during the period between actual weaning and entry

[1]Associate Professor.
[2]Assistant Professor.

TABLE 1. FEEDLOT PERFORMANCE OF STEERS

Item	Year of calf birth 1985	1986	1987	1988	1989	Average[a]
No. calves started	56	57	55	106	94	
No. calves finished	54	57	54	104	91	
Days in feedlot	211	203	210	206	196	205
Avg daily gain, lb/day	3.18	3.16	3.12	3.41	3.11	3.20
Final live wt, lb	1185	1158	1188	1177	1158	1173
Avg feed intake, lb/day	25.3	26.7	24.8	26.4	25.9	25.8
Feed/gain, air dry	6.94	6.92	6.55	6.01	6.78	6.64
Percent Choice carcasses	77	73	78	60	68	71
Cost/lb gain, $[b]	.433	.324	.353	.398	.439	.389
Cost/head/day, $[b]	1.34	1.03	1.10	1.34	1.36	1.23

[a] Simple average of the 5 years.
[b] Does not include death loss.

TABLE 2. ECONOMIC PERFORMANCE OF STEERS IN THE FEEDLOT

Item	Year of calf birth 1985	1986	1987	1988	1989
Estimated calf price at weaning, $/cwt	62.00	67.00	85.00	98.00	95.00
Slaughter price, $/cwt	54.52	67.60	73.34	72.09	76.46
Slaughter sales, $/head	617.00	778.83	855.22	832.52	857.12
Feedlot charges, $/head	282.93	208.24	229.84	276.07	262.02
Estimated value of calves entering feedlot, $/head	318.86	345.72	452.05	465.45	502.92
Estimated gross profit, $/head	15.21	224.87	173.33	91.00	92.18
Estimated net profit (less operating interest), $/head	1.83	215.41	162.75	78.58	80.65

into the custom feedlot were not considered in the postweaning analysis. Slaughter price is the price at which the calves were actually marketed, and slaughter sales represents the amount received per head when marketed. The figures for both slaughter price and slaughter sales have had costs of trucking from the feedlot to slaughter plant and beef promotion check-off charges deducted. The line labeled feedlot charges was the total amount actually paid to the custom feedlot per calf entering the feedlot for feed, lot space, health treatment, etc. All items expressed on a per-head basis in Table 2 are based on the number of calves entering the feedlot. Therefore, financial losses associated with death loss in the feedlot have been accounted for.

Estimated gross profit during the postweaning feedlot period was computed as slaughter sales minus the estimated value of calves at weaning minus cumulative feedlot charges. Estimated net profit was computed by deducting interest on feedlot charges from estimated gross profit. Interest on feedlot costs accrued during the first half of the feedlot period was charged for the full feedlot period. Interest on feedlot costs accrued during the second half of the feeding period was charged for only one-half of the feedlot period. No interest was charged for the value of calves entering the feedlot.

Results and Discussion

Cattle performance in the feedlot is presented in Table 1. Postweaning death losses in the feedlot over the 5-year period amounted to 8 out of 368 steers (2.2%). Average daily gain and feed conversion were quite consistent from year to year except for the 1988-born calves. Apparently, drought conditions in 1988 were associated with depressed weights of calves entering the feedlot and with subsequent compensatory gains and improved feed efficiency in the feedlot. Relatively mild weather during the winter and spring of 1988-89 may have contributed to the improved feedlot performance compared to the other years. Average daily feedlot costs per animal and cost per pound of gain tended to vary over years (death loss effects were not included in these figures). These costs appeared to be more closely associated with feedstuff costs than with calf performance.

Presented in Table 2 are various costs and returns associated with postweaning feedlot production. A striking feature of these figures is the magnitude of variation over years in cattle prices, feedlot costs (primarily a function of feed prices) and estimated profitability of retaining ownership. Relative profitability was largely dependent upon feedlot cost of gain and the relationship between estimated weaned calf price and slaughter calf price. Death losses were also an important factor. Profitability was not closely related to fall calf price alone. Relatively high feed costs and a death loss of two out of 56 calves contributed to the relative lack of profitability of the 1985-born calves. Retaining ownership of the 1986-born calves proved to be highly profitable, as there was a general increase in cattle prices between fall of 1986 and spring of 1987, along with low feed costs and no death loss in the feedlot. Relatively large profits from retaining ownership continued for the 1987-born calf crop. Relatively higher opportunity costs associated with not selling at weaning (i.e., higher estimated fall calf price), along with relatively higher feed costs, contributed to lower profits for the 1988- and 1989-born calf crops compared to the two previous calf crops. As mentioned previously, no interest charge was assumed for the value of calves entering the feedlot (capital investment). Thus, the estimated net profit figures in Table 2 should be interpreted as dollar return on the value of calves entering the feedlot (dollar return on investment). If interest for the opportunity cost associated with not selling calves at weaning was charged for the feedlot period at an annual rate of 11%, then estimated net profit figures would be $-18.45, $194.26, $134.14, $49.68 and $50.94 per head for 1985, 1986, 1987, 1988 and 1989, respectively.

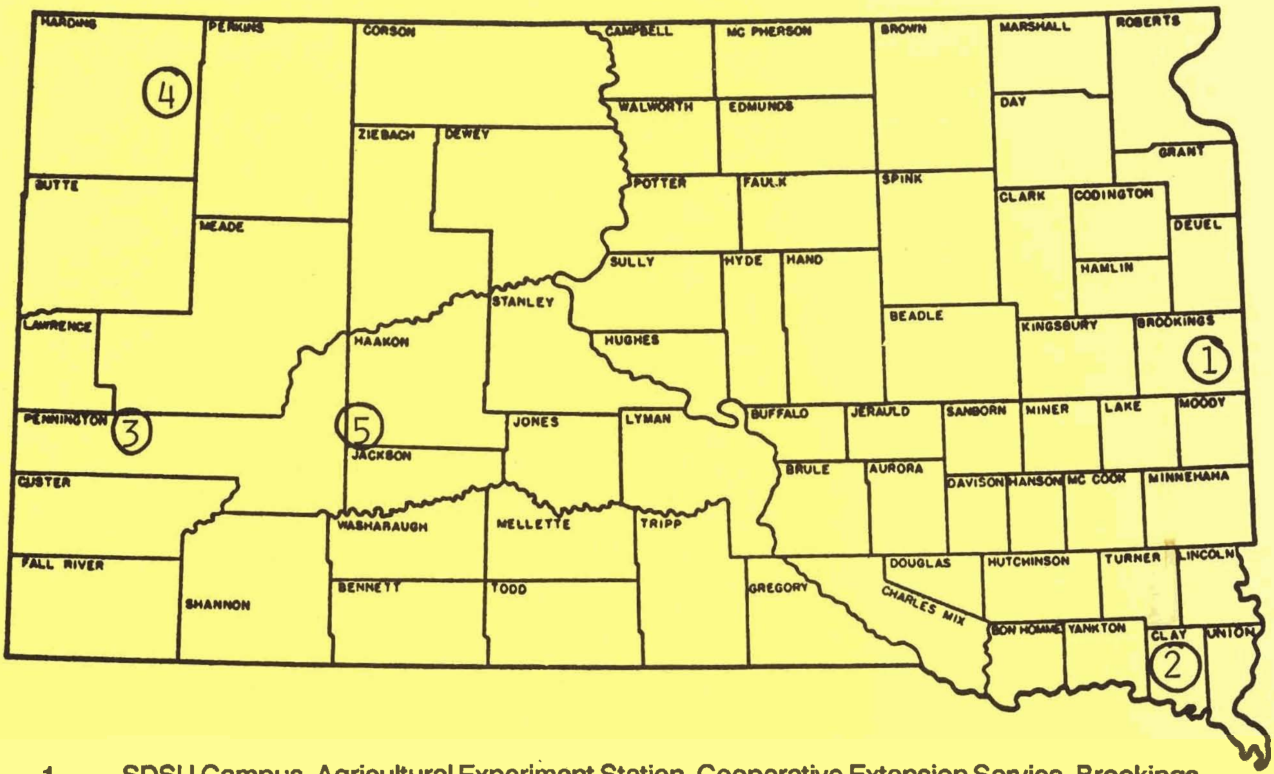
These figures do not take profitability of the cow-calf operation into account, which helps explain why profitability of retained ownership for the 1986-born calf crop exceeded that of the last three calf crops even though cattle prices were lower. If calves had been marketed at weaning, profitability would have been higher for the last three calf crops than for the 1986-born calf crop. Profitability of retained ownership was calculated essentially the same as it would be if calves were purchased at weaning, with the purchase price equal to the estimated value of calves at weaning. With all other factors held constant, an increase in the value of calves at weaning would result in increased profitability of the cow-calf operation but decreased profitability of retaining ownership. Of course, the combined profitability of weaned calf production and postweaning production through slaughter is not actually affected by weaned calf value if the calf is not marketed at weaning.

The decisions involved in participation in retained ownership must be determined by each individual cow-calf producer after careful consideration of various factors such as financing, risk tolerance, price outlook for cattle and feed, identification of a feedlot and postweaning performance of the cattle. Also, the choice to retain ownership isn't simply a yes/no question but also one of magnitude, because of the option to limit participation in retained ownership to only a portion of the calf crop. The fact that the financial figures tended to fluctuate relatively much more than cattle performance over years illustrates the risks associated with retaining ownership. Postweaning performance should not vary tremendously from year to year for cattle from the same herd fed in the same feedlot. Therefore, it is possible that price risks could be reduced through use of forward contracting and(or) futures markets.

The following companies and individuals generously provided livestock commercial products, equipment, grant funds or their time in support of beef cattle research, extension and teaching programs at South Dakota State University:

American Cyanamid Co., Inc., Wayne, NJ
Central Bi-Products, Redwood Falls, MN
Fall River Feedlots, Fall River, SD
Hoescht Roussel, Sommerville, NJ
IMC, Pitman-Moore, Inc., Terre Haute, IN
MacKenzie Associates, Roundhill, VA
Merck and Company, MSD-AGVET, Rahway, NJ
Purina Mills, Inc., St. Louis, MO
R and L Feedyard, Kimball, SD
Select Sires, Inc., Plain City, OH
Sioux Falls Stockyards, Sioux Falls, SD
Southeast SD Experiment Farm Corporation
SD Beef Cattle Improvement Association
SD Cattlemen's Association
SD Corn Utilization Council
SD Livestock Foundation
SD Stockgrowers Association
SD Veterinary Medical Association
Syntex Corporation, Des Moines, IA

ANIMAL AND RANGE SCIENCES
RESEARCH AND EXTENSION UNITS



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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