2000

2000 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

SOUTH DAKOTA

Department of Animal and Range Sciences

2000 BEEF Report

South Dakota State University
Agricultural Experiment Station
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February 2000

Dear Beef Producers, Industry Personnel, Researchers and Educators:

It is a pleasure for the faculty and staff of the Department of Animal and Range Sciences at South Dakota State University to present this report of the results of our beef research programs. The report is a compilation of the most recent results from trials conducted at our campus research centers, the Cottonwood and Antelope Research Stations, the Southeast Research Farm and on-farm trials.

The research addresses a broad spectrum of topics ranging from very applied feeding and management trials to more basic investigations of what is happening within the animal. All of the research is directed at solving problems that those of you working in the industry face on a daily basis. It is our intent that these research findings will help to make you more profitable and competitive.

We are very appreciative of the input that so many of you have provided to our program and of the support we have received from our state commodity organizations and from numerous allied industry organizations.

I thank you for your interest in our SDSU beef programs and I invite you to not only read the report, but to contact the appropriate faculty if you have questions. More information regarding our department and programs can be found at our web site.

www.abs.sdstate.edu/ars/index.htm

South Dakota State University is your Land Grant University and we are here to serve the people of the State. Please let us know if you have questions, concerns or ideas that you would like to see us explore.

Sincerely,

Don Boggs

Donald L. Boggs, Head
Department of Animal and Range Sciences

Interpreting Experiment Results

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

CATTLE 00-1

A typical experimental format involves evaluating the response caused by application of alternative 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. Statistical procedures can be useful to determine the extent to which observed variation is due to treatment effects versus other factors.

For example, suppose that animals receiving Diet A grow faster than animals receiving Diet B. Was the observed difference in growth rates actually due to dietary differences or to other factors (e.g., genetics, age, sex, measurement error, 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 statistical analyses. A brief discussion of some of the more common statistics encountered in animal research follow.

Average or Mean. These two terms are used interchangeably. We often compare mean values of treatment groups for variables of interest. In some studies, least-squares means are reported rather than the raw means. In so-called "balanced" studies, least-squares means are often the same as raw means. However, when experimental subjects are distributed across treatment groups in an uneven or biased manner, than adjustments to the means are needed to account for the bias. Appropriate adjustments are made by the procedure of least squares.

Correlation Coefficient. This statistic is a measure of the degree of association between two variables and can range from -1 to +1. A strong positive correlation (close to +1) indicates that high values of one variable tend to occur more often than not in combination with high values of the other variable. Similarly, low values of one variable tend to be associated with low values of the other variable. In humans, for example, we generally expect a rather strong, positive correlation between height and weight. Taller individuals tend to be heavier, whereas shorter individuals tend to weigh less, on average. A strong negative correlation (near -1) indicates that high values of one trait tend to be associated with low values of the other trait. A correlation coefficient near zero indicates that the two variables are largely independent of one another.

Regression Coefficient. This statistic indicates the average change in variable Y for each one-unit increase in variable X. In its simplest form (i.e., linear regression), the regression coefficient is simply the slope of a straight line. A regression equation can be used to predict the value of the dependent variable (Y) for a given value of the independent variable (X). A more complicated procedure, known as multiple regression, can be used to derive an equation that uses several independent variables to predict a single dependent variable. An example is the USDA beef cutability equation, in which % cutability is predicted from carcass weight, external fat thickness, KPH fat, and rib-eye area.

Variance. This is a measure of variation of a variable (trait). Its unit is the square of the unit of measurement (e.g., lb^2).

Standard Deviation. This is also a measure of variation calculated as the square root of the variance. Thus, its units are the same as the original trait.

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[1]Professor

Coefficient of Variation (C.V.). The C.V. is calculated as the standard deviation divided by the mean for a particular variable or trait. Dividing by the mean removes the effects of scale and units from the variable, which allows a comparison of the relative variation between two traits. The variance or standard deviation of different traits cannot be directly compared, but it might be appropriate to compare their C.V.'s.

Standard Error. Data presented in an experiment are normally based on a sample of experimental subjects drawn from some larger population. Hence, a statistic (parameter) calculated from the sample group is only an estimate of that parameter's value in the entire population. A value known as a standard error is often calculated for parameter estimates such as the mean, correlation, or regression coefficient. The standard error is an indication of the possible error associated with such estimates. It is calculated as a ± value (deviation).

The magnitude of the standard error depends on the animal to animal variation and on the number of animals in the sample from which the parameter was estimated. As sample size increases, a larger proportion of the whole population is included, and the likelihood is increased that the parameter estimated from the sample will closely approximate the overall population parameter. The standard error decreases as sample size increases.

Probability Value or Statistical Significance (P-Value). Statistical comparisons will often be accompanied by a probability (P) value. Suppose, for example, a research paper indicated "calves receiving Diet A gained .35 lb per day more (P=. 05), on average, than calves receiving Diet B." For practical purposes, we can interpret this statement to mean that the probability of attaining a difference of at least .35 lb/day for reasons other than dietary effect is about 5%. Such a difference may be said to be statistically significant at the .05 level of probability.

A difference larger than .35 lb/day in the example above would have resulted in a smaller P-value. A smaller P-value reflects increased confidence that there is a true underlying effect of the treatment. When differences between treatment means are relatively small—compared to differences between animals receiving the same treatment—then the P-value will be higher and we cannot confidently conclude that there was a true treatment effect. The size of difference required to achieve a given P-value varies between traits and studies. All other factors being equal, as sample size increases, a smaller treatment difference is required to achieve a given level of statistical significance.

Evaluating the Agronomic Feasibility of Planting Late Season Corn for Feedlot Cattle

W.M. Cerkoney[1], R.H. Pritchard[2] and Z.W. Wicks III[3]
Animal and Range Sciences and Plant Science

CATTLE 00-2

Summary

Yield, lb/acre, bushel weight (**BD**), lb/bu, relative maturity (**RELMAT**), chemical composition and in vitro dry matter digestibility (**IVDMD**) were used to screen corn varieties (n = 20) of varying maturities grown under the stress of a shortened growing season. Corn varieties were planted in late June of 1996. Whole shell corn (**WSC**) and ear corn (**EC**) were harvested. Bushel weight was quantified on WSC. Yields for WSC, and EC were 1941 ± 706 and 2307 ± 997 lb DM/acre, respectively. Whole shell corn and EC were sorted into yield (**YGP**) groups. Whole shell corn yields were 2942 ± 248, 2305 ± 138, and 1292 ± 343 lb DM/acre for YGP1 through YGP3, respectively. The EC yields were 3740 ± 207, 2980 ± 208, 1897 ± 235 and 1139 ± 455 lb DM/ acre for YGP 1 through 4, respectively. For WSC, YGP 1, YGP 2 and YGP 3 produced 2529, 1956 and 1099 lb TDN/ac, respectively. Ear corn YGP 1, YGP 2, YGP 3 and YGP 4 produced 2980, 2180, 1437 and 780 lb of TDN/ac, respectively. Increased yield in corn varieties grown under the stress of a shortened growing season was attributed to an increase in starch content. Even so, digestibility and energy content were not related (P > .05) to yield or BD. Relative maturity did not influence (P > .05) chemical composition, digestibility or energy content. Results suggest that while selecting earlier maturing corn for short growing seasons improves yields, it gives no advantage to feed value. Bushel weight, yield or maturity date should not be used as single criteria when predicting feed value of corn grown under the stress of a shortened growing season.

Key words: Stressed corn, Feeding value, Ear corn

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Introduction

Wet springs, drought, disease and early frost, are all factors that prevent corn, in this region, from reaching maximum yield, desired moisture content, and full maturity. When corn crops do not reach full maturity and are grown under stressful growing conditions, "soft corn" production or corn with low bushel weights is often the result. Low yielding corn generally is associated with a decrease in BD and assumed to have a lower feeding value for livestock.

However, previous research here and at the University of Nebraska concluded that corn that was below USDA Grade No. 2 corn did not have a lower feeding value than No.2 corn.

The objective of this research was to screen corn varieties grown under the stress of a shortened growing season for usefulness as livestock feed. Corn varieties were evaluated for yield, chemical composition, and digestibility. This information is intended to aid cropping decisions in years when planting is delayed.

Materials and Methods

Twenty corn varieties of varying maturity were planted late June, 1996. Corn plots were located at the South Dakota State University Agronomy research plots at Brookings. Corn varieties planted and their respective growing degree day (**GDD**) requirements are listed in Table 1.

Each corn variety was represented by 12 rows. Three test plots (P1, P2, and P3) consisting of two rows/plot were marked out for each variety to collect harvest yield data.

Table 1: Research Corn Varieties and Respective Growing Degree Day (GDD) Requirements

Variety	Growing Degree Day Requirement
De Kalb (DK)	
DK 471	NA
DK 646	2830
Cargill (CG)	
CG 7697	2550
CG 3777	2200
Pioneer (PI)	
PI 3357	2610
PI 3559	2530
PI 3733	2400
PI 3563	2550
PI 3751	2400
PI 3730	2400
Dairyland (DL)	
DL 10803	2470
DL 1407	2465
Golden Harvest (GH)	
GH H2502	2502
GH H2547	2547
Terra (TR)	
TR E1106	2560
TR E1136	2620
TR TR1126	2600
TR TR1130	2650
Croplan (CR)*	
CR 661	3394
CR 674	3394

*Croplan varieties GDD were based on a 55-86 °F scale. All other varieties were based on a 50-86 °F scale.

Relative maturity was calculated for each variety by dividing the actual growing degree units (**GDU**) that occured by the total GDU each corn variety required for full maturity and was expressed as a percentage. Each variety was exposed to 2015 actual GDD (from planting to the first killing frost).

Fall snow storms delayed harvest until December 26 and 27, 1996. Ears were hand picked from one row of each test plot. Test plots within a variety were pooled. De Kalb 471 was lodged and lost due to the heavy snowfall. Five sample ears from each variety were collected and frozen for subsequent determination of moisture content of the EC at harvest. The remainder of the harvested ears, were dried down to approximately 12% moisture content. After drying, ear corn weights were recorded for each pooled variety sample. Each variety sample was divided into two equal aliquots. One aliquot was shelled for WSC yield and bulk density calculations.

Ear corn samples frozen at harvesting were lypholized to determine the DM content (FIELDM) at harvest. Whole shell corn and EC were analyzed for CP, starch, ether extract (EE), ADF, NDF and ash content.

The TDN content of EC and WSC was estimated based upon ADF content and also by two stage in vitro digestion.

Energy content (ME, NE_m and NE_g) was predicted from both ADF content and IVDMD derived TDN.

Variety data were compared using the General Linear Models procedure of SAS (1996) for a completely randomized design. Statistical analysis was based on assay replication not plot replication since plots 1, 2 and 3 for individual varieties were composited. Linear regression analysis was used to determine relationships among yield, bulk density (bushel weight), RELMAT, chemical composition, digestibility and energy content.

Results and Discussion

Whole Shell Corn Analysis

Chemical composition, yield, BD, RELMAT, IVDMD, and energy content (ME, NE_m, and NE_g) of corn grain varieties are presented in Table 2, along with, 1996 Beef NRC chemical composition and energy content values for 54 lb/bu corn.

Table 2: Whole Shell Corn: Composite Chemical Composition[a] of 17 Corn Varieties

Nutrient	Mean	SD	NRC '96[b]
DM/acre, lb	1941	706	
BD, lb/bu	36	4.28	56
RELMAT,%	80.58	4.46	
Ash, %	1.84	.19	1.60
CP, %	9.42	.72	9.80
NDF, %	17.89	2.58	9.00
ADF, %	4.88	.77	3.30
Starch, %	74.97	4.22	75.3[c]
Ether Extract, %	2.43	.36	4.30
TDN, %[d]	84.72	1.18	88
ME, Mcal/,lb[e]	1.42	.04	1.45
NE_m, Mcal/lb[e]	.95	.04	.99
NE_g, Mcal/lb[e]	.65	.03	.68
IVDMD, %	88.29	2.62	
ME, Mcal/lb[f]	1.45	.04	
NE_m, Mcal/lb[f]	1.00	.03	
NE_g, Mcal/lb[f]	.69	.03	

[a]Differences were detected ($P < .01$) among varieties in chemical composition, yield, and maturity.
[b]National Research Council (NRC), Nutrient Requirements of Beef Cattle
[c]NRC '96 starch content was calculated by subtracting CP, NDF, Ether Extract and ash content NRC '96 values from 100
[d]TDN, % was derived from ADF content
[e]ME, NE_m and NE_g values were calculated using NRC '96 equations applied to TDN estimate
[f]ME, NE_m and NE_g values obtained for IVDMD were calculated by replacing TDN values in the NRC '96 computer program with IVDMD values

As BD increased, there was a linear decrease in NDF (P< .01), ash (P< .01), CP (P< .05) and ADF content (P< .05). Bulk density was positively related to starch (P< .01) and EE content (P< .10). Even though ADF content was influenced by BD, IVDMD and energy content were not related to BD (P> .10). BD and yield were related (r^2=.65; P< .0001).

As RELMAT increased, the agronomically important traits of BD and yield increased linearly (P< .10). However, RELMAT did not influence feed value (P> .10) measured as chemical composition, IVDMD, or energy content. As yield increased, CP, NDF and ash content (%) decreased linearly (P< .05). Ether extract content increased linearly (P< .10), and starch content increased linearly (P< .01) as yield increased. Yield was related to ADF content cubically (P< .05). In vitro dry matter digestibility and energy content were not related to yield (P> .10).

Table 2 compares energy content predicted from TDN content and IVDMD. Energy content predicted from IVDMD values were higher and more closely related to 1996 Beef NRC (1996) energy content values for No. 2 corn than energy content predicted from ADF values.

Whole shell corn varieties were sorted into DM yield groups (YGP 1, YGP 2, and YGP 3) based on natural separations in yield production records. Yield group 1 consisted of the following varieties: PI 3559, PI 3733, and PI 3751. Pioneer 3357, CG 3777, PI 3563, PI 3730, DL 1407 and GH H2547 were the varieties represented by YGP 2. Yield group 3 was represented by the remaining varieties: CG 7697, DK 646, DL 10803, GH H2502, TR E1106, TR TR1126, CR 661 and CR 674. Dry matter group yields and chemical composition results are represented in Table 3.

Bushel weight decreased linearly (P< .01), as yield declined from YGP 1 to YGP 3. Crude protein, NDF, and ash content decreased (P< .05) linearly as yield increased, while ADF content was not influenced (P> .10).

Table 3: Whole Shell Corn: Corn Yield Groups (YGP)

	YGP 1 n = 3	YGP 2 n = 6	YGP 3 n = 8	
Nutrient	Mean	Mean	Mean	EMS
DM/acre, lb	2949[a]	2310[b]	1295[c]	67108
BD, lb/bu	41[a]	38[b]	33[c]	1301
RELMAT, %	82.52	82.10	78.09	52.97
Ash, %	1.66	1.80	1.94	0.02
CP, %	8.93[a]	9.22[ab]	9.76[b]	0.42
NDF, %	15.51[a]	16.81[a]	19.60[b]	3.84
ADF, %	4.25	4.93	5.09	0.53
Starch, %	79.61[a]	77.06[a]	72.03[b]	10.68
Ether Extract, %	2.63	2.53	2.28	0.11
IVDMD, %	87.82	88.32	89.13	8.43
ME, Mcal/kg[d]	1.44	1.46	1.45	0.002
NE_m, Mcal/kg[d]	.99	1.00	.99	0.001
NE_g, Mcal/kg[d]	.68	.69	.68	0.001

[a,b,c]Means in a row with uncommon superscripts differ (P < .05)
[d]ME, NE_m and NE_g values obtained for IVDMD were calculated by replacing TDN values in the NRC '96 computer program with IVDMD values

Ear Corn Analysis

Chemical composition, yield, RELMAT, IVDMD and energy content (ME, NE_m, and NE_g) of whole ear samples (n = 19) are presented in Table 4 along with 1996 Beef NRC chemical composition and energy content values for 56 lb/bu (No. 2) EC.

As FIELDM content increased, EC yield was influenced quadratically ($P < .05$). As yield increased, EE content (%) increased linearly ($P < .01$). Starch, CP, and ash content (%) were affected quadratically ($P < .001$) by yield. NDF and ADF content (%) were affected cubically by yield ($P < .01$).

As RELMAT (%) increased, yield increased ($P < .01$). The DM content of EC at harvest was influenced cubically ($P < .05$) by RELMAT. Relative maturity also had a cubic effect ($P < .05$) on ash, starch, NDF, and ADF content (%) of EC.

In vitro dry matter digestibility was not related to ($P > .10$) yield. As ADF and NDF content increased, IVDMD decreased ($P < .01$). Relative maturity influenced IVDMD cubically ($P < .05$).

Ear corn varieties were sorted into DM yield groups (YGP 1, YGP 2, YGP 3, and YGP 4) based on natural separations in yield production records (Table 5). Pioneer 3559 and PI 3733 varieties made up YGP 1. Yield group 2 consisted of the following varieties: PI 3357, CG 3777, PI 3563, PI 3751, PI 3730, DL 1407, GH H2502 and GH H2547. Yield group 3 was represented by the following varieties: DK 646, DL 10803 and TR TR1126. Yield group 4 consisted of the remaining varieties: CG 7697, TR E1106, TR E1136, TR TR1130, CR 661 and CR 674.

As yield increased from YGP 4 to YGP 1, FIELDM, RELMAT, starch and EE content increased linearly ($P < .10$). Crude protein, ADF, NDF and ash content decreased linearly ($P < .10$) as yield increased, while energy content and IVDMD were not influenced ($P > .10$).

To evaluate the feed potential per acre of cropland, TDN production per acre was calculated based upon dry matter yields and IVDMD. Whole shelled corn from yield group 1, 2, and 3 produced 2529, 1956 and 1099 lb TDN/ac respectively. Total TDN production could be increased by harvesting the crops as ear corn. , This would also accommodate dry down and shelling problems associated with soft corn. TDN production for the four ear corn yield groups was 2980, 2180, 1437 and 780 lb/ac.

Conclusion

Delayed planting and/or early frost create several concerns for farmer/feeders. When planting is delayed and corn is being planted for the sole purpose of livestock feed production, neither, maturity or bushel weight, (lb/bu) were consistently related to total digestible nutrient production/acre. Yield (lb DM/acre) and especially production/acre are the top priority when the production of livestock feed is the goal. Among the corn varieties screened, Pioneer 3559, Pioneer 3733 and Pioneer 3751 were the most suitable for the production of livestock feed when corn was grown under the stress of a shortened growing season.

Table 4: Ear Corn Chemical Composition[a] of 19 Corn Varieties

Nutrient	Mean	SD	NRC '96[b]
DM/acre, lb	2307	997	
RELMAT, %[h]	80.65	5.07	
Ash, %	1.95	.37	1.90
CP, %	8.52	1.38	9.00
NDF, %	35.79	8.56	28.00
ADF, %	14.46	3.86	9.20[c]
Starch, %	57.97	13.08	57.4[d]
Ether Extract, %	2.04	.31	3.70
TDN, %[e]	71.93	7.33	82.00
ME, Mcal/lb[f]	1.18	.05	1.35
NE_m, Mcal/lb[f]	.77	.04	.91
NE_g, Mcal/lb[f]	.49	.03	.61
IVDMD, %	82.54	2.82	
ME, Mcal/lb[g]	1.35	.05	
NE_m, Mcal/lb[g]	.92	.04	
NE_g, Mcal/lb[g]	.62	.03	
FIELD DM, %	47.87	12.60	

[a]Differences were detected ($P < .01$) among varieties in chemical composition, yield, and maturity.
[b]National Research Council (NRC), Nutrient Requirements of Beef Cattle
[c]ADF was calculated from 1996 NRC TDN content
[d]NRC '96 starch content was calculated by subtracting CP, NDF, Ether Extract and ash content NRC '96 values from 100
[e] TDN, % was estimated from ADF content
[f]ME, NE_m and NE_g values were calculated using NRC '96 equations applied to estimated TDN
[g]ME, NE_m and NE_g values obtained for IVDMD were calculated by replacing TDN values in the NRC '96 computer program with IVDMD values

Table 5: Ear Corn: Yield Groups (YGP)

	YGP 1n = 2	YGP 2n = 8	YGP 3n = 3	YGP 4n = 6	
Nutrient	Mean	Mean	Mean	Mean	EMS
DM/acre, lb	3740[a]	2980[b]	1897[c]	1139[d]	98972
RELMAT, %[e]	87.10[a]	82.14[ab]	76.76[ab]	77.36[b]	435319
FIELD DM, %	58.43[a]	54.52[a]	47.55[ab]	35.65[b]	92.19
Ash, %	1.70[a]	1.71[a]	1.99[ab]	2.33[b]	0.07
CP, %	7.75[a]	7.76[a]	8.67[ab]	9.72[b]	1.30
NDF, %	27.14[a]	33.09[ab]	32.66[ab]	43.93[b]	45.63
ADF, %	10.66[a]	13.93[ab]	12.39[ab]	17.47[b]	11.29
Starch, %	68.41[a]	63.11[ab]	61.66[ab]	45.81[b]	114.69
EE, %[f]	2.47[a]	2.08[ab]	2.10[ab]	1.81[b]	0.07
IVDMD	85.71	81.90	84.61	81.31	6.53
ME, Mcal/kg[g]	1.41	1.35	1.39	1.34	.002
NE_m, Mcal/kg[g]	.96	.91	.95	.90	.001
NE_g, Mcal/kg[g]	.65	.61	.64	.60	.001

[a,b,c,d]Means in a row with uncommon superscripts differ P < .05

[e]RELMAT (relative maturity) for YGP 4, there are only 4 varieties included in the mean. Croplan 674 and Croplan 661 were eliminated from the data set because of different growing degree day ratings.

[f]Ether Extract

[g]ME, NE_m and NE_g values were calculated using NRC '96 equations applied to estimated TDN

The Effects of Energy Source and Yeast (Biosaf Sc47) on Feedlot Performance During the Receiving Period

B. J. Johnson[1] and B. D. Rops[2]

CATTLE 00-3

Summary

An experiment was conducted to determine the effects of soyhulls and Biosaf yeast (Saccharomyces cerevisiae) on feedlot performance during the receiving period of newly weaned calves. Two energy sources; corn and soyhulls were fed with or without Biosaf yeast (10g/hd/d). We utilized 154 head of newly weaned steer calves (BW=509 lb). Energy source had no effect (P>.10) on feedlot performance during the 35d receiving period. Inclusion of Biosaf yeast had no effect on feedlot performance during the 35d receiving period. Consequently, feed cost of gain ($/cwt) was identical for all treatments. Those results indicate soyhulls can replace corn in receiving diets if priced competitively. A longer receiving trial may be needed to detect difference in feedlot performance due to Biosaf yeast inclusion.

Introduction

Starting newly weaned calves on feed can be very challenging. Cattle feeders can be faced with feed intake problems, health disorders, and digestive problems. The energy density of the diet as well as the amount of the diet fed can impact the feedlot performance during the receiving period (first 21 to 35d) and the overall health status of the cattle during that period.

Calves fed a high roughage (low energy) diet most often have reduced performance (ADG and F/G) as compared to calves fed a more energy dense diet (≥.48 Mcal NEg/lb). Interestingly, calves fed the higher energy diet most often encounter more health problems (respiratory, digestive, and metabolic disorders) as compared to calves on a high roughage diet. One of these specific problems is subacute acidosis. A newly weaned calf may go days without eating, when it does come to the bunk it often over consumes. If the diet is high in starch, over consumption may cause subacute acidosis, which can manifest itself by causing reduced efficiency throughout the feeding period. One way to circumvent this problem is to feed a diet that is relatively high in energy but low in starch. Soyhulls are an example of a feedstuff that meet this criteria.

Soyhulls are a co-product of soybean processing. Soyhulls represent the outer coating of the soybean. The energy density of soyhulls is quite high (77% TDN; .55 Mcal NE g/lb). However, there is little to no starch in soyhulls. The energy is derived from the highly digestible neutral detergent factor **(NDF)**. Due to the low starch content in soyhulls, the inclusion of soyhulls in receiving diets should help alleviate metabolic disorders while maintaining adequate performance.

Inclusion of "microenhancers" such as Biosaf (Saccharomyces cerevisiae) yeast[3] may also improve feedlot performance during the receiving phase period. First, research has shown yeast may have a positive associative effect on fiber digestion. It may be plausible to expect Biosaf to enhance the NDF digestion of the soyhulls in this particular trial. Secondly, there is evidence that Biosaf increases rumen pH in cattle fed high starch diets. This slight increase in rumen pH could help eliminate acidosis in cattle with erratic eating behaviors. To our knowledge, no one has ascertained the efficacy of Biosaf in receiving diets with varying levels of starch in the diets. Therefore, the objective of this experiment was to determine the effects of soyhulls and Biosaf on feedlot performance during the receiving period of newly weaned calves.

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Table 1. Experimental Design

Energy Source	Corn	Corn	Soyhulls	Soyhulls
Biosaf	-	+	-	+
No. Pens	5	4	4	5
No. Steers	43	34	34	43
Initial Wt., lb.	508	511	507	511

Materials and Methods

We utilized 154 head of predominately straight-Angus steer calves with an average initial weight of 509 lbs. These steers were newly weaned calves (within 36 h of going on test) from a ranch in Western South Dakota. This trial began November 3, 1998 and ended December 7, 1998 for a total of 35 days. These steers were randomly assigned to four treatments (Table 1).

Processing on day 1 included vaccinations for IBR, BRSV, BVD, PI_3, 7-way, Pasteurella and administered Dectomax pour-on for internal and external parasites. The steers were not implanted during this receiving trial.

Pens of steers were allowed to consume feed ad libitum. Pens were fed once daily beginning at 0830. The appropriate receiving diet (Table 2 and 3) was fed for the duration of the 35d-trial.

On test weights were recorded approximately 12 h after feedlot arrival. Steers had access to grass hay and water during this period. Forty-eight hours prior to completion of the trial all pens were placed on the soyhull diet (Table 2) to equilibrate the fill effects on final weight. The appropriate supplements (Table 3) were fed for the entire 35 d period. Water was removed the afternoon before going off test. Weekly samples of every ingredient (Table 2) of the diet were collected and frozen for lab analysis. Samples were ground and analyzed for bulk dry matter and Kjeldahl N (crude protein). Weekly samples of the supplements (Table 3) were analyzed for total viable yeast counts (Silliker Labs, MN).

Performance data (average daily gain, dry matter intakes and feed efficiency) were analyzed by procedures appropriate for completely random design experiments. Pen was considered to be the experimental unit. All statistical analyses were conducted using the GLM component of SAS.

Results and Discussion

Energy Source. Feedlot performance data is illustrated in Table 4. Energy source had no effect ($P > .10$) on feedlot performance during the 35 d receiving period. Numerically, steers fed corn-based diets gained 9.0% faster as compared to steers fed soyhull-based diets (2.40 vs. 2.20 lbs/d). It is interesting to note the expected NEg was 13% higher for the corn-based diets (Table 2). Although not illustrated in this report, feed cost of gain ($/cwt) was identical for all treatments.

Biosaf. Inclusion of Biosaf had no effect ($P > .10$) on feedlot performance during the 35 d receiving period (Table 4). Numerically, steers consuming Biosaf gained 4% faster as compared to steers consuming the control diets (2.34 vs. 2.25 lbs/d). Also, feed efficiency was improved numerically 5% with the inclusion of Biosaf (not significant).

The lack of significant differences in feedlot performance with Biosaf inclusion was difficult to explain. This experiment was only 35 d in length. It is plausible that the benefits of Biosaf on feedlot performance are not manifested in a 35 d period. In fact, communication with Saf Agri personnel would suggest that 21 d are needed to alter rumen fermentation. In this case only 14 d were left to affect growth rate and efficiency. A longer receiving trial (approximately 75d) may show positive results. Secondly, with any feeding trial, we are concerned about delivering the diet we formulated on paper. Table 5 illustrates the uniformity of mix of the four rations during this trial. Coefficients of variation (CV) less than 10% are often thought to be adequate. Our acid detergent fiber CV for the corn/Biosaf treatment was the only variable over 10% (Table 5). Finally, we analyzed weekly subsamples of the

supplement for yeast counts. These results are illustrated in Table 6. Our theoretical target was 50 x 10^9 CFU/hd/d. We observed an average intake of only 15 x 10^9. As shown in Table 6, we experienced extreme variation in Biosaf intake during the trial. The entire supplement (Table 3) used in this trial was manufactured the last week of October 1998 in one batch. In fact, only during week 5 (Table 6) did Biosaf intake exceed the recommended level. This variation in Biosaf intake may be an artifact of testing error or random variation in mixing during the manufacturing of the supplement. However, the lack of response to feeding Biosaf in this receiving trial could be attributed to the extreme variation in weekly Biosaf intake.

Acknowledgement

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Table 2. Receiving Diet Formulation, %DMB

Energy source	Corn	Soyhulls
Ingredient		
Corn, rolled	36.86	-
Soyhulls	-	39.86
Hay, prairie	32.3	32.3
Hay, alfalfa	15.9	15.9
Molasses, cane	3.0	3.0
Soybean meal, 44%	3.0	-
Supplement[a]	7.14	7.14
AS700[b]	1.8	1.8
Dry matter, %	84.9	87.5
Crude protein, %	12.6	12.9
NE_m, Mcal/cwt[c]	70.7	64.7
NE_g, Mcal/cwt[c]	43.6	38.7

[a]See Table 3 for formulation
[b]2g/lb chlortetracycline; 2g/lb sulfamethazine
[c]Based upon tabular feed values

Table 3. Receiving Supplement Formulation

Biosaf®	-	+
Ingredient		
Ground corn	43.93	41.74
Soybean meal, 44%	35.65	35.65
Fat	1.8	1.8
Dicalcium phosphate	8.5	8.5
KCl	2.55	2.55
TM Salt	7.0	7.0
Biosaf Yeast[a]		2.19
Vitamin A[b]	.47	.47
Vitamin E[c]	.10	.10

[a]1 x 10^{10} CFU/g of Saccharomyces cerevisiae, strain Sc47
[b]13.6 x 10^{6} IU/lb
[c]2.27 x 10^{5} IU/lb

Table 4. Feedlot Performance[a]

Energy Source	Corn	Corn	Soyhulls	Soyhulls	SE
Biosaf®	-	+	-	+	
Initial Wt., lb	508	511	507	511	-
ADG, lb	2.36	2.43	2.14	2.25	.2
DMI, lb	12.5	12.3	12.4	12.5	.5
F/G	5.40	5.14	5.73	5.45	.32

[a]LS Means

Table 5. Coefficients of Variation for Three Variables in The Receiving Diet

Energy Source	Corn	Corn	Soyhulls	Soyhulls
Biosaf®	-	+	-	+
Crude Protein	3.2	.03	4.06	5.40
Acid Detergent Fiber	12.2	4.5	2.2	0.7
Neutral Detergent Fiber	9.2	4.9	4.4	3.4

Table 6. Calculated Biosaf® Sc47 (Saccharomyces Cerevisiae, Strain Sc47) Intake (CFU/hd/d)

Biosaf®	-	+	
Week			
1	ND[a]	3.3	x 10^9
2	ND	0.4	x 10^9
3	ND	4	x 10^9
4	ND	7.6	x 10^9
5	ND	60	x 10^9
Mean	-	15	x 10^9

[a]Non-Detectable

Field Peas in Finishing Cattle Diets and the Effect of Processing

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CATTLE 00-4

Introduction

Field peas are usually grown for human consumption. However, quality problems can make them available at times for feeding to livestock. Field peas contain a moderate amount of protein (20–29%) which is highly rumen degradable. They are high in starch (41– 54%) and low in fiber (<9%) suggesting fairly high energy content. The few cattle feeding studies conducted to date have focused on their use in dairy cows and growing calves. No feeding trials have apparently been conducted with finishing cattle fed high-energy diets.

The objectives of this study were 1) to evaluate yellow field peas as a replacement for soybean meal and corn grain in a high energy finishing diet and 2) to determine whether or not rolling altered their feeding value.

Materials and Methods

One hundred seventy nine yearling steers of mixed breeding were purchased from local sale barns. Upon arrival at the feedlot, they were vaccinated (IBR, BRSV, BVD, PI_3, and Blackleg), treated for internal and external parasites, implanted with revalor-S, individually ear tagged and weighed. From these, 154 steers (average weight 914 lb) were randomly allotted to 18 pens. Eight pens were 16' x 50' with a cement floor and partially covered by a roof. Ten were conventional dirt pens measuring 48' x 112' with mounds and wind breaks. They housed 8 and 9 steers per pen, respectively. Weights on and off test were taken after overnight removal of feed and water. The interim weight was taken after overnight removal of water only. Data were subjected to analysis of variance with diet, housing and diet and housing included in the model. Pen was the experimental unit for feedlot, performance variables. Individual animal was the experimental unit for carcass variables.

Finishing diets fed during the study are presented in Table 1. The control diet was predominantly whole corn, corn silage and soybean meal. The test diets contained either whole or rolled field peas in place of corn and soybean meal. All three diets contained 12.8% crude protein from day 1-56 and 12.2% from day 57-105. The field peas were grown at the Dakota Lakes Research Farm near Pierre, SD, half were dry rolled at the SDSU feedmill in Brookings, and shipped to the Southeast South Dakota Research Farm where the feeding trial was conducted.

Results and Discussion

Feedlot performance data are presented in Table 2. There were no differences between whole and rolled pea treatments for any of the variables measured (P>.10). Dry matter intake did not differ between control and pea treatments from day 1-56, day 57-105 or overall (P>.10). Treatment (control vs. pea diets) effects on daily gain and feed efficiency, although present, were mixed. Steers consuming the pea diets grew faster than controls through 56 days on feed but slower from 57-105 days (P<.10). As a result, overall daily gain did not differ among treatments (P>.10). Feed efficiency was 6% better for steers fed the pea diets than controls (P<.10) through 56 days on feed. However, there were no differences in the latter half of the trial or overall (P>.10).

Why treatment differences present in the first half of the study were either not present, or were reversed, in the latter half is not clear.

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However, it is noteworthy that intakes were greater from day 57-105 than from day 1-56. As intake increases, so does the rate at which feed passes through the digestive tract. Slowly digested feeds are usually utilized to a lesser extent as a result, and dry rolling could reduce this effect. Because of their very hard, dry physical form and slow rate of starch digestion, field peas may be particularly susceptible to digestibility depression with increasing intake. Although not statistically significant, performance on the whole pea diet declined in the latter half of the study more than on the rolled pea diet. This would be consistent with the scenario just described.

Carcass characteristics are presented in Table 3. Dietary treatment had no effect on carcass characteristics (P>.10) with the exception of dressing percent. Dressing percent for cattle consuming the rolled pea diet was one percentage point lower than that of the other treatments (P<.10). The reason for this difference is not clear and seems inconsistent with the balance of the data, which suggest no difference in degree of carcass fat content. Likewise, gut fill does not likely explain this difference, either, since the steers had similar intakes at the end of the trial and were removed from feed and water before weighing.

In conclusion, the replacement of corn and soybean meal with yellow field peas resulted in comparable feedlot performance and carcass quality and yield grades. From a nutritional standpoint, field peas are an effective source of protein and energy in cattle finishing diets. It appears that dry rolling is not necessary when peas are fed as part of a whole corn/corn silage diet. This may not be the case, however, with other types of diets.

Table 1. Finishing Diet Compositions (dry matter basis).

		Finishing Diet	
Item	Control	Whole Pea	Rolled Pea
Ingredient			
Whole corn	72.8	64.1	64.1
Corn silage	20.0	20.0	20.0
Yellow field peas		10.0	10.0
Soybean meal	4.0		
Ground corn		2.5	2.5
Limestone	1.2	1.2	1.2
Urea	.9	.9	.9
Trace mineral salt[a]	.5	.5	.5
Dicalcium phosphate	.3	.3	.3
Potassium chloride	.3	.5	.5
Premix[b]	.1	.1	.1
Chemical Analysis			
Dry matter	65.6	65.6	65.6
Crude protein[c]	12.5	12.5	12.6

[a]Contained 97% Na Cl, .007% I, .24% Mn, .24% Fe, .05% Mg, .032% Cu, .11% Co, .032% Zn and .5% Ca
[b]Provided 28 g of Monensin and 4.5 million IU Vitamin A per ton of diet DM.
[c]Weighted average crude protein content for the entire trial.

Table 2. Feedlot Performance of Yearling Steers Fed Finishing Diets With or Without Field Peas. (least squares means).

		Finishing Diet	
Item	Control	Whole Peas	Rolled Peas
Initial weight, lb	917	912	914
Final weight, lb	1333	1322	1332
Daily DM Intake, lb/hd			
1-56 d	22.70	22.65	22.72
57-105 d	26.10	25.02	25.22
1-105 d	24.27	23.75	23.89
Daily gain			
1-56 d[a]	3.94	4.20	4.21
57-105 d[b]	3.94	3.57	3.73
1-105 d	3.94	3.90	3.98
Feed: gain			
1-56 d[a]	5.78	5.42	5.42
57-105 d	6.65	7.06	6.80
1-105 d	6.17	6.11	6.01

[a]Control vs. others P=.07.
[b]Control vs. others P=.10.

Table 3. Carcass Characteristics of Yearling Steers Fed Finishing Diets With or Without Field Peas (least squares means).

		Finishing Diet	
Item	Control	Whole Peas	Rolled Peas
Hot carcass wt., lb.	787	782	775
Dress, %[a]	59.0	59.1	58.1
Prime/Choice, %	76.5	82.4	84.3
Yield grade	2.6	2.5	2.6

[a]Control vs. other P=.09; whole vs. rolled P=.001.

Influence of Dietary MP on the Production Rates and N Usage by Steers Fed High Grain Content Diets

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CATTLE 00-5

Summary

An experiment was conducted to determine if dietary metabolizable protein **(MP)** could be manipulated to reduce N content of feedlot effluent without compromising production rates in yearling steers fed high grain content diets. Three feeding programs included: LO) 11% CP fed throughout; HI) 13% CP fed throughout; and LHL) 11% fed from d 1 to 35, 13% CP (HI) fed d 36 to 94 and 11% CP **(LO)** fed from d 95 to 117. An estradiol-trenbalone acetate implant was administered on d 35. There were 5 pens of 8 steers (BW=756lb) assigned to each treatment. The MP allowed ADG for the diets were 3.3 and 4.0 lb for the LO and HI diets respectively. Cumulative ADG and feed efficiency were improved (P<.05) by feeding the HI diet. Fluctuations in interim growth rates obscured the determination of specifically when this effect occurred. The faster growth rate was associated with heavier and fatter carcasses. An evaluation of serum urea-N concentrations suggested that the influence of the growth promotant on N metabolism was beginning to diminish within 56d. The HI diet caused higher (P< .05) serum urea-N levels at 63, 91 and 117d on feed. Total N intake was calculated by pen and increased (P< .01) from 41.4 to 47.3 to 51.2 lb/steer for treatments LO, LHL and HI respectively. The N intake/100 BW gained increased (P< .01) from 9.89 to 10.90 to 11.33 lb for LO, LHL and HI treatments respectively. These results indicate that increasing production efficiency by elevating the MP content of diets may not cause a concomitant improvement in the efficiency of N retention on the feedlot scale.

Key words: feedlot, steers, crude protein

Introduction

Growth promotant implants can dramatically increase the growth rate of cattle fed high grain diets. They also cause animals to have more muscle mass at a common body weight. Presumably these conditions would increase the dietary CP requirements of a steer. That increased CP requirement has been demonstrated in controlled research studies. In response to those data and for other reasons the dietary CP level in most cattle finishing diets is greater than 12.5% CP.

Most of the increase in growth rate associated with higher CP diets occurs early in the feeding program. This coincides with a less physically mature stage of growth that should include proportionally greater muscle growth than occurs later in the feeding period. Typically, this also coincides with peak implant activity since we traditionally administered implants as cattle are placed on feed.

Recently there has been an increase in the practice of delaying administration of the more potent implants available until after cattle are on full feed. There is also an increased awareness of the N balance in feedlots and there are new regulations controlling the handling of N in feedlot effluent. Both management changes could affect the optimization of CP supplementation of feedlot cattle fed high grain diets. The N metabolism models available in the current NRC Nutrient Requirements for beef cattle allows us to evaluate potential metabolizable protein requirements and ways to optimize N usage. These model estimates must then be compared with production experiments to verify biologic and economic responses.

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Methods

The experiment was designed to evaluate production efficiencies and the efficiency of N utilization in three dietary management schemes for yearling steers. The three treatments compared were: LO) 11% CP diet fed throughout; HI) 13% CP diet fed throughout; and LHL) 11% CP diet fed for 35d, followed by the 13% CP diet fed for 59d and then returned to the 11% CP diet. The timing of diet switches corresponded with the anticipated period of peak activity of an estradiol-trenbalone acetate implant (revalor-s[4]) administered on d 35.

Yearling steers (n=120, BW=756) were received in two drafts 3 and 7d prior to initiating the experiment. Initial processing included individual identification and BW determination as well as vaccination against clostridia sp[5] IBR[6] BVD[6] PI_3[6] BRSV[6]and H. somnus[5] and treatment for internal and external parasites[7]. This processing weight was used to eliminate outliers, block steers into two BW groups (BWG) and then to allot them to treatment. For allotment, steers were ranked by BW within BWG and then randomly assigned a treatment code. Once assigned to a BWG and treatment, the process was repeated to assign to replicates. Each BWG x treatment x replicate assignment corresponded to a pen. There were 5 pens of 8 steers assigned to each treatment. Two of these replicates were included in the light BWG and 3 pen replicates were from the heavy BWG. Final diets used are outlined in Table 1. Three step-up diets involving the substitution of ground hay and oat silage for corn were used during the initial 14d on feed. Cattle were fed twice daily. Feed ingredients were sampled weekly for composition analyses. Final diet composition was calculated on a weekly basis based upon actual feed batching records and ingredient analyses.

Steers were weighed on the first day of the experiment and after 35, 63, 91 and 117d on feed. Implanting was done on d 35. All BW determinations were done in the morning prior to feeding. There was no restriction of feed or water prior to weighing steers. Feed records were compiled to correspond with interim BW data. Blood was collected by jugular vena-puncture during the weighing process after 63, 91 and 117d on the same 5 steers from each pen for determination of serum urea-N (SUN) content.

Steers were shipped (140 mi.) to a packing plant after 118d on feed. Individual steer identity was maintained for collection of carcass data that included hot carcass weight, ribfat depth, ribeye area, (all measured) and KPH% and marbling (estimated by USDA Grader on duty).

Production data were evaluated by considering pen as the experimental unit. Cumulative performance was calculated by assigning a 4% shrink to BW on d 117 and also by assuming a constant dressing percentage of 62.26% which was the overall average value. Carcass data and SUN data analysis involved using each individual as an experimental unit. The statistical model was a 2 x 3 factorial arrangement of treatments where sums of squares were partitioned into body weight group (n=2), diet management (n=3) and their interaction.

This experiment was conducted from January 27 to May 26, 1999.

Results

Actual CP content of diets was only slightly lower than projected. This occurred because of decreases in the CP content of the oat silage fed over the course of the feeding period. This would have uniformly affected each dietary treatment. The CP levels during the experiment were d 1 to 7 11.5% (LO) and 13.8% (HI); d 36 to 42 10.8% (LO) and 13.4%(HI); d 71 to 77 10.3% (LO) and 12.8% (HI); d 105 to 112 10.4% (LO) and 12.7% (HI).

One steer died after 44d on feed from a respiratory infection. Three other steers in that pen were hospitalized at that time. The problem was limited to one pen and affected (depressed) performance for the LO treatment during the period 36 to 63d on feed. The BWG affected most traits measured (Table 2), but BWG x treatment interactions were not evident in the data. The target harvest point was .4" ribfat. The overall mean ribfat depth was near this value (.385"), but there was a significant difference between BWG. Differences in marbling levels were consistent with this

[4]Hoechst Roussell
[5]Ultrabac 7, Pfizer
[6]Resvac 4, Smithline
[7]Dectomax, Pfizer

observation. Only 41% of BWG 1 steers graded choice or higher, while 65% of the heavier, fatter steers (BWG 2) graded Choice or higher.

Cumulative ADG calculated by either shrinking final BW or estimated from hot carcass weight resulted in ADG similar to the ME allowed ADG predicted by NRC 96. This growth rate (3.72 lb/d) was well above the MP allowed ADG of 3.3 as predicted by the NCR for the LO treatment (Table 1). The HI treatment should have provided adequate MP for the cumulative ADG exhibited by the steers. When growth was evaluated on a carcass weight basis the HI treatment increased (P<.05) ADG and reduced feed/gain (P<.05) over the LO treatment.

The cumulative performance of the LHL treatment was intermediate to and not different from the LO and HI treatments (Table 3). Cumulative DMI was not affected by treatment. There were no detectable differences in production rates due to treatment in any of the interim periods. This experiment spanned winter to spring seasons and changing environmental conditions may have masked treatment effects during interim periods.

Carcass weight increased with increasing dietary CP (P<.05, Table 4). Higher CP intake also resulted in fatter carcasses (P<.05) which was probably a consequence of faster growth and heavier final body weight. There was a reduction (P<.05) in marbling associated with the LHL treatment. These treatments should be re-evaluated with more cattle to determine if this effect was real or was an artifact of the allotment of steers to treatments. While numerical differences in quality grade distributions existed, the limited population size precludes drawing any conclusions regarding treatment.

The SUN values were determined as a more direct indicator than growth of status of N metabolism. At 63d on feed SUN was lower in steers fed the 11% CP diet than in steers fed the 13% CP diet (Table 5). With additional time on feed the requirement for metabolizable protein would be expected to decline. In turn SUN would be expected to increase. The SUN levels were higher at d 91 than at d 63 and the increase in SUN was greater for steers being fed the 13% CP diet. This suggests that the 13% CP diet was providing an excess of MP for steers implanted with an estradiol-trenbalone acetate implant just 56d earlier.

The LHL treatment involved changing from the 13% CP diet back to the 11% CP diet on 94d. This caused lower SUN levels for the LHL treatment at 117d. SUN was reduced to a level lower than that for the steers persistently fed the 11% CP diet (treatment LO), suggesting some type of compensation process was involved.

Average daily N intake was calculated using daily feed records for each pen and the weekly CP determinations of each dietary ingredient. These data were totaled by pen over the 117d on feed and expressed on a per steer basis (Table 6). As expected total N consumed increased (P<.01) across LO to LHL to HI treatments. The efficiency of use of this N was determined as total N intake, lb. ÷ total live weight gain (using the carcass weight derived final BW). Although the HI treatment caused higher total weight gains with similar DMI than the LO treatment, the efficiency of N use per 100lb weight gain was lower (P<.01; Table 6). The 1.44 lb N/100lb live weight gain difference between LO and HI treatments would presumably all be lost to the environment. Future research evaluating CP supplementation should address the efficiency of N utilization as well as the production efficiencies that are typically evaluated since both variables affect the cost of beef production.

These results suggest that the dietary CP requirement of steers fed high grain diets and implanted with estradiol-trenbalone acetate growth promotants is somewhere between 11 and 13%. It also appears (based upon SUN levels) that the demand for MP caused by growth promotants begins to diminish within 56d of exposure to the implant. Careful management of dietary CP can cause significant reductions in feedlot emissions of N per unit of growth in steers.

Table 1. Diet Formulations

	11% CP	13% CP
Oat Silage, %	9.50	9.50
WSC, %	86.25	78.80
LS475U, %	4.25	4.25
Dried Distillers Grains + Solubles, %		4.00
SBM, %		2.70
Blood Meal, %		.35
Feather meal, %		.40
CP, %	11.1 (10.5)[a]	13.6 (12.9)[a]
DIP, %	59.3	56.1
DIP Balance, g/d	-139	-31
NE_m, Mcal/lb	1.04	1.04
NE_g, Mcal/lb	.63	.63
P, %	.293	.325
Allowed ADG		
ME	3.81	3.77
MP	3.3	4.0

[a]Values on parentheses are actual values

Table 2. Comparison of Performance and Carcass Traits Between Initial Body Weight Groups[a]

	Light	Heavy	Var
Initial BW, lb[c]	713	785	25
Final BW, lb[c]	1139	1227	415
ADG, lb	3.64	3.77	.0271
DMI, lb[c]	21.09	23.21	.5594
F/G[c]	5.81	6.15	.0793
Dress, %[c]	62.65	62.01	2.7012
Hot Carcass WT, lb[c]	714	761	1433
Ribeye area, in^{2c}	12.9	12.4	1.4355
Ribfat, in[c]	.33	.42	.0183
KPH, %	2.3	2.4	.1275
Marbling[bc]	4.87	5.51	.6563
Yield Grade[c]	2.38	2.95	.3830

[a]Least squares means
[b]4.0 = slight°; 5.0 = Small°
[c]P<.05

Table 3. Interim and Cumulative Production Characteristics[a]

	Treatment			
	LO	LHL	HI	
	11%CP	11%/13%/11%CP	13%CP	SEM
Initial BW	747	749	751	2.4
1-35d				
BW 35	906	905	917	7.5
ADG	4.55	4.56	4.76	.162
DMI	19.42	19.36	19.51	.344
F/G	4.29	4.36	4.11	.121
36 to 63d				
BW 63	1001	1016	1036	11.9
ADG	3.41	3.98	4.23	.410
DMI	21.37	21.88	22.25	.787
F/G	6.68	5.69	5.31	.576
64 to 91d				
BW 91	1115	1120	1135	8.8
ADG	4.07	3.69	3.55	.272
DMI	23.39	23.50	23.04	.519
F/G	5.93	6.42	6.47	.406
92 to 117d				
BW 117	1219	1229	1247	9.5
ADG	4.01	4.21	4.28	.179
DMI	24.48	25.09	25.15	.493
F/G	6.15	6.01	5.89	.249
Cumulative (Shrunk)				
Final BW	1171	1180	1197	9.1
ADG	3.63	3.68	3.81	.074
DMI	21.97	22.21	22.26	.334
F/G	6.06	6.04	5.84	.126
Carcass Adjusted				
Final BW	1166[b]	1184[bc]	1202[c]	10.8
ADG	3.58[b]	3.70[bc]	3.86[c]	.086
F/G	6.14[d]	6.03[de]	5.76[e]	.142

[a]least squares means
[b, c]means without common superscripts differ (P<.05)
[d, e]means without common superscripts differ P<.10)

Table 4. Carcass Characteristics by Treatment[a]

	Treatment			
	LO	LHL	HI	
	11%CP	11%/13%/11%CP	13%CP	SEM
Dress, %	62.03	62.40	62.57	.27
Hot carcass wt, lb	726[e]	737[ef]	749[f]	6.1
Ribeye area, in^2	12.47	12.82	12.65	.194
Ribfat depth, in	.34[c]	.39[cd]	.40[d]	.022
KPH, %	2.29	2.35	2.42	.058
Marbling Score[b]	5.34[d]	4.95[c]	5.39[d]	.131
Yield Grade	2.58	2.63	2.79	.100
>Ave. choice, %	15	8	20	
Low choice, %	49	43	35	
Select, %	36	48	43	
Standard, %	0	3	3	

[a]least squares means
[b]4.0 = slight; 5.0 = small
[c, d] means without common superscripts differ (P< .05)
[e, f] means without common superscripts differ (P<.10)

Table 5. Serum Urea-N Levels Across Treatment and Time[a]

	Treatment			
Day on Feed	LO	LHL	HI	Var
		SUN, mg/dl		
63	7.64[b]	9.83[c]	9.91[c]	3.055
91	8.14[b]	12.53[c]	12.75[c]	4.648
117	9.12[b]	8	12.43[c]	3.574

[a]least squares means
[b, c]means without common superscripts differ (P<.05)
*adjacent means differ (P=.06)

Table 6. Nitrogen Intake and Efficiency Differences Due to Treatment[a]

	Treatment			
	LO	LHL	HI	
	11%CP	11%/13%/11%CP	13%CP	SEM
Total N intake, lb	41.4[b]	47.3[c]	51.2[d]	.78
N Intake/100lb BW gain	9.89[b]	10.90[c]	11.33[c]	.255

[a]least squares means
[b, c, d] means without common superscripts differ (P<.01)

Relative Feed Values for High Fiber Corn and Conventional Corn Silage for Growing Steers

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CATTLE 00-6

Summary

The relative feed value of a corn variety developed for the primary purpose of corn silage production was evaluated using a 70-d steer growing trial. The high fiber corn (CSV1) and conventional corn (CSV2) varieties were planted in adjacent plots and harvested at approximately 30% DM. Silage varieties were stored in separate bunker silos and allowed to ferment for 52 d. CSV1 yielded 5.4 T/acre while CSV2 yielded 4.7 T/acre (DM basis). Variety affected (P<.001) NDF (43.3% vs 38.6%), ADF (24.1% vs 20.2%), lignin (5.7% vs 4.6%), starch (18.69% vs 30.18%) and CP content (7.37% vs 6.89%) of CSV1 and CSV2, respectively. IVDMD was not different (P>.10) between varieties. One hundred sixty steers were divided into light (516 ± 7.1 lb.) and heavy (595 ± 9.7 lb.) BW groups. Steers within those groups were stratified by BW into 10 pens, and pens were randomly assigned to one of two corn silage variety treatments. Steers that were consuming CSV2 tended to gain faster (P<.10) and were more efficient (P< .05). CSV2 had a greater (P<.05) caloric density than CSV1, as predicted by three prediction methods. Net energy values predicted using NIR were significantly (P=.05) lower than energy values predicted by proximate analysis or by steer performance. This trial demonstrates the need for multiple selection criteria when choosing a corn variety for corn silage production. CSV1 yielded 1593 lb. of beef per acre compared to 1417 lb. of beef per acre yielded by CSV2 when evaluating varieties on a field-to-feedbunk basis.

Key words: Beef, Corn Silage, Feedlot

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Introduction

The success of a new corn silage variety depends on three main factors: 1) yield of DM per unit of land area, 2) DM intake and, 3) nutrient and (or) energy density of the silage. It has been well established that a majority of the digestible energy (DE) obtained from the corn plant is contained in the ear component, particularly the grain. With the advent of plant engineering researchers are able to focus their research on areas of the plant that were previously ignored (i.e. stover), and develop corn varieties especially for corn silage production. Researchers have attempted to increase the DE content of the stover in proportion to the whole plant, focusing mainly on increasing the neutral detergent fiber (NDF) fraction. The NDF fraction is known to be higher in digestibility than other fiber fractions (i.e. acid detergent fiber). The use of advanced technologies in silage production are of diminished value if the end product fails to satisfy the three major factors that make silage production profitable.

Materials and Methods

Two plots in close proximity were planted with the individual corn varieties. Plots were randomly assigned to either corn variety. CSV1 was a high fiber corn variety (Mycogen[4]) developed specifically for corn silage, while CSV2 was a conventional corn variety (Dekalb[5]). Varieties were planted on June 13, 1996, at recommended populations. The plot containing CSV2 was harvested on October 1-2 (184T) and the CSV1 plot was harvested on October 3-4 (186T). The corn plants were harvested at approximately 30% DM using a chopper that reduced the particle size to approximately one-half inch. The corn silage was unloaded into concrete horizontal silos. Each load was leveled throughout the bunker and packed using a tractor with loader and additional weights. Silos were then covered with plastic sheeting that was anchored using rubber tires.

Silos were allowed to ferment for 52 d prior to being reopened.

One hundred ninety-eight Angus cross steer calves were used in a growing trial to evaluate the feed value of both corn silage varieties. Calves received long-stem grass hay and free access to water upon arrival at the research feedlot. The following day, all calves were individually tagged and vaccinated with Resvac 4/Somubac[6] and Ultrabac 7[6]. Ivermectin[7] was used for parasite control. Starting on the first day after arrival all steers were fed a receiving diet that consisted of grass hay, whole shelled corn and soybean meal supplement. The receiving diet was fed for 21 d at a level that restricted ADG to 1.75 lb. After the initial 21 d on the receiving diet, 160 of the original 198 steers were assigned to 20 pens using allotment weights obtained 6 d prior to sorting. Steers were separated by BW into a light (LBW; 516 ± 7.1 lb.) and heavy (HBW; 595 ± 9.7 lb.) group. Body weights were stratified within pens across each weight group. Pens were then randomly assigned to one of two CSV treatments. Ralgro[8] implants were administered to all steers during the initial BW measurement. Initial and subsequent BW measurements were determined at 0730, prior to being fed.

All cattle were fed silage diets once daily in the morning. Bunks were scored daily to ensure cattle were consuming all feed that was offered and to obtain ad libitum intake by d 21. The growing diets (Table 1) were formulated to be isonitrogenous (11% CP) and contain equal proportions of corn silage and pelleted supplement. The pelleted supplement contained soybean meal, macro- and micro-minerals and vitamins to meet NRC nutrient requirements for 650 lb. calves. The pelleted supplement also contained laidlomycin propionate[9] at a level that provided 7 g laidlomycin propionate per ton of diet (DM basis). Table 1 also illustrates that the diet containing CSV1 had a significantly higher proportion of fiber and ash versus the diet containing CSV2.

Weekly feed ingredient sample assays and daily feed delivery records were used to calculate and summarize DMI on a weekly basis throughout the experiment. Two steers were removed during the trial. One steer died due to bloat and one steer was a chronic bloater. The trial was terminated after 70 d due to depletion of corn silage. A 3% pencil shrink was used to adjust final BW for fill.

Net energy values for the silages were predicted using three methods. The first method estimated TDN from silage ADF content, which was then converted to NE_m and NE_g. The second method used NIR analysis to estimate NE_m and NE_g, while the third method utilized steer performance from the growing trial to predict caloric density of the silages.

Statistical analysis of performance data was conducted using procedures appropriate for a randomized complete block design. Pen mean data were used in the analysis. Chemical and energetic means were compared using GLM procedures of SAS. Methods to predict net energy were compared using procedures appropriate for Duncan's Multiple Range Test.

[6]SmithKline Beecham Animal Health Corp., West Chester, PA
[7]Merial Limited, Iselin, NJ
[8]Schering-Plough Animal Health Corp., Union, NJ
[9]Roche Vitamins, Inc., Parsippany, NJ

Table 1. Diet Formulations

Item	DM basis CSV1	CSV2	SEM	P<[a]
Corn Silage	88.60	88.60		
Soybean Meal[b]	8.95	10.45		
Ground Corn[b]	1.50			
Limestone[b]	0.65	0.65		
Trace Mineral Salt[b]	0.30	0.30		
DM, %	31.55	30.98	.228	NS
Crude Protein, %	11.17	11.13	.065	NS
Neutral Detergent Fiber, %	47.81	41.04	.482	.0001
Acid Detergent Fiber, %	25.65	21.79	.274	.0001
Ash, %	5.77	5.33	.059	.0015

[a]NS=(P>.10)
[b]fed as a pelleted supplement

Table 2. Agronomic Results

Treatment	Planting rate, plants/acre[a]	Harvest Relative maturity, %[b]	Harvest DM, %	DM basis Harvested crop, tons	DM basis Tons/Acre
CSV1	24,000	72.01	29.30	53.90	5.37
CSV2	27,000	72.78	28.00	52.10	4.50

[a]Approximation based on counting the number of plants in a row for a distance of 17 feet 5 inches, then multiplying by 1000 to equal plants/acre (Distance between rows was 30 inches).
[b]Approximation based on 2500 growing degree units for CSV1 and 2470 growing degree units for CSV2.

Results

Harvest comparisons

Harvest DM differed significantly (P<.05) with CSV1 having a greater DM than CSV2 (Table 2). Tons of DM per acre (Table 2) was higher for CSV1, even though CSV1 was planted at a lighter population per acre than CSV2.

Chemical analysis

Differences were observed in the comparison of the nutrient fractions (Table 3) between the two silage varieties. The NDF, ADF and lignin fractions were greater (P<.001) in CSV1 than CSV2. The starch fraction was greater (P<.001) in CSV2. The differences in starch content may be a result of differences in kernel starch deposition rate, since relative maturity of both varieties were similar (Table 2). Differences in starch content may also arise from unexpected differences in true physiological maturity, since growing degree units were based on estimates of physiological maturity. Corn silage variety 1 expressed a higher degree (P<.001) of protein accumulation with a CP content of 7.4% compared to CSV2 which was comprised of 6.9% CP. Both varieties were similar (P>.10) when comparing digestibilities using *In vitro* DM digestibility (IVDMD) techniques (69.17% vs 69.23% for CSV1 and CSV2, respectively).

Steer performance

Interim feeding periods expressed little to no performance differences between varieties, but cumulative steer performance (Table 4) did indicate some varietal differences. Corn Silage Variety 2 tended (P<.10) to cause higher ADG over the entire 70 d,
while DMI did not differ between treatments. Utilizing CSV2 in the growing diet resulted in a

5.9% improvement in feed conversion (P<.05) versus CSV1.

Predicted net energy

The use of ADF analysis and steer performance data to calculate energy values caused similar energy content predictions (Table 5). The NIR values were similar in the degree of difference between varieties, but the actual values are much lower compared to the other two methods. The NE_m values predicted using NIR were approximately 6.3% to 7.3% lower, while NE_g values were 9.0% to 12.0% lower compared to using ADF analysis or feedlot performance data, respectfully. The discrepancy in net energy values supports the use of multiple assays to derive more appropriate energy values.

When comparing varieties, utilizing both harvest and feedlot performance data, CSV1 yielded 1593 lb. of beef per acre compared to 1417 lb. of beef per acre yielded by CSV2. The data emphasizes the need to evaluate corn silage varieties on multiple bases. While CSV1 produced more DM per acre, performance in the feedlot was lower compared to CSV2. The basis of a producer's decision to use CSV1 is dependent on whether the increased DM produced per acre will offset the cost of reduced performance and additional days on feed.

Table 3. Silage Composition

Item	CSV1	CSV2	SEM	P<[a]
NDF, %	43.27	38.61	.154	.0001
ADF, %	24.12	20.18	.061	.0001
Lignin, %	5.69	4.62	.054	.0001
Starch, %	18.69	30.18	.197	.0001
CP, %	7.37	6.89	.058	.0005
IVDMD, %	69.17	69.23	.190	NS

[a]NS = (P>.10).

Table 4. Cumulative Steer Performance

Item	CSV1	CSV2	SEM	P=[a]
Final BW, lb.	698	709	2.77	.0634
ADG, lb.	2.30	2.40	.030	.0965
DMI, lb/d.	13.72	13.49	.146	NS
F/G	5.97	5.62	.063	.0148

[a]NS = (P> .10)

Table 5. Predicted Net Energy Values

Item	ADF[d]	Feedlot performance[e]	NIR[d]
NE_m, Mcal/cwt			
CSV1	75.24[a] ± .397	75.57[a] ± .532	70.50[b] ± .841
CSV2	79.14[a] ± .561	79.80[a] ± .752	73.50[b] ± 1.190
NE_g, Mcal/cwt			
CSV1	47.60[a] ± .349	49.27[b] ± .469	43.50[c] ± .741
CSV2	51.04[a] ± .443	52.70[a] ± .595	46.25[b] ± .940

[a,b,c]Means on the same line with different superscripts differ (P=.05).
[d]Variety differs (P<.001).
[e]Variety differs (P<.05).

Effect of Calving Time and Weaning Time on Cow and Calf Performance - A Preliminary Report

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CATTLE 00-7

Summary

Cows grazing native range year round were allotted to 3 management systems: 1.) A calving season starting in mid March with calves weaned in late October; 2) A calving season starting in mid March with calves weaned in mid September; and 3) A calving season starting early May with calves weaned in late October. After 2 years of the study, pregnancy rate and calving interval were not affected by management system. Average weaning weight was the highest for the March calving/October weaned group in both years. In the first year of the study, severe winter weather caused a lower calf survival to weaning for the March calving groups compared to the May calving group. This resulted in similar pounds of calf weaned per cow exposed for the March calving/October weaned and May calving/October weaned groups. Estimated income per exposed female was similar for these two groups. In the second year of the study, calf death loss was not affected by calving time. The heavier weaning weights of the March calving /October weaned group resulted in more pounds weaned per cow exposed and $30 greater income per exposed female. The potential to reduce costs for winter-feed, equipment, calving facilities and labor would favor later calving and must be considered.

Introduction

When calf prices are high, there is an incentive to increase weaning weights. This has led many cattle producers to start the calving season early in the year for older and heavier calves at weaning time

In more recent years when calf prices have been relatively low in relation to input costs, there is a greater incentive to reduce costs of production. Hoyt and Oedekoven (1994 SDSU Beef Report) reported that feed costs are approximately two-thirds of the cost of production for South Dakota beef cowherds and that high profit operators have approximately 10 % lower nonpasture feed costs than average. A common management strategy is to manage cow winter weight loss and then time the beginning of the breeding season to allow cows to gain weight rapidly on pasture for about 30 days prior to the breeding season. In western South Dakota this results in a breeding season starting in early June and a calving season starting in March. In this system it is difficult to meet the cow's NRC nutrient requirements during the winter with the forages available without high levels of supplementation. But winter weight loss can be compensated by rapid weight gain before breeding.

Another strategy is to match the cow's production cycle and nutrient requirements to the forage production cycle. In this system the cow's highest requirements after calving are matched with peak pasture forage quality. In western South Dakota this fits a breeding season starting in late July and a calving season starting in May. Later calving also has the potential advantages of reduced calf disease and death loss from severe weather, reduced costs for calving facilities and reduced labor during the calving season. Potential disadvantages of a May calving season include reduced reproductive performance from breeding in the hottest months of the year when forage quality is relatively low and lighter weaning weights if calves are weaned on the same date.

Another approach to reducing winter feed costs is to wean the calves early, which would

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allow the cows to be in higher body condition early in the winter.

There is strong interest among some cow-calf producers to change from a late winter calving to a spring calving season. There is limited information to predict how production and cost of production will change with this management adjustment. The overall objectives of this study are to determine the effect of time of calving season and weaning on: 1) the performance of beef cows managed to optimize the use of native range. 2) the performance of calves from birth through slaughter.

Materials and Methods

This study involves 126 crossbred cows grazing native range pastures at the SDSU Range and Livestock Research Station near Cottonwood, SD from November to May and pastures near Sturgis, SD during the summer. In the spring of 1996 cows were allotted by age and breed composition to 3 management systems (Table 1).

Cows graze native pasture year round and receive 1 lb. supplemental crude protein from December 1 to May 1. Grass hay is fed only when snow cover prevents grazing. Cows in estrus during 7 days following a prostaglandin injection are artificially inseminated. Cows are then exposed to bulls for 53 days and rectally palpated to determine pregnancy in November. Only cows that are not pregnant or have severe physical defects are culled.

To ascertain absorption of colostrum, blood samples are collected after 24 hours of birth. Plasma samples are frozen and later analyzed for total protein using refractometry. Total protein is well correlated with total immunoglobulin. If calves have plasma protein concentrations of 5.8 mg/dl or greater, they are considered to have adequate absorption of colostrum.

Following weaning heifers are fed in drylot to gain 1.5 lb per day until May 1 when they are turned out to native pasture. Potential replacement heifers from each system are selected based on actual weight. Heifers are bred to start calving 30 days earlier than the cows. They are estrus synchronized with Synchromate B and inseminated 48 to 56 hours after implant removal. They are then exposed to a bull for 45 days and rectally palpated for pregnancy diagnosis in the fall.

All male calves are branded, castrated and implanted at an average age of approximately 45 days of age and reimplanted 90 days later. Following weaning, steer calves are transported to the SE Experiment Station; Beresford, SD where they are fed a high grain diet for maximum gain to harvest.

Results and Discussions

In 1997 the percentage of calves alive at 1 week ($P=.07$) and at weaning ($P=.10$) was greater for the May calving group than the March calving groups (Table 2). Since calf survival was calculated as the number of calves alive divided by the number of pregnant cows the previous fall, loss of calves includes both abortions and losses after birth. The number of calf deaths shortly after birth in the March calving groups was affected by the severe winter weather during the winter of 1997.

In 1998 the overall low calf survival was due to the number of cows examined pregnant in the fall that did not calve. Calf survival was similar for the March and May calving groups. The mild winter of 1998 resulted in a low calf death loss after calving. Absorption of colostrum as indicated by total plasma protein was not affected by calving time.

Calf birth weights were similar for each management system (Table 3). In both years the calves born in March and weaned in late October were the heaviest at weaning ($P<.05$) due to being older at weaning. In 1997 the May calving/October weaned group was 25 lb. heavier than the March calving/September weaned group that were about the same age at weaning. This was due to a higher average daily gain from birth to weaning for the May calving group ($P<.05$). In 1998 there was the same tendency for greater average daily gain for the May calving group but it was not significant.

In the first year there was a higher percentage of cows in the May calving group in estrus ($P=.001$) during the first 7 days of the breeding season following an injection of prostaglandin (Table 4). In the second year, the cows cycling in each group were similar. The calving interval for both years was not affected by calving time or weaning time. (Table 3).

The time of the calving season did not affect pregnancy rate (Table 4). The possible nutritional advantage during the calving season in May and June might have been offset by a breeding season during late July and August when the weather is hot and forage quality is relatively low. Weaning calves early in the fall of 1997 did not result in a higher pregnancy rate in 1998.

Table 5 shows calculations based on the preliminary data presented in this paper. Even though calf weaning weights were lower for the May calving/October weaned group compared to the March calving/October weaned group, the pounds of calf weaned per cow exposed were nearly identical in 1997. Due to a greater potential price per hundred weight, the income per exposed cow for the May calving/October weaned group is slightly higher than the March calving/October weaned group.

With similar calf survival in 1998, the advantage in weaning weights resulted in more pounds weaned per cow exposed for the March calving/October weaned group compared to the other two systems. Although the income per exposed cow is $30 less for the May calving/October weaned system in 1998, it may be possible to reduce annual cow cost in a May calving system through reduced dependence on equipment and facilities or reduced labor that would allow more cows per family unit or lower labor costs. Although each management group received the same level of nutrition in this study, in many cases a reduction in winter-feed costs greater than $30/cow could be achieved by calving in May.

The current project will continue to record reproductive performance for 5 years. It will be important to evaluate the cumulative effect of the three systems on reproductive performance. A more complete economic analysis will be done.

Table 1. Three Management Systems

Calving season starts	March 15	March 15	May 1
Weaning time	late October	mid September	late October
No. of cows	42	42	42
Approximate calving season [a]	3/15 to 5/14	3/15 to 5/14	5/1 to 6/13
Approximate breeding season [a]	6/5 to 8/4	6/5 to 8/4	7/22 to 9/20
Approximate weaning date	10/31	9/14	10/31

[a]The breeding and calving seasons start 30 days earlier for the replacement heifers.

Table 2. Effect of Calving Season on Calf Survival

Calving season starts	March 15	May 1	probability of a difference
Total plasma protein, mg/dl			
1997	7.55	7.98	0.79
1998	7.06	7.17	0.51
% adequate total plasma protein [a]			
1997	94.6	91.9	0.58
1998	94.1	93.8	0.95
% calves alive at 1 week [b]			
1997	88.1	97.6	0.07
1998	91.6	92.7	0.83
% calves alive at weaning [b]			
1997	85.5	95.2	0.10
1998	90.4	87.8	0.66

[a]>5.8 mg/dl
[b]of cows pregnant the previous December

Table 3. Effect of Calving Time and Weaning Time on Calf Performance

Calving season starts	March 15		March 15		May 1		
Weaning time	late October		mid September		late October		probability
Calf birth weight, lb							
1997	91.1		89.2		88.0		.45
1998	85.3		84.5		84.0		.82
age at weaning, days							
1997	212	a	172	b	175	b	<.001
1998	216	a	182	b	180	b	<.001
Actual calf weaning weight							
1997	571	a	484	b	509	c	<.001
1998	615	a	532	b	544	b	<.001
Calf average daily gain, lb/day							
1997	2.29	a	2.32	a	2.43	b	.02
1998	2.46		2.49		2.59		.08
Calving interval (includes only cows weaning a calf)							
1997-98	371		372		374		.84
1998-99	375		380		376		.53

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

Table 4. Effect of Calving Season on Reproductive Performance

Calving season starts	May 15	May 1	Probability of a difference
% in estrus first week breeding season [a]			
1997	28.2	61.5	0.001
1998	46.7	55.6	0.38
% pregnant [a]			
1997	91.6	89.7	0.75
1998	92.0	88.9	0.59

[a]includes only cows weaning a calf

Table 5. Calculated LB Weaned and Income Per Cow Exposed[a]

Calving season starts	March 15	March 15	May 1
Weaning time	late October	mid September	late October
1997			
assume % pregnant, 1996	90.7	90.7	90.7
% alive at weaning	85.5	85.5	95.2
actual weaning weight	571	484	509
lb weaned/cow exposed	443	375	440
estimated $/cwt[b]	76.83	80.48	79.43
income/cow exposed, $	340	302	349
1998			
% pregnant, 1997	90.7	90.7	90.7
% alive at weaning	89.1	89.1	89.1
actual weaning weight	615	532	544
lb weaned/cow exposed	497	430	440
estimated $/cwt[b]	75.00	78.47	77.96
income/cow exposed, $	373	337	343

[a] If affected by treatment (P<.10) then treatment means is used. If not affected by treatment, the overall mean is used.

[b] estimated from calf prices at SD sale barns during October of 1998, adjusted for calf weight and sex.

Effect of Calving Time and Weaning Time on Feedlot Performance - A Preliminary Report

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CATTLE 00-8

Summary

Cows grazing native range year round at the SDSU Cottonwood Research Station were allotted to 3 management systems; Group 1) a calving season starting in mid March with calves weaned in late October, Group 2) a calving season starting in mid March with calves weaned in mid September, and Group 3) a calving season starting early May with calves weaned in late October. Following weaning the steer calves are transported to the Southeast South Dakota Experiment Farm. For two calf crops the steer calves have been fed a high grain diet for maximum gain from weaning to harvest.

Group 2 had a lower mean average daily gain than Groups 1 and 3. Feed conversion was not affected by treatment. There was not a consistent indication that groups weaned at a younger age (Groups 2 and 3) had more health problems than Group 1. Group 3 had the highest mean dressing percentage and carcass weight. Weaning at a younger age and a longer time on feed resulted in higher marbling scores for Group 2 compared to Group 1. This advantage in marbling was not observed for Group 3.

Introduction

When calf prices are high, there is a strong incentive to increase weaning weights. This has led many cattle producers to start the calving season early in the year for older and heavier calves at weaning time. In more recent years when calf prices have been relatively low in relation to input costs, there is a greater incentive to reduce costs of production.

There is strong interest among some cow-calf producers to change from a late winter calving to a spring calving season to reduce calf death loss, disease and input costs. There is limited information to predict how production and cost of production will change with this adjustment. The overall objectives of this study are to determine the effect of time of calving season and weaning on; 1) the performance of beef cows managed to optimize the use of native range; 2) the performance of calves from birth to carcass. The information reported in this paper addresses the second objective.

Materials and Methods

This study involves 126 crossbred cows grazing native range pastures at the SDSU Range and Livestock Research Station near Cottonwood, SD from November to May and pastures near Sturgis, SD during the summer. In the spring of 1996 cows were allotted by age and breed composition to 3 management systems (Table 1).

All male calves are branded, castrated and implanted with Ralgro at an average age of approximately 45 days of age and reimplanted with Synovex C approximately 90 days later. Steers are implanted with Synovex S at an approximate average age of 200 days and with revalor S at an approximate average age of 300 days. Following weaning, steer calves are transported to the Southeast South Dakota Experiment Farm, Beresford, SD where they are allotted by weight to 2 pens per treatment and fed a high grain diet for maximum gain to harvest. Upon arrival weaned calves are fed a receiving diet for 2 weeks that contains .47 Mcal NEg/lb dry matter (48.2% alfalfa hay, 39.9% corn, 8.9% supplement and 3% molasses on a dry basis). The amount of hay is decreased and the corn is increased so that after 6 weeks

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calves are full fed a diet that contains .61 Mcal NEg/lb dry matter (79.5% corn, 10% alfalfa, 7.5% supplement, 3% molasses, 28 g/ton rumensin and 8.2 g/ton Tylan on a dry basis) for the remainder of the feeding period.

Weights, average daily gain, dry matter intake, feed conversion, number of days treated and cost of medical treatment were analyzed by the GLM procedure of SAS with pen as the experimental unit. Year and treatment were included as independent variables. Means were separated using the predicted difference option. The percentage choice and the incidence of lung and liver lesions were analyzed using the Chi-Square procedure of SAS. Other carcass characteristics were analyzed by the GLM procedure of SAS with steer as the experimental unit and year, treatment and age as independent variables. Means were separated using the predicted difference option.

Results and Discussions

Due to age, Group 1 (March calving/October weaned) was heavier at weaning and upon arrival in the feedlot ($P < .05$) than the other 2 groups (Table 2). Group 2 (March calving/September weaned) had lower average daily gain ($P < .05$) than the other 2 groups. Dry matter intake and feed conversion were similar for all treatments.

Since Group 1 (March calving/October weaned) was older and heavier at weaning they required less total dry matter ($P < .05$) during the feedlot phase compared to the other 2 groups (Table 2). This points out that weaning at a younger age (by weaning earlier in the year or by calving later and weaning at the same time) shifts production from grazed forage to harvested feeds.

A concern for weaning calves earlier than the traditional 7 months is their health following weaning. In the first year, the number of calves treated early in the feeding period was greater for Group 2 (weaned in mid September, $P = .01$) than Group 1 and 3 weaned in late October (Table 3). During the second year, Group 1 that was the oldest at weaning had the highest percentage of calves that were treated for illness, but the differences were not significant. The analysis of the number of days treated and the cost of medical treatment indicates that Group 2 and 3 did not require more medical treatment (Table 3) than Group 1 that was older at weaning.

Evaluation of lung and liver lesions at harvest is a tool to evaluate previous health status (Table 4). The incidence of each was low and the lesions were mostly small, indicating that serious health problems did not exist in this group of calves. The two groups weaned at a younger age did not experience greater health problems as indicated by the number of lesions detected.

The higher dressing percentage ($P < .01$; Table 4) of Group 3 and a tendency for higher final weights resulted in heavier carcass weights ($P < .001$) compared to Groups 1 and 2. Group 2 (March calving/September weaned) had higher mean marbling scores ($P < .05$) compared to the other groups. Studies at other research stations have shown dramatic increases in quality grades when calves were weaned as early as 90 days of age and fed a high grain diet to harvest. It is interesting that the Group 3 steers that started on feed at approximately the same age and on feed approximately the same length of time did not show the same advantage in marbling scores.

Steers from the third year of this project are currently on feed. Feedlot performance, health status and carcass information will be collected. An economic analysis using cowherd performance and post-weaning performance of the calves is planned.

Acknowledgment

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Table 1. Three management systems.

Group	1	2	3
Calving season starts	March 15	March 15	May 1
Weaning time	late October	mid September	late October
No. of cows	42	42	42
Approximate calving season [a]	3/15 to 5/14	3/15 to 5/14	5/1 to 6/13
Approximate breeding season [a]	6/5 to 8/4	6/5 to 8/4	7/22 to 9/20
Approximate weaning date	10/31	9/14	10/31

[a]Breeding and calving seasons start 30 days earlier for the replacement heifers.

Table 2. Post weaning performance (Years 1 and 2)

Group	1	2	3		
Calving season starts	March 15	March 15	May 1		
Weaning time	late October	mid September	late October	SE[a]	Probability
Number of steers	30	43	38		
Age at weaning, days	208	173	162		
Days on feed	189	230	220		
Weight, lb					
Weaning weight	625[b]	534[c]	551[c]	6	<.001
Initial feedlot weight	606[b]	526[c]	536[c]	7	<.001
At last implant	984[b]	996[b]	1059[c]	10	.001
Final weight	1256	1237	1275	20	.43
Average daily gain, lb./day					
Initial feedlot weight to last implant	3.56	3.18	3.44	.11	.10
Last implant to harvest	3.12	2.84	3.17	.16	.34
Initial feedlot weight to harvest	3.44[b]	3.09[c]	3.37[b]	.07	.02
Dry matter intake, lb./day					
Initial feedlot weight to last implant	18.7	17.4	18.9	.6	.25
Last implant to harvest	22.4	21.6	22.4	.8	.78
Initial feedlot weight to harvest	20.4	18.9	20.1	.6	.22
Total dry matter per steer, lb.	3840[b]	4350[c]	4421[c]	136	.03
Feed/Gain					
Initial feedlot weight to last implant	5.25	5.48	5.54	.20	.57
Last implant to harvest	7.85	7.87	7.12	.51	.52
Initial feedlot weight to harvest	5.96	6.12	6.00	.15	.74

[a]Standard error of the least square mean.
[b,c]Means in a row with uncommon superscripts differ (P< .05).

Table 3. Health records.

Group	1		2		3		
Calving season starts	March 15		March 15		May 1		
Weaning time	late October	SE[a]	mid September	SE[a]	late October	SE[a]	Probability
% treated for disease							
Year 1	0.0		21.7		0.0		.01
	0/18		5/23		0/19		
Year 2	25.0		15.8		5.3		.29
	3/12		3/19		1/19		
No. of days treated/steer	.25	.09	.20	.08	.03	.08	.15
medical treatment, $/steer	3.13	1.11	1.84	.94	.64	.99	.25

[a]Standard error of the least square mean.

Table 4. Data collected at harvest (Year 1 and 2)

Group	1		2		3		
Calving season starts	March 15		March 15		May 1		
Weaning time	late October	SE[a]	mid September	SE[a]	late October	SE[a]	Probability
Number of steers	30		42		38		
Age at slaughter	397		403		392		
Hot carcass weight, lb	761[b]	12	748[b]	10	798[c]	11	<.01
Dressing percentage, %	60.9[b]	.3	60.4[b]	.3	62.4[c]	.3	<.001
Yield grade	3.12	.10	3.20	.09	3.28	.09	.50
Marbling score (5.0=small[0])	5.48[b]	.13	5.91[c]	.12	5.55[b]	.12	.03
% choice	83.3		90.5		79.0		.35
Lesions at harvest, Year 2							
% with liver lesions	0.0		21.7		0.0		.01
	0/18		5/23		0/19		
% with lung lesions	25.0		26.3		6.7		.31
	3/12		5/19		1/15		

[a]Standard error of the least square mean.
[b,c]Means in a row with uncommon superscripts differ (P< .05)

An Evaluation of Three TRM Feed-Mixing Wagons

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CATTLE 00-9

Summary

Three mixer wagons, three-auger, reel-type auger, and four-auger, were used to evaluate the adequacy of mix of a grower diet. All three mixers were considered in good mechanical condition. The grower diet contained 12.4% rolled corn, 23.7% wet corn gluten feed, 42% soybean hulls, 15.8% grass hay, and 6.19% liquid supplement on an as-is basis. Monensin was added to the diet at 28g/ton on an as-fed basis. Samples were obtained after 2, 4, 6, and 8 minutes **(min)** of mixing. Following the 8-min mixing time, the feed was unloaded as a windrow onto a concrete pad. Samples were obtained from the beginning, middle, and end of the windrow. These samples were used for nutrient analysis and ionophore (Monensin) recovery. Dry matter **(DM)** content and crude protein **(CP)** showed little variance across treatments. The coefficient of variation **(CV)** was greater for acid detergent fiber **(ADF)** levels than for other assayed components. The three-auger mixer produced a ration that was adequately mixed after 8 min of mixing. The reel-type auger required 4 min and the four-auger required only 2 min of mixing based on the observed CV. Monensin recovery gave similar results. The three-auger mixer gave the most accurate Monensin levels as compared to theoretical values. These studies indicate any well-maintained mixer will work well if the timing and sequence of adding ingredients is correct for the type of mixing action.

Key Words: Mixer Wagon, Ration Quality Control, Ionophores

Introduction

Feed represents a major cost in the production of livestock. Not only is it crucial that we supply an adequate amount of nutrients, but we must formulate and deliver a ration that will encourage optimum consumption without excessive feed wastage. Diets that are not properly and thoroughly mixed can result in erratic consumption patterns, which can cause cattle to go off feed, thus, costing the feedlot operator lost cattle performance and lost opportunity.

There are several different types of mixing equipment available. Mixers that are currently used by feedlots may need repairs and adjustments to produce an adequately mixed diet. The objective of this research was to evaluate three different mixer wagon types and evaluate methods used to determine the uniformity of the mix.

Materials and Methods

The mixers in this study included an Oswalt® three-auger, a Farm-aid® reel-type auger, and a Renn® four-auger. All three mixers were used, but considered in good condition.

Table 1 shows the ingredient composition (as fed basis) of the grower ration used in the experiment. Rolled corn was the first ingredient added to the mixer. Following the corn, soybean hulls and liquid supplement were added and allowed to mix for 30 seconds. Finally, wet corn gluten feed and grass hay were added to the load. Malted milk ball candies, styrofoam packaging peanuts, and cinnamon red hots were added to represent different particle sizes and bulk densities and were added markers for adequacy of mix. Once the last ingredient was added, the mixer was started and allowed to run for 2 minutes **(min)**. The mixer was stopped and a sample was taken off the top of the load from the front, middle and back. The mixer was then started again and stopped at 2-min intervals. Thus, samples were obtained after 2, 4, 6, and 8 min of mixing. After 8 min of mixing, feed was unloaded onto a concrete pad in

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windrows. Collection pans were strategically placed at the beginning, middle, and end of the windrow. Upon emptying the wagon, the malted milk balls, styrofoam packaging peanuts, and cinnamon red hots were counted from each collection pan. Representative samples were analyzed for dry matter **(DM)**, crude protein **(CP)**, and acid detergent fiber **(ADF)** according to standard wet chemistry procedures. Monensin recoveries were determined by Elanco Animal Health from representative samples of the windrow.

Samples collected from the front, middle, and back (top of load) were considered replicates one, two, and three at each time period. Mean values were calculated at each time period and the coefficient of venation (CV) was used to determine adequacy of mix.

Results and Discussion

Load Sampling

Table 2 illustrates the mean DM, CP, and ADF values by mixer. Table 3 illustrates the CVs associated with these sample means. Dry matter appeared to have been adequately mixed, as evidenced by the low CV, which is not surprising as the grower ration contained feed ingredients with similar dry matters. The CV for CP was not very useful in evaluating the integrity of mix. Acid detergent fiber values were more useful in evaluating the adequacy of mix. The three-auger required 8 min to adequately mix the ration. The CV for ADF decreased from 4.75% to 0.21%. The reel-type auger appeared to be mixed after 4 min of mixing and the four-auger after only 2 min of mixing. With increased time, these two types of augers appeared to have overmixed the diet, as evidenced by greater CV.

Windrow Sampling

Following the 8-min mixing period, feed was unloaded in a windrow onto a concrete pad. Three samples were obtained (beginning, middle, and end) for DM, CP, ADF, and candy marker analysis. Five samples (same three plus two additional) were obtained to determine ionophore (Monensin) recovery.

Table 4 illustrates the mean DM, CP, and ADF values for the three mixers in samples obtained from the windrows after 8 min mixing time and delivery.

Table 5 illustrates the CV of the three samples collected from the windrow. The CV for DM was quite low for the three mixers. Dry matter appeared to be adequately mixed, which is not surprising as the grower ration had a relatively high dry matter content. Crude protein CV's were variable, but still quite low. The three-auger mixer had the lowest CV for crude protein, again suggesting 8 min were required to thoroughly mix the diet. Finally, CV for ADF was relatively low in the windrow suggesting an adequate mix.

Exogenous markers included malted milk balls, cinnamon red hots, and styrofoam packaging peanuts. We included these items as markers due to differences in physical characteristics. These markers differed significantly in particle size, particle shape, bulk density, hygroscopicity, static charge, and adhesiveness. The added markers were sorted out of the collected samples (beginning, middle, and end). Recovery of these markers is illustrated in Table 6.

We were able to recover at least one of the markers in each load. We experienced relatively high CVs (>20%) for all markers in all wagons. The ability to use these items as quantitative markers is still in question.

The ultimate test for accurate mixing would be to analyze for a compound that is exogenous to natural feed. Ionophores or other feed additives would be an example of this. The ability to recover ionophore (Monensin) is shown in Figure 1. In this demonstration, five samples were obtained from the windrow to determine Monensin recovery. The Monensin recoveries were analyzed in comparison to the theoretical value of 28.5 g/ton (as is). The samples were expected to fall within the acceptable +/- 15% from the theoretical mean.

After 8 min, the three-auger gave the most accurate Monensin levels as compared to theoretical values (Figure 1). Values ranged from 28 g/ton to 35 g/ton. The average Monensin recovery of the sample for the three-auger was 113% of theoretical. The reel-type auger created the most variation in Monensin recovery. Recovered values ranged from 18 g/ton to 35 g/ton. The average recovery of the

samples for the reel-type mixer was 84.1% of theoretical. The four-auger was fairly consistent. One outlier was present (41 g/ton) making the average 115.1% of theoretical.

The most consistent mix was obtained with the three-auger mixer. The reel-type mixer produced a wide range of ionophore levels from the beginning to the end of the load. One explanation of this large variation is the reel-type mixer required only 4 min to adequately mix the diet. By overmixing (8 min) the integrity of the mix apparently deteriorated. In contrast, the three-auger mixer required 8 min to produce an optimum mix.

These findings support the idea that each feed mixer and ration type needs to be evaluated to determine optimum mixing time. A well-maintained mixer will work, if the timing and sequence of adding ingredients is correct for the mixer type. Finally, a quality control test is necessary to routinely evaluate mix integrity and consistency.

Acknowledgements

The authors wish to thank Sioux Automation of Sioux Center, IA for providing the mixers used in this study. We also appreciate Beckman and Sons of Brookings, SD for providing tractors to power the mixers. Finally, our thanks are extended to Elanco Animal Health for conducting the Monensin assays.

Table 1. Ingredient Composition of Grower Diet Used to Evaluate Mixing Equipment[1]

Ingredient	% As Fed
Corn, rolled	12.4
Corn gluten feed	23.7
Soybean hulls	42.0
Grass hay	15.8
Liquid supplement	6.1
	100.00%

[1]As fed basis

Table 2. Assayed Nutrient Composition of the Grower Diet for Each Mixer Wagon[a,b]

Variable	Time, min	3-Auger	Reel-Type	4-Auger
Dry Matter	2	81.21	77.13	76.20
	4	77.96	76.90	76.99
	6	78.25	76.95	76.75
	8	77.94	76.84	76.51
Crude Protein	2	15.19	14.89	14.99
	4	15.05	15.62	15.40
	6	15.61	15.84	15.39
	8	15.76	15.15	15.66
Acid Detergent Fiber	2	31.96	30.30	30.44
	4	30.93	31.10	30.13
	6	30.48	30.95	30.37
	8	30.92	30.84	30.67

[a]n = 3
[b]DM basis, except DM

Table 3. Coefficients of Variation of the Grower Diet for Each Mixer

Variable	Time, min	3-Auger	Reel-Type	4-Auger
Dry Matter	2	1.28	1.90	2.79
	4	1.91	0.81	0.91
	6	0.48	0.35	0.90
	8	0.41	0.46	0.85
Crude Protein	2	1.90	1.73	3.83
	4	5.03	3.27	2.00
	6	0.39	1.71	1.97
	8	2.78	3.25	2.28
Acid Detergent Fiber	2	2.91	3.45	1.15
	4	4.75	1.27	2.46
	6	2.06	3.25	4.35
	8	0.21	2.37	2.54

Table 4. Assayed Nutrient Composition for Grower Diet in the Windrows[a,b]

Variable	Windrow Position	3-Auger	Reel-Type	4-Auger
Dry Matter	Beginning	78.65	77.24	78.31
	Middle	78.25	77.21	78.67
	End	78.44	77.02	78.56
Crude Protein	Beginning	15.26	16.03	14.87
	Middle	15.38	15.20	15.25
	End	15.39	15.38	14.92
Acid Detergent Fiber	Beginning	30.93	30.27	31.39
	Middle	31.44	29.65	30.77
	End	30.49	29.43	30.99

[a]n = 3
[b]DM basis, except DM

Table 5. Coefficients of Variation for the Grower Ration in the Windrows

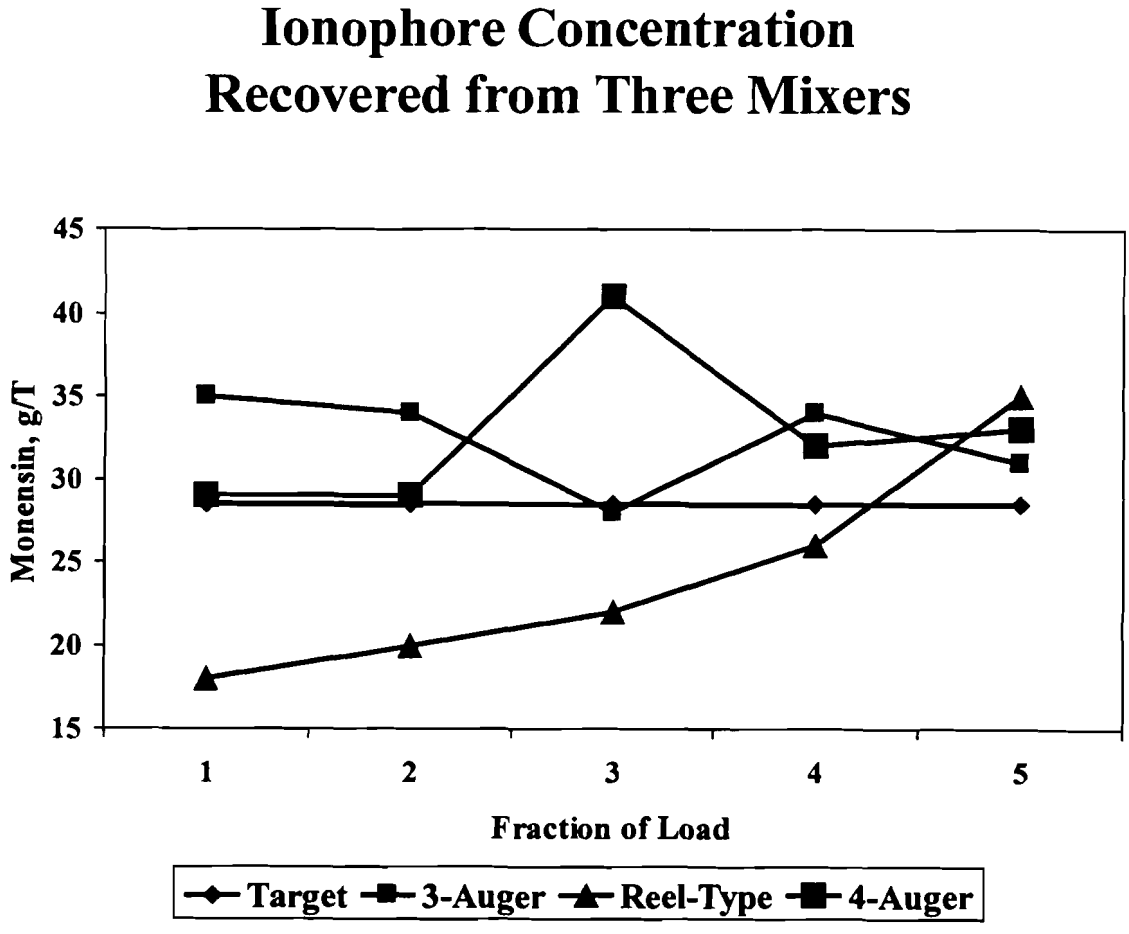
Variable	3-Auger	Reel-Type	4-Auger
Dry Matter	0.26	0.15	0.23
Crude Protein	0.47	2.81	1.38
Acid Detergent Fiber	1.54	1.46	1.01

Table 6. Recovery of Markers in Mixing Demonstrations[a]

	Beginning	Middle	End	Mean	CV
Three-Auger					
Cinnamon Red Hots	6	4	3	4.33	35.3
Malted Milk Balls	5	7	13	8.33	50.0
Styrofoam Packaging Peanuts	7	3.5	3	4.50	48.4
Reel-Type					
Cinnamon Red Hots	8	11	8	9.00	19.2
Malted Milk Balls	2	3	2	2.33	24.7
Styrofoam Packaging Peanuts	9	2.5	5	5.50	59.6
Four-Auger					
Cinnamon Red Hots	9	2	3	4.67	81.1
Malted Milk Balls	11	4	2	5.67	83.4
Styrofoam Packaging Peanuts	6.5	7	3	5.50	39.6

[a]3000 pieces of each item were added to each load with the exception of 2000 malted milk balls to the four-auger and 1000 malted milk balls to the reel-type

Figure 1.


Ionophore Concentration
Recovered from Three Mixers
Monensin, g/T
45
40
35
30
25
20
15
1
2
3
4
5
Fraction of Load
Target
3-Auger
Reel-Type
4-Auger

Comparison of Estradiol-Trenbolone Acetate Implant Programs for Yearling Steers of Two Genotypes

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CATTLE 00-10

Summary

Yearling steers (n = 400) were used to evaluate relative payout periods for implants when feeding high grain content diets. Implant treatments included (1) control (nonimplanted), (2) Synovex Plus, (3) revalor-S, and (4) Ralgro-revalor-S. The Synovex Plus (2), revalor-S (3) and Ralgro (4) were administered on day 1. The reimplant with revalor-S (4) was admnistered after 56 d on feed. Steers were managed in two groups. Initial BW and days fed were 782 lb, 131 d (Group I), and 661 lb, 145 d (Group II). Implants increased production rates and efficiencies, increased carcass size and reduced marbling when compared to nonimplanted controls. Production rates and efficiencies and carcass sizes were similar among steers that received implants. Marbling scores and percentage choice carcasses were affected by implants. In general, the delayed use of an estradiol-trenbolone acetate implant improved marbling over d 1 implanting even though there were 56 fewer days on feed after implanting. The energy density of live weight gain was calculated over the course of the feeding period based upon interim period BW and DMI determinations. Higher energy content of gain early in the feeding period for treatments 1 and 4 were related to marbling, while the energy content of gain late in feeding period was not. These data showed no differences in the relative effective duration of Synovex Plus and revalor-S implants. The influence of implants on carcass quality grades was affected by factors other than elapsed time from implanting to harvest.

Introduction

Optimizing implant strategies requires striking a balance between implant payout, production costs, and carcass specifications. The influence of implants on cost of gain erodes over time. This encourages shortening the expected payout of the implant. However, it is generally considered that carcass marbling is increased as the elapsed time from implanting to slaughter is increased. The label associated with implant clearances generally does not stipulate how prolonged exposure to the implant relates to these conflicting variables.

Presently there are two estradiol-trenbolone acetate implant formulations available for use in steers being fed for slaughter. One product provides 24 mg estradiol and 120 mg trenbolone acetate. A second available product provides the equivalent of 20 mg estradiol as estradiol benzoate and 200 mg trenbolone acetate. These are potent tools for improving production rates in steers. The concentration and proportion of active ingredients in these implants differ as does the carrier matrix. This experiment was designed to compare the relative payout of these products. The information is intended to help producers define the time exposure appropriate for their production constraints.

To evaluate effective payout, it is advantageous to have a nonimplanted control to use as a reference point during growth. It would also be advantageous to have a positive control that provides high levels of implant payout during the same time frame associated with the expected depletion of the test implant(s). This could be accomplished by administering implants in a staggered time schedule in the positive control treatment. Coincidentally, this would also allow consideration of a re-implant program.

In the experiment described here we wished to evaluate the relative effective payout for revalor-s[2] (20 mg estradiol/120 mg trenbolone

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acetate) and Synovex Plus[3] (28 mg estradiol benzoate/200 mg trenbolone acetate). Nonimplanted steers were used as the negative control. The positive control involved delaying revalor-S implanting for 56 d to provide a staggered payout during the later stages of the feeding period. In the positive control Ralgro[4] (36 mg zeranol) was used to provide growth promoting activity during the initial 56 d on feed.

Approach

The implant strategies used included (1) Control (nonimplanted); (2) Synovex Plus; (3) revalor-S; and (4) Ralgro-revalor-S. The Synovex Plus (2), revalor-S (3), and Ralgro (4) were administered on day 1. The re-implant with revalor-S (4) was administered after 56 d on feed.

Forty pens of 10 steers were assigned to the experiment. Steers were purchased as two major groups. Group I consisted primarily of black hided steers and Group II was predominately continental crosses. Each group provided enough steers to fill 20 pens (5 pens per implant treatment per group). The groups were fed and managed as distinctive lots of cattle to accommodate differences in implant response and marketing needs that could occur between differing biological types. The nutrition, processing and implant management was common across groups. Days on feed were 131 for Group I and 145 for Group II.

The 200 steers used in Group I were selected from a group of 223 steers. The Group II steers (n=200) were drawn from a pool of 234 steers. At arrival cattle were observed for thriftiness, structural soundness and type characteristics. Any unacceptable subjects were deleted. Within a source group, cattle were ranked by arrival BW and outliers were deleted. Once the pool was reduced to 200 subjects, treatment was assigned (1 to 4) using a random sequence of treatment codes. Data were resorted by treatment and BW and assigned a random sequence of replicate codes. The treatment-replicate combinations were then assigned pen numbers such that treatment was randomly distributed throughout the 20 pens allocated to the group. This allotment system distributed BW ranges similarly in all pens.

[3]Ft. Dodge Animal Health,
[4]Schering Plough
[5]Smithkline Beecham

Starting dates were May 1, 1996, for Group I and May 23, 1996, for Group II.

Incoming cattle were eartagged and then vaccinated for IBR, BVD, PI_3, BRSV, H. somnus and 7 clostridial SP using Ultrabac 7 and Resvac 4/somubac[5]. Parasite control was provided by administering Expar[4] (external) and Panacur[2] (internal) according to label instructions. During processing, ears were palpated for evidence of viable implants. None were found. During the receiving period long hay and the step 1 diet (Table 1) were fed. The milled feed delivery was limited to 1.5% BW during receiving (3 or 4 d).

Initial and final individual BW each were recorded on two consecutive days. Initial implants were administered during the second initial BW processing. Re-implanting with revalor-S was done during the d 56 BW processing. Implant integrity was evaluated at the next weigh day following implanting. Interim BW was determined as noted in Table 2. All BW were collected with no prior restriction of feed or water.

Cattle were fed twice daily. A five step program was used to adapt cattle to the finishing diet (Table 1). Feed calls were made daily at 0700 based on bunk and cattle condition. A clean bunk management system was used. Rations were mixed using a stationary mixer. A single batch of feed was distributed within replicate so that implant treatment and feed batch were not confounded. Samples of feed ingredients were collected once each week. The analyses of these samples were combined with batching records to reconstruct the composition of diets fed. While on step 5, these diets contained DM 75.5% ± .5, CP 12.4% ± .07, ADF 5.6% ± .15, NDF 12.6% ± .8, and ash 2.7% ± .04. The estimated final diet energy density was NE_m 94.8 Mcal/cwt ± .12 and NE_g 63.7 Mcal/cwt ± .10. All pens were fed the final diet (5) within 15 d on trial. These weekly assays and feed delivery records were used to produce DMI summaries each week or more frequently when necessary.

Initial and interim BW reported in Table 3 were not corrected for fill. The final BW referred to in Table 3 included a 3% shrink. This shrunk BW was used to calculate cumulative ADG and dressing percentage. To evaluate the performance response to the re-implant

treatment (4), performance variables were summarized for the periods prior to (EARLY) and following re-implanting (LATE). The Group I cattle were fed for 131 d and the Group II were fed for 145 d. This caused the LATE performance windows to be 57 to 131 and 57 to 145 d, for Group I and II, respectively.

Two steers were removed from the study; one for lameness and one suffered apparent metabolic disorders. These individuals had been individually hospitalized prior to deleting them from the study. Their BW contribution to the pen mean was deleted from the onset of the experiment. Feed records were corrected for the days the subjects were hospitalized. It was assumed that these individuals consumed pen average DMI up to the point of hospitalization.

On the evening following the final BW, steers were transported 75 miles to the beef packing plant at Luverne, MN. They stood overnight and were processed at 0700 the following day. Individual carcass identity was maintained. Hot carcass weight was recorded the day of slaughter. Longissimus area, ribfat thickness, marbling score, bone maturity, lean maturity, KPH (omitted in Group I), and masculinity were collected 24 h after exsanguination. Data were collected by SDSU personnel trained in carcass evaluation.

One steer was mishandled during transit and was not slaughtered as part of this experiment. Consequently, carcass data were available for 397 subjects.

All performance variables were evaluated in a statistical model that included treatment, group, and the treatment x group interaction using the GLM package of SAS. The experimental unit in these analyses was the pen. Orthogonal contrasts were used to separate treatments. The contrasts included (a) control vs. implants; (b) Synovex Plus and revalor-S vs. Ralgro/revalor-S, and (c) Synovex Plus vs. revalor-S. Carcass data were handled similarly except that the individual steer was considered to be the experimental unit.

Results

The initial BW for Groups I and II were 782 lb ± 5.5 and 661 lb ± 4.2, respectively. The predominately Angus x Hereford steers in Group I were large framed and had never been implanted prior to entering our feedlot. The Continental cross steers used in this study were smaller framed than the Angus x Hereford steers. Initial body condition was not quantified. Flesh was considered typical for yearlings entering our feedlot.

Implants increased (P<.001) ADG and DMI and reduced feed/gain (P<.001). These responses were evident during most interim measures of performance (Table 3). In the latter stages of feeding period, interactions developed between cattle group and implant treatment for ADG and feed/gain. The nonimplanted steers in Group II were growing more rapidly and more efficiently than Group I contemporaries during 113 to 130 d on feed. These (Group II) steers started on feed at a lighter weight and were not as close to finish at 130 d. In contrast, the Group II steers implanted with Synovex Plus had lower ADG at 112 d (3.63 vs. 3.09) and 130 d (3.47 vs. 2.44) than Group I contemporaries. The DMI of these steers also tended to be lower during these interim periods.

Short intervals between BW measurements can be misleading. To average responses overtime ADG from 90 to 130 d was calculated (Table 3). This approach showed that cattle were becoming less efficient as they approached harvest BW. A response to implanting was still in effect as feed/gain was 15% lower in steers initially receiving Synovex Plus or revalor-S than in nonimplanted steers. There was an additional 11% improvement (P<.01) in feed/gain during this period in re-implanted steers.

To evaluate the merits of re-implanting, data were calculated for 1 to 56 (early) and 57 to final (late) feeding periods. During the early phase, combination implants caused better ADG and feed/gain than Ralgro implants (P<.001). Synovex Plus tended (P=.095) to cause higher ADG than revalor-S. During the late phase, re-implanted steers grew faster (P=.012) and more efficiently (P=.006) than single implant steers. Interactions existed because the magnitude of response to implants differed between groups. This may be an artifact of this experiment or that cattle respond differently to these implants based upon their relative size when implants are administered.

Implants increased hot carcass weight (HCW) by 65 lb. The carcasses produced by

implanted steers were of comparable weight (Table 5). The dressing percentage was affected when comparing Synovex Plus and revalor-S. This may have been due to differences in DMI at the termination of the feedlot study.

Longissimus area was increased (P<.001) by implants. There was no appreciable influence on ribfat thickness. Bone maturity and masculinity were increased by implants. Bone and lean maturity were greater for re-implanted than single implanted cattle, but the magnitude of difference is probably inconsequential as regards carcass value.

Influences on marbling were more distinctive. Implants reduced marbling scores and percentage Choice carcasses (Table 5). Marbling scores were lower (P<.05) for single implant strategies (Synovex Plus and revalor-S) than the re-implant strategy. These influences were more pronounced in the lighter cattle of Group II (Table 6). As was noted earlier regarding late gain responses, cattle may be responding differently to implants based on their relative size when implants are administered.

A desirable approach to addressing implant payout would be to evaluate changes in interim period feed/gain. However, fluctuations in feed/gain within treatment can occur during latter stages of the feeding period. This problem becomes exaggerated with short intervals of BW change. Because of these circumstances, the interim ADG, DMI, and feed/gain were not useful for explaining differences in marbling scores attributable to implant treatment. When intake was re-evaluated as DMI, g/kg $BW^{.75}$ the only distinctive separation that occurred was much lower relative DMI for non-implanted steers. This response began to appear after 112 d on feed (Figure 1).

To further evaluate implant payout, the energy density of live weight gain (ED_G) was calculated as NE_g (Mcal)/live weight gain (lb). Higher ED_G values would be indicative of higher fat content in live weight gain. The NE_m and NE_g intakes used were based upon tabular values for feedstuffs and actual feed ingredient intakes. Maintenance requirements were calculated based upon the mean BW for each pen during interim periods. The NE_m requirement was estimated to be increased by 10% during exposure to E_2TBA implants (Birkelo, personal communication). The final period was averaged to 138 d on feed.

During the initial 56 d ED_G was lower (P<.05) in steers exposed to E_2TBA. Ralgro caused only a slight numerical decline from control values during this period. The ED_G content of re-implanted steers converged with the d-1 E_2TBA treatments during the 57 to 89 d and 90 to 112 d periods. The ED_G of nonimplanted steers continued to climb and create an increasingly wider separation from values for implanted steers.

During the final feeding period, the ED_G was lower (P<.05) for re-implanted steers than for either d-1 E_2TBA treatment. This followed a 137-d payout for the d-1 E_2TBA treatments. The E_2TBA implant payout for the re-implant treatment was only 81 d at this point. The difference in ED_G reflects more active implant activity at this late date and is consistent with expectations of implant responses over time.

If the deposition of fat as marbling is most pronounced late in the feeding period, the ED_G curves suggest that marbling would be highest in the nonimplanted steers and lowest in the re-implanted steers. Consistent with this concept, marbling scores were highest (P<.001) for the nonimplanted steers. However, marbling scores were higher (P<.05) for the re-implanted steers than for those on the d-1 E_2TBA treatments. When the pattern of ED_G is compared with the ranking by marbling scores, it is the early ED_G values that best matched the rank of marbling scores. The ED_G was higher through 56 d for those treatments causing higher marbling scores. The separation that occurred between the nonimplant and re-implant treatments at d 89 may be indicative of the phase of growth when marbling scores among re-implanted steers was depressed.

Conclusions

Actual payout optimums for implants were not defined by this research. In Group I it appeared that Synovex Plus was more potent at 130 d than was revalor-S. This observation was reversed in the Group II replication.

Cumulative feedlot production costs would be comparable for the implants used in that weight gain and DMI were similar among implanted steers. There is an additional cost

associated with re-implanting (treatment 4). This cost may be offset by the increased carcass value associated with this strategy in the Group II steers in some fed cattle pricing mechanisms. The explanation for improved grading associated with re-implanting may relate to fewer total days of TBA exposure. However, an evaluation of gain energy density suggested that it may be the influence of implants early in the feeding period that has the greatest effect on marbling scores. Theoretically this influence may be lessened in cattle carrying more flesh when placed in the feedlot. This (along with genetics) would help explain why the Choice percentage can vary dramatically among cattle receiving the same implant strategy. Consideration of this aspect of growth would be important in determining optimum management of implants. Future studies may reveal that Choice percentage may be dictated more so by the existing body condition when E_2TBA implants are administered than by the days from implanting to harvest.

Table 1. Diets Fed

	Step 1	Step 2	Step 3	Step 4	Step 5	Step 5[a]
	% DM basis					
Corn silage	55.00	35.00	25.00	15.00	10.00	–
Oat silage	–	–	–	–	–	8.00
Whole shelled corn	26.65	40.65	47.65	54.65	57.65	59.65
High moisture corn	9.75	15.75	18.00	21.00	23.00	23.00
LS460[b]	3.50	3.50	4.25	4.25	4.25	4.25
Soybean meal, 44%[c]	5.00	5.00	5.00	5.00	5.00	5.00
Limestone[c]	.10	.10	.10	.10	.10	.10

[a]Switch occurred on August 20, 1996.
[b]70% DM, contained 460 g Monensin/T AFB. Diet provided 28.5 g Monensin/T DMB.
[c]Fed as a pelleted supplement that included tylosin. Diet provided 11 g tylosin/T DMB.

Table 2. Processing schedule

Group I		Group II		
DOF	Date	DOF	Date	Procedure
-2	April 29	-2	May 21	Allotment weight
-1	April 30	-1	May 22	Sort to pens
0	May 1	0	May 23	Initial BW_1
1	May 2	1	May 24	Initial BW_2, implant
28	May 30	28	June 21	BW, palpate implant
56	June 27	56	July 19	BW, Re-implant (4)
89	July 30	89	August 21	BW, palpate implant
112	August 22	112	September 13	BW
130	September 9	130	October 1	BW
131	September 10			BW
		144	October 15	BW
		145	October 16	BW

Table 3. Pooled performance summary

	Treatment				SE	Contrast P <			
	Control	Synovex Plus	revalor-S	Ralgro revalor-S	M	1 vs 2,3,4	2,3 vs 4	2 vs 3	Trt*Grp
Initial BW, lb	721	721	722	722	1.7	NS[a]	NS	NS	NS
1 to 28 d									
BW 28, lb	839	864	856	848	3.4	.001	.007	.120	NS
ADG, lb	4.23	5.10	4.81	4.49	.110	.001	.002	.073	NS
DMI, lb/d	17.54	17.92	17.92	17.82	.257	NS	NS	NS	NS
F/G	4.23	3.57	3.81	3.99	.095	.001	.015	.082	NS
29 to 56 d									
BW 56, lb	953	1002	993	973	4.3	.001	.001	.129	NS
ADG, lb	4.05	4.94	4.87	4.46	.114	.001	.004	NS	.005
DMI, lb/d	20.82	21.63	21.03	21.38	.287	.124	NS	.148	NS
F/G	5.15	4.40	4.33	4.85	.091	.001	.001	NS	.001
57 to 89 d									
BW 89, lb	1076	1146	1140	1122	4.8	.001	.001	NS	NS
ADG, lb	3.75	4.37	4.47	4.49	.106	.001	NS	NS	NS
DMI, lb/d	22.27	23.40	23.32	23.12	.279	.004	NS	NS	NS
F/G	6.01	5.39	5.24	5.18	.129	.001	NS	NS	.149
90 to 112 d									
BW 112, lb	1136	1223	1222	1207	6.3	.001	.055	NS	NS
ADG, lb	2.61	3.36	3.55	3.73	.159	.001	NS	NS	NS
DMI, lb/d	21.52	23.85	23.68	23.88	.337	.001	NS	NS	NS
F/G	8.59	7.24	6.75	6.45	.361	.001	NS	NS	NS
113 to 130 d									
BW 130, lb	1173	1277	1268	1267	6.0	.001	NS	NS	.003
ADG, lb	2.03	2.96	2.54	3.29	.197	.001	.032	.146	.003
DMI, lb/d	20.14	23.87	23.35	23.63	.227	.001	NS	.118	.001
F/G	11.14	8.85	9.89	7.49	.851	.021	.082	NS	.005
90 to 130 d									
ADG, lb	2.36	3.18	3.10	3.54	.113	.001	.008	NS	.005
DMI, lb/d	20.90	23.86	23.53	23.76	.248	.001	NS	NS	.025
F/G	9.02	7.67	7.63	6.79	.251	.001	.009	NS	.001

Table 3. Pooled performance summary (con't)

	Treatment					Contrast P <			
	Control	Synovex Plus	revalor-S	Ralgro revalor- S	SEM	1 vs 2,3,4	2,3 vs 4	2 vs 3	Trt*Grp
Early (1 to 56 d)									
ADG, lb	4.14	5.02	4.84	4.48	.073	.001	.001	.095	NS
DMI, lb/d	19.18	19.77	19.47	19.60	.244	.135	NS	NS	NS
F/G	4.65	3.95	4.05	4.40	.044	.001	.001	NS	.029
Late (57 to end)									
ADG, lb	2.89	3.66	3.71	3.92	.073	.001	.012	NS	.004
DMI, lb/d	21.41	23.66	23.47	23.51	.233	.001	NS	NS	.053
F/G	7.49	6.49	6.34	6.00	.114	.001	.006	NS	.001
Cumulative									
Final BW[b], lb	1191	1301	1298	1296	6.1	.001	NS	NS	.007
ADG, lb	3.14	3.92	3.88	3.86	.039	.001	NS	NS	.001
DMI, lb/d	20.51	22.07	21.85	21.93	.200	.001	NS	NS	NS
F/G	6.56	5.63	5.63	5.69	.050	.001	NS	NS	.001

[a]P>.15.
[b]Final BW includes a 3% shrink.

Table 4. Interactions between implant and group

	Treatment					Contrast P <			
	Control (1)	Synovex Plus (2)	revalor-S (3)	Ralgro revalor-S (4)	SEM	1 vs 2,3,4	2,3 vs 4	2 vs 3	Trt*Grp
Late (56 to end)									
ADG, lb									
Group I	2.63	3.81	3.65	3.85	.073	.001	.012	NS[a]	.004
Group II	3.15	3.50	3.78	4.00					
DMI, lb/d									
Group I	21.23	24.26	23.80	23.30	.233	.001	NS	NS	.053
Group II	21.59	23.06	23.14	23.72					
F/G									
Group I	8.09	6.37	6.53	6.07	.114	.001	.006	NS	.001
Group II	6.88	6.60	6.14	5.94					
Cumulative									
ADG, lb									
Group I	2.93	3.95	3.75	3.68	.039	.001	NS	NS	.001
Group II	3.35	3.89	4.01	4.04					
DMI, lb/d									
Group I	20.47	22.41	22.18	21.79	.200	.001	NS	NS	NS
Group II	20.56	21.73	21.52	22.06					
F/G									
Group I	6.98	5.68	5.91	5.92	.050	.001	NS	NS	.001
Group II	6.14	5.59	5.36	5.46					

[a]NS indicates P>.15.

Table 5. Effect of implant treatment on carcass traits

	Treatment					Contrast P <			
	Control (1)	Synovex Plus (2)	revalor-S (3)	Ralgro revalor-S (4)	SEM	1 vs 2,3,4	2,3 vs 4	2 vs 3	Trt*Grp
HCW, lb	717	781	785	781	5.8	.001	NS[f]	NS	.139
Dressing %	62.10	61.85	62.35	62.17	.161	NS	NS	.028	NS
REA, in^2	12.77	13.86	13.82	13.64	.135	.001	NS	NS	NS
Ribfat, in.	.385	.394	.419	.390	.014	NS	NS	NS	NS
Marbling[a]	5.37	4.90	5.02	5.17	.082	.001	.026	NS	NS
Bone maturity[b]	133	145	146	149	1.7	.001	.114	NS	NS
Lean maturity[c]	141	139	136	141	1.6	NS	.054	NS	NS
Masculinity[d]	.63	.96	1.03	1.05	.060	.001	NS	NS	.002
% Choice[e]	68.4	43.0	51.0	59.6					

[a]4.0 = select° ; 5.0 = small° .
[bc]100 = A° ; 200 = B° .
[d]scale 0 to 3; 3 = stag.
[e]P=.002 by Chi square analysis.
[f]NS indicates P>.15.

Table 6. Marbling scores and percentage Choice by implant x group

Item		Treatment				$\bar{X}$
		Control (1)	Synovex Plus (2)	revalor-S (3)	Ralgro revalor-S (4)	
Marbling[ab]	Group I	5.52	4.95	5.13	5.19	5.20
	Group II	5.21	4.85	4.90	5.16	5.03
Choice, %[cd]	Group I	67.4	54.0	58.0	59.2	59.6
	Group II	69.4	32.0	44.0	60.0	51.3
Ribfat[e], in	Group I	.414	.430	.470	.418	.433
	Group II	.356	.357	.369	.362	.361

[a]Treatment effect (P<.001).
[b]Group effect (P<.05).
[c]Treatment effect (P=.002).
[d]Group effect (P=.09).
[e]Group effect (P<.001).

Associations of Beef Production Traits with Polymorphisms in the Growth Hormone Gene and Insulin-Like Growth Factor-1 Gene

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CATTLE 00-11

Summary

The effects of cow and (or) calf genotype for two candidate gene markers [growth hormone (GH) and insulin-like growth factor-1 (IGF-1) genes] on production traits were evaluated in a beef cattle herd. The GH polymorphism is located in exon V of the GH gene and is associated with a leucine/valine amino acid substitution. The IGF-1 polymorphism is located in the 5' flanking region of the IGF-1 gene. Cow GH genotype was not significantly associated with cow production traits (milk yield, average weight, hip height, and condition score) or progeny weight at birth or weaning. The regression of weaning weight on number of valine (versus leucine) alleles in the calf GH genotype indicated a possible association with calf weaning weight, although genotype least-squares means were not significantly different. Calf GH genotype tended to be associated with carcass cutability, but not with birth weight, carcass weight, or marbling score. Cow IGF-1 genotype was significantly associated with estimated milk yield and progeny weaning weight, but not with cow size traits or cow body condition score. Calf IGF-1 genotype was not significantly associated with any of the calf growth or carcass traits evaluated.

Introduction

Developments in genetic technology have created much interest in the possible use of DNA-based diagnostic tests to enhance strategies for genetic evaluation and improvement of livestock. Molecular marker-assisted selection could be especially beneficial for improvement of traits that are difficult to measure (e.g., feed efficiency) and to evaluate genetic potential of animals that do not express a trait (e.g., meat quality of breeding stock or maternal traits of bulls). Other potential advantages of DNA-based evaluation include a reduction in generation interval (animals can be evaluated at any age) and an increase in accuracy in cases when marker information can be combined with conventional performance records.

Gene mapping research has led to the discovery of many polymorphic sites throughout the cattle genome that can serve as genetic markers. However, relatively little is known regarding relationships between specific markers and production traits. Polymorphic sites in genes involved in the mediation of growth factors are logical candidates to study for possible associations with livestock production traits. The objective of this study was to determine if polymorphisms within the growth hormone (GH) gene and insulin-like growth factor-1 (IGF-1) gene were associated with economically important production traits in beef cattle.

Experimental Procedures

The cowherd used in the study consisted of two-breed rotations of Angus x Hereford, Simmental x Hereford, and Tarentaise x Hereford. Calves were sired by purebred bulls in conventional rotational backcrosses or by Charolais in terminal crosses. Calves were born primarily in March and April, and weaned in October at an average age of about seven months. Milk yield was estimated periodically throughout lactation by the calf nursing method. Calves were placed in a feedlot immediately after weaning and slaughtered in one or two groups per year at an average age of 427 days.

The GH polymorphism is located in exon V of the bovine GH gene and is responsible for an amino acid substitution (leucine versus valine) at

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position 127 of the GH polypeptide. The IGF-1 polymorphism is located in the 5' flanking region of the IGF-1 gene.

DNA samples of individual cows and their progeny were extracted from blood and amplified by polymerase chain reaction (PCR). Primer sequences used in PCR were 5'-CCG-TGT-CTA-TGA-GAA-GC-3' and 5'-GTT-CTT-GAG-CAG-CGC-GT-3' for GH and 5'-ATT-ACA-AAG-CTG-CCT-GCC-CC-3' and 5'-ACC-TTA-CCC-GTA-TGA-AAG-GAA-TAT-ACG-T-3' for IGF-1.

Allelic makeup of a given animal for GH was determined following Alu-I restriction enzyme digestion of a 427-bp amplified PCR product (L allele: 264, 96, 51, and 16 bp; V allele: 264, 147, and 16 bp) and gel electrophoresis. Allelic makeup for IGF-1 was determined following digestion of a 249-bp amplified PCR product with SnaB-I (A_1 allele: 223 and 26 bp; A_2 allele: 249 bp). Each animal was assigned a GH genotype of LL, LV, or VV and an IGF-1 genotype of A_1A_1, A_1A_2, or A_2A_2.

Data were analyzed separately for the two marker systems by mixed linear models, accounting for fixed effects of marker genotype (of either cow or calf), year-management, cow breed-type, calf sire breed, cow age, and calf sex. Random effects included calf sire within sire breed and (or) cow sire within cow breed-type. The linear effect of calf weaning age, slaughter age, or carcass weight was included as a covariate when appropriate. Additional analyses were conducted in which the discrete effect of genotype was replaced with the linear and quadratic effects of the number (i.e., 0, 1, or 2) of V alleles in the GH genotype or A_2 alleles in the IGF-1 genotype.

Results and Discussion

Cow GH genotype was not significantly associated with estimated milk yield, cow body weight, cow body condition score, or progeny weight at birth or weaning (Table 1). Least-squares means did not differ significantly between calf GH genotypes for calf birth weight or age-adjusted weaning weight (Table 2). However, there was a slight linear trend toward increased weaning weight for each additional L allele in the genotype.

When calf carcass traits were adjusted to a constant final age of 427 days (Table 3), calf GH genotype tended to be associated with external carcass fat thickness, estimated KPH fat percentage, and estimated retail cutability, but not with carcass weight, rib-eye area or marbling score. Allele V was associated with slightly decreased external fatness and higher cutability than allele L. Animals with the LV genotype tended to have the most KPH fat, whereas VV animals had the least. When carcass traits were adjusted to a constant carcass weight (Table 4), the tendency toward leanness for allele V was similar to that noted above for age-constant analyses. There was a linear tendency toward larger ribeye area (relative to carcass weight) with increasing number of V alleles in the GH genotype, although least-squares means did not differ significantly across genotypes.

Cow IGF-I genotype was not significant for cow size traits or cow body condition score (Table 5). Cows with genotype A_1A_1 produced more milk and heavier progeny weaning weights than cows with A_1A_2 or A_2A_2 genotype (A_1A_2 and A_2A_2 cows did not differ significantly). Calf IGF-I genotype was generally not significantly associated with calf weights (Table 6) or carcass composition (Tables 7-8).

Implications

There was evidence that polymorphisms in the GH and IGF-1 genes were associated with several production traits, although the magnitude of effects tended to be modest in most cases. The GH allele that displayed possible association with increased calf weaning weight could be antagonistic with respect to carcass cutability. It should be noted that an association detected between marker and trait does not necessarily indicate a direct effect of this polymorphism on the trait, but could to some degree reflect the effect of a linked polymorphism.

Table 1. Effect of Cow GH Genotype (LL, LV, or VV) on Cow-Calf Production Traits.

	LL		LV		VV		F-test	Gene action[a]	
Trait	N	LSMean ± SE	N	LSMean ± SE	N	LSMean ± SE	P-value	Linear	Quadratic
Cow mature weight, lb	190	1208 ± 13	155	1217 ± 13	28	1213 ± 26	0.84	NS	NS
Cow hip height, in	189	52.5 ± 0.17	154	52.4 ± 0.16	28	52.3 ± 0.33	0.86	NS	NS
Cow condition score[b]	190	4.4 ± 0.08	155	4.5 ± 0.08	28	4.7 ± 0.16	0.24	NS	NS
Estimated milk yield, lb/day[c]	186	16.3 ± 0.31	150	16.3 ± 0.31	26	16.7 ± 0.62	0.83	NS	NS
Progeny birth weight, lb	186	104.1 ± 1.5	150	103.4 ± 1.5	26	103.0 ± 2.8	0.86	NS	NS
Progeny weaning weight, lb	186	518 ± 6.6	149	517 ± 6.8	26	525 ± 12.3	0.76	NS	NS

[a]Trait value regressed on number of V alleles in genotype.
[b]Scale of 1=extremely emaciated to 9=extrememly obese.
[c]Calf nursing method.

Table 2. Effect of Calf GH Genotype (LL, LV, or VV) on Calf Birth Weight and Weaning Weight.

	LL		LV		VV		F-test	Gene action[a]	
Trait	N	LSMean ± SE	N	LSMean ± SE	N	LSMean ± SE	P-value	Linear	Quadratic
Calf birth weight, lb	208	103.6 ± 1.5	129	103 ± 1.7	18	101 ± 3.3	0.55	NS	NS
Calf weaning weight, lb	205	522 ± 6.6	126	514 ± 7.3	18	505 ± 13.9	0.19	-9.5 ± 5.1[+]	NS

[a]Trait value regressed on number of V alleles in genotype.
[+]P<.10

Table 3. Effect of Calf GH Genotype (LL, LV, or VV) on Carcass Traits, Adjusted to Constant Final Age (427 Days).

	LL		LV		VV		F-test	Gene action[a]	
Trait	N	LSMean ± SE	N	LSMean ± SE	N	LSMean ± SE	P-value	Linear	Quadratic
Carcass Weight, lb	204	734 ± 6	122	725 ± 7	18	719 ± 16.0	0.45	NS	NS
Rib eye area, in^2	204	12.7 ± 0.1	122	12.8 ± .2	18	12.9 ± 0.34	0.69	NS	NS
External fat, in	204	.45 ± .02	122	.41 ± .02	18	0.39 ± 0.04	0.07	-.035 ± .015*	NS
Marbling score[b]	204	393 ± 5.8	122	401 ± 6.3	18	405.0 ± 14.0	0.43	NS	NS
Choice grade, %	204	52.3 ± 4.6	122	55.3 ± 5.2	18	48.6 ± 11.6	0.79	NS	NS
KPH, %	204	2.21 ± 0.04	122	2.30 ± 0.05	18	1.97 ± 0.13	0.04	0.30 ± 0.13*	-0.21 ± .083*
Retail cut, %	204	51.3 ± 0.16	122	51.6 ± 0.17	18	52.0 ± 0.38	0.05	0.35 ± 0.14*	NS

[a]Trait value regressed on number of V alleles in genotype
[b]slight = 300 to 399, small = 400 to 499, etc.
*P<.05

Table 4. Effect of Calf GH Genotype (LL, LV, or VV) on Carcass Traits, Adjusted to Constant Carcass Weight (739 lb).

	LL		LV		VV		F-test	Gene action[a]	
Trait	N	LSMean ± SE	N	LSMean ± SE	N	LSMean ± SE	P-value	Linear	Quadratic
Rib eye area, in^2	204	12.8 ± .1	122	13.0 ± .1	18	13.3 ± .31	0.20	.21 ± .12+	NS
External fat, in	204	.45 ± .02	122	.43 ± .02	18	.39 ± .04	0.18	-.028 ± .015*	NS
Marbling score[b]	204	396 ± 5.5	122	407 ± 6.1	18	405 ± 4.1	0.20		NS
Choice grade, %	204	53.0 ± 4.5	122	56.0 ± 5.0	18	52.0 ± 11.0	0.83	NS	NS
KPH, %	204	2.22 ± 0.04	122	2.32 ± 0.05	18	2.03 ± 0.13	0.06	0.29 ± 0.13*	-0.19 ± 0.08*
Retail cut, %	204	51.2 ± 0.17	122	51.5 ± 0.18	18	51.8 ± 0.38	0.10	0.31 ± 0.14*	NS

[a]Trait value regressed on number of V alleles in genotype
[b]slight = 300 to 399, small = 400 to 499, etc.
+P<.10, *P<.05

Table 5. Effect of Cow IGF-1 Genotype (A_1A_1, A_1A_2, OR A_2A_2) ON Cow-Calf Beef Production Traits.

	A_1A_1		A_1A_2		A_2A_2		F-test	Gene action[a]	
Trait	N	LSMean ± SE	N	LSMean ± SE	N	LSMean±SE	P-value	Linear	Quadratic
Cow mature weight, lb	90	1224 ± 16	186	1208 ± 13	97	1210 ± 15	0.62	NS	NS
Cow hip height, in	90	52.4 ± .2	184	52.4 ± .2	97	52.4 ± .2	0.98	NS	NS
Cow condition score	90	4.6 ± 0.10	186	4.5 ± 0.08	97	4.5 ± 0.09	0.64	NS	NS
Estimated milk yield, lb/day[b]	86	17.0 ± .4	183	16.1 ± .3	93	16.3 ± .3	0.04	-1.39 ±.62*	.51 ± .29^{+}
Progeny birth weight, lb	86	106.0 ± 1.9	183	103.4 ± 1.5	93	102.7 ± 1.7	0.17	-1.72 ±.95^{+}	NS
Progeny weaning weight, lb	85	533 ± 7.7	183	512 ± 6.4	93	519 ± 7.3	0.01	-35.1 ± 2.1**	13.8 ± 5.6*

[a] rait value regressed on number of A_2 alleles in genotype.
[b]Calf nursing method.
$^{+}$P<.10, * P<.05, ** P<.01

Table 6. Effect of Calf IGF-1 Genotype (A_1A_1, A_1A_2, OR A_2A_2) on Calf Birth Weight and Weaning Weight.

	A_1A_1		A_1A_2		A_2A_2		F-test	Gene action[a]	
Trait	N	LSMean ± SE	N	LSMean ± SE	N	LSMean ± SE	P-value	Linear	Quadratic
Birth weight, lb	101	103.2 ± 1.8	190	103.4 ± 1.5	65	101.9 ± 1.9	0.72	NS	NS
Weaning weight, lb	100	520 ± 8.2	187	518 ± 6.6	63	518 ± 8.6	0.99	NS	NS

[a]Trait value regressed on number of A_2 alleles in genotype

Table 7. Effect OF Calf IGF-1 Genotype (A_1A_1, A_1A_2, OR A_2A_2) on Carcass Traits, Adjusted to Constant Final Age (427 DAYS).

	A_1A_1		A_1A_2		A_2A_2		F-test	Gene action[a]	
Trait	N	LSMean ± SE	N	LSMean ± SE	N	LSMean ± SE	P-value	Linear	Quadratic
Carcass Weight, lb	98	736 ± 8	185	730 ± 6	62	728 ± 9	0.75	NS	NS
Rib eye area, in^2	98	13.0 ± .18	185	12.9 ± .14	62	12.6 ± .20	0.20	NS	NS
External fat, in	98	.41 ± .02	185	.43 ± .02	62	.44 ± .02	0.52	NS	NS
Marbling score[b]	98	404 ± 7.1	185	400 ± 5.6	62	395 ± 8.0	0.61	NS	NS
Choice grade, %	98	48.0 ± 6.0	185	54.4 ± 4.6	62	53.5 ± 6.6	0.54	NS	NS
KPH, %	98	2.29 ± 0.06	185	2.22 ± 0.04	62	2.15 ± 0.07	0.26	-0.07 ± 0.04[+]	NS
Retail cut, %	98	51.6 ± 0.20	185	51.5 ± 0.16	62	51.2 ± 0.22	0.25	NS	NS

[a]Trait value regressed on number of A_2 alleles in genotype
[b]light = 300 to 399, small = 400 to 499, etc.
[+]P<.10

Table 8. Effect of Calf IGF-1 Genotype (A_1A_1, A_1A_2, or A_2A_2) on Carcass Traits, Adjusted to Constant Carcass Weight (739 lb).

	A_1A_1		A_1A_2		A_2A_2		F-test	Gene action[a]	
Trait	N	LSMean ± SE	N	LSMean ± SE	N	LSMean ± SE	P-value	Linear	Quadratic
Rib eye area, in^2	98	13.0 ± .16	185	13.0 ± .13	62	12.7 ± .18	0.18	NS	NS
External fat, in	98	.42 ± .02	185	.44 ± .02	62	.46 ± .02	0.39	NS	NS
Marbling score[b]	98	400 ± 7.1	185	400 ± 5.7	62	406 ± 8.0	0.78	NS	NS
Choice grade, %	98	48.0 ± 5.9	185	55.0 ± 4.5	62	45.0 ± 6.5	0.47	NS	NS
KPH, %	98	2.28 ± 0.06	185	2.23 ± 0.05	62	2.17 ± 0.07	0.43	NS	NS
Retail cut, %	98	51.6 ± 0.21	185	51.5 ± 0.17	62	51.1 ± 0.22	0.15	-0.22 ± 0.12[+]	NS

[a]Trait value regressed on number of A_2 alleles in genotype
[b]slight = 300 to 399, small = 400 to 499, etc.
[+]P<.10

Effects of Breed-Type and Breeding System on Efficiency of Weaned Calf Production

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CATTLE 00-12

Summary

The objective of this study was to evaluate effects of cow breed-type (two-breed rotations of Simmental x Hereford, Angus x Hereford, and Tarentaise x Hereford) and breeding system (rotational vs terminal sires) on production efficiency to weaning. Cows were limit fed in drylot for one year to simulate weight change of range cows. Both cow breed-type and sire type significantly affected efficiency of weaned calf production (weaning weight divided by cow and calf creep feed ME intake). However, there was an interaction of cow breed-type with breeding system for efficiency of weaned calf production. In particular, Hereford-sired Simmental-Hereford cows had higher weaning efficiency when mated to Simmental (i.e., rotational) bulls than when mated to Charolais (i.e., terminal) bulls. In contrast, cows of other breed-types were more efficient when mated to terminal bulls than when mated to rotational bulls. Because cow breed-type rankings for production efficiency can vary depending on the type of sire to which cows are mated, it is important to consider genetic complementarity in the design of breeding systems.

Introduction

In choosing germ plasm for commercial cow-calf production, a common suggestion is to match cow genetic type to existing resources such as climate, feedstuffs, and management preferences. Sire selection should complement dam type by accounting for calf performance and market demands. Rotational mating systems provide maternal and direct heterosis and generate replacement heifers within the system. Terminal matings of crossbred females to sires of different breeding provide maternal and direct heterosis and allow increased opportunities for genetic complementarity by emphasizing maternal traits in the dam and growth/carcass traits in the sire. Terminal matings have arguably been under-utilized by the beef industry because of issues related to replacement of breeding females. In herds large enough to support the use of two or more bulls, it is possible to simultaneously utilize terminal matings and matings in which potential replacement females are born.

A series of studies have been conducted at SDSU to evaluate factors, including genetic type of dam, affecting efficiency of production. The effects of sire genetic type or complementarity between dam and sire type were usually not addressed in the previous studies. The objective of this study was to determine if dam breed-type rankings were consistent in rotational versus terminal matings for traits related to efficiency of weaned calf production.

Materials and Methods

Three conventional two-breed rotations (Simmental x Hereford, Angus x Hereford, and Tarentaise x Hereford) were developed at the Antelope Range Livestock Station. A small number of foundation Tarentaise-Hereford cows were purchased. Otherwise, the rotations were initiated by mating Hereford cows to Simmental, Angus, or Tarentaise bulls. F_1 cows were bred to Hereford bulls, and cows in subsequent generations were bred to a bull of the breed other than that of her own sire. Cows evaluated in the present study were born after the F_1 generation. The Simmental x Hereford and Angus x Hereford rotations were begun several years earlier than the Tarentaise x Hereford rotation. Consequently, there were no Tarentaise-sired cows available for this study. For the present study, some of the cows were mated within their respective rotations, while others were mated to Charolais bulls in a terminal cross (Table 1). Samples of cows from each of the mating types were transported to a drylot at the Beef Cattle Breeding Research Unit

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near Brookings. Only cows that had been diagnosed as pregnant were used. Prior to being transported to the drylot, the cows had spent the previous year under conventional management at the Antelope Range Livestock Station. In drylot, cows were limit-fed in individual stalls for a one-year period, from soon after weaning a previous calf through weaning of the subsequent calf.

Cows were placed in stalls once daily precalving and twice daily postcalving for approximately one hour per feeding. Initial feed levels offered to cows were based on NRC (1984), and so differences between cows varied with cow weight. The pre-trial weight used to calculate the amount of feed offered was measured at weaning at the Antelope Range Station just prior to transport to drylot. At subsequent 4-week intervals, cow weights and body condition scores were monitored and feed levels were adjusted to simulate weight and body condition changes of contemporary cows under conventional management. The base cow diet in drylot consisted of chopped prairie hay and pelleted alfalfa hay, although corn grain was added during lactation. Most cows consumed all feed offered at each feeding.

Calves were born in March and April and were weaned at an average age of about 7 months. Calves were allowed to nurse only when the cows were in the individual feeding stalls. Calves were also provided ad libitum amounts of high roughage creep feed from early summer until weaning to simulate replacement of forage they would have had access to under conventional pasture management. Milk production was estimated by the calf nursing method on six separate dates, and cumulative milk yield was estimated by within-cow non-linear regression.

Data were analyzed by least-squares procedures. Initial statistical models included cow breed-type, breeding system (i.e., rotational versus terminal sire), year, calf sex, and significant two-way interactions. Calf age at weaning (equivalent to length of lactation) was included as a linear covariate for all traits except cow weight and body condition score.

Results and Discussion

The full array of matings used in the study is shown in Table 1. The Simmental x Hereford and Angus x Hereford rotations were each divided into two groups for purposes of analyses depending on whether the cows were Hereford-sired or non-Hereford-sired. Cow breed-type abbreviations are defined in Table 1.

The interaction between cow breed-type and breeding system was not significant for cow-calf productivity traits (Table 2). Thus, least-squares means are presented for the main effects only. Cow breed-types tended to have relatively similar means with the exception of Angus x Hereford cows of high percentage Hereford (HAH). Cows in the HAH group, on average, were fatter, produced less milk, and weaned lighter-weight calves compared to the other cow breed-types. Terminal-sire matings produced heavier (P=.04) calf weights than rotational matings. Interestingly, the increased preweaning growth of terminal-sired calves apparently stimulated their dams to produce more (P=.08) milk than cows nursing rotational calves.

Breeding system and the interaction between cow breed-type and breeding system were nonsignificant for intake traits (Table 3). Creep feed intake varied modestly (P=.10) among calves of different cow breed-types. Cow intake of metabolizable energy (ME) varied significantly among cow breed-types on an absolute basis and as a proportion of cow weight. It should be emphasized that these values for cow ME intake were based on limit feeding and might not accurately reflect differences under ad libitum conditions. Cow ME intakes were greatest for SHS, intermediate for HSH, HTH, and AHA, and lowest for HAH. Relative to body weight, cow ME intakes were greatest for HTH and SHS, intermediate for HSH and AHA, and lowest for HAH. The fact that HAH cows maintained the most body condition while consuming the least feed energy can be at least partly explained by their lower milk production.

Efficiency of milk production was calculated as cumulative milk yield (lb) divided by cumulative cow feed ME intake (kcal). Least-squares means (Table 4) are presented for each cow breed-type by breeding system combination because of a significant interaction. In rotational matings, differences between cow breed-types were relatively small with a slight advantage for HSH and HTH cows. However, cow breed-type rankings changed considerably in matings to terminal sires. The AHA and SHS cow breed-types benefited the most in milk production efficiency from being mated to terminal sires.

Efficiency of weaned calf production was calculated as calf weaning weight (lb) divided by cumulative cow feed and calf creep feed ME intake (kcal). Again, cow breed-type rankings varied depending on breeding system (Table 5). In rotational matings, weaning efficiency was greatest for the HSH cow group, intermediate for AHA, HTH, and SHS, and lowest for HAH. In terminal matings, weaning efficiency was greatest for the AHA and HTH cow breed-types, intermediate for SHS, and lowest for HSH and HAH. All cow breed-type groups benefited from terminal matings except for HSH cows. This is perhaps not too surprising considering that HSH cows were mated to bulls of high-growth breeds in both rotational and terminal matings (i.e., Simmental and Charolais, respectively).

The previous discussion has been based on efficiency of feed utilization. Reproductive performance is also an important component of overall production efficiency. All cows were pregnant at the beginning of the study. There were no significant differences between cow breed-types in rebreeding percentage, although numbers of observations were too small for adequate comparison.

Implications

Output traits (e.g., milk yield, weaning weight) by themselves are not always good indicators of production efficiency when evaluating breed-types. Extra costs associated with increased production must also be considered. Both cow breed-type and sire type significantly affected efficiency of weaned calf production. Cow breed-type rankings varied depending on whether cows were bred to rotational or terminal sire breeds, indicating the importance of genetic complementarity in the design of breeding systems for commercial beef production.

Table 1. Matings, Breed Composition, and Expected Heterosis Levels.

			Average % Hereford		Average % Heterosis	
Cow breed-type[a]	Calf sire breed	N	Cow	Calf	Cow	Calf
		Simmental x Hereford Rotation				
SHS	P. Hereford	6	37.0	68.5	74.0	63.0
	Charolais	10	37.2	18.6	74.4	100.0
HSH	Simmental	7	71.0	35.5	58.0	71.0
	Charolais	10	69.4	34.7	61.3	100.0
		Angus x Hereford Rotation				
AHA	P. Hereford	11	36.1	68.0	72.2	63.9
	Charolais	15	35.8	17.9	71.7	100.0
HAH	Angus	10	67.5	33.8	65.0	67.5
	Charolais	11	69.6	34.8	60.8	100.0
		Tarentaise x Hereford				
HTH	Tarentaise	8	74.2	37.1	51.6	74.2
	Charolais	8	73.4	36.7	53.1	100.0

[a] H=Hereford, S=Simmental, A=Angus, T=Tarentaise. First letter denotes breed of cow's sire. Second letter denotes breed of cow's maternal grandsire.

Table 2. Cow-Calf Production Traits.

Cow breed-type [a]	Calf weaning wt, lb wt wt, kg		Avg cow wt, lb		Avg cow Condition score		Cumulative Milk yield, lb	
	mean ±	se	mean ±	se	mean ±	se	mean ±	se
HSH	603 ±	12	1246 ±	22	5.0 ±	.1	3294 ±	121
HAH	506 ±	11	1222 ±	20	5.7 ±	.1	2786 ±	107
HTH	568 ±	12	1186 ±	23	4.9 ±	.1	3259 ±	135
SHS	595 ±	13	1243 ±	23	4.7 ±	.1	3387 ±	127
AHA	594 ±	10	1220 ±	18	5.2 ±	.1	3270 ±	97
P-value of F-test	<.01		.38		<.01		<.01	
Breeding system								
Rotational	562 ±	8	-		-		3105 ±	77
Terminal	584 ±	7	-		-		3294 ±	71
P value of F-Test	.04		-		-		.08	

[a]H=Hereford, S=Simmental, A=Angus, T=Tarentaise

Table 3. Metabolizable Energy (ME, Mcal) Intake in Drylot [a].

Cow breed-type [b]	Cumulative calf creep ME, Mcal		Cumulative cow feed ME, Mcal		Cumulative cow feed ME (Mcal) / body weight (lb)	
	mean ±	se	mean ±	se	mean ±	se
HSH	408 ±	17	8898 ±	109	7.20	.14
HAH	379 ±	15	8299 ±	104	6.77	.13
HTH	364 ±	17	8802 ±	125	7.42	.15
SHS	368 ±	18	9173 ±	114	7.39	.15
AHA	412 ±	13	8611 ±	89	7.09	.11
P-value of F-test	.10		<.01		.01	
Breeding System						
Rotational	392 ±	11	8776 ±	73	7.16	.09
Terminal	380 ±	9	8737 ±	62	7.19	.08
P value of F-Test	.40		.69		.79	

[a]Intake values shown were for approximately one year
[b]H=Hereford, S=Simmental, A=Angus, T=Tarentaise

Table 4. Efficiency of Milk Production (lb cumulative milk / Mcal cumulative cow feed ME) for Main Effects and Interaction of Cow Breed-Type and Breeding System[a]

	Breeding system				
	Rotational		Terminal		Cow breed-type
Cow breed-type[b]	mean ±	se	mean ±	se	average
HSH	.357 ±	.018	.351 ±	.015	.354
HAH	.331 ±	.016	.312 ±	.014	.322
HTH	.353 ±	.017	.367 ±	.020	.360
SHS	.329 ±	.019	.382 ±	.016	.356
AHA	.332 ±	.015	.391 ±	.012	.362
Breeding system average	.341		.361		

[a] P-values for AOV F-tests were.06 for cow breed-type, .05 for breeding system, and .06 for the cow breed-type x breeding system interaction.
[b]H=Hereford, S=Simmental, A=Angus, T=Tarentaise.

Table 5. Efficiency of weaned calf production (lb weaning wt/Mcal cow and calf creep ME) for main effects and interaction of cow breed-type and breeding system[a]

	Breeding system				
	Rotational		Terminal		Cow breed-type
Cow breed-type[b]	Mean ±	se	mean ±	se	average
HSH	.0674 ±	.0019	.0619 ±	.0016	.0647
HAH	.0558 ±	.0016	.0618 ±	.0015	.0588
HTH	.0611 ±	.0018	.0664 ±	.0021	.0637
SHS	.0603 ±	.0020	.0649 ±	.0017	.0626
AHA	.0628 ±	.0015	.0678 ±	.0013	.0653
Breeding system average	.0615		.0646		

[a]P-values for AOV F-tests were<.01 for cow breed-type, <.01 for sire type, and .01 for the cow breed-Type x breeding system interaction.
[b]H=Hereford, S=Simmental, A=Angus, T=Tarentaise

The Influence of Body Weight and Marbling EPD on the Relationship of Intramuscular Fat Content and the Value of Lean Retail Product in Serially Slaughtered Angus Steers.

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CATTLE 00-13

Summary

It is unclear how age, physiological maturity, and genetics affect intramuscular fat (**IM**) desposition in cattle. The study used beef cattle of known age and parentage to study the development of primal cuts, total carcass fat and IM fat depots as part of the growth process.

Selecting cattle for marbling with the use of paternal grandsire's EPD for marbling was not indicative of differences in the onset or the rate, of development of marbling. Greater differences in EPD for marbling may be needed to observe phenotypic differences. Harvest group affected the level and extent of marbling (P<.10), however there was no harvest group x marbling group interactions indicating no differences occurred in the pattern of marbling development due to marbling EPD. Carcasses expressed a Small degree of marbling between the hot carcass weights of 550 and 650 lbs. and at a back fat depth of approximately .30 in. In this study utilizing non-implanted steers of the same breed, we found that as days on feed increased, hot carcass weights, back fat depth, and percent carcass fat increased along with marbling score as well as percent 12th rib lipid content. No differences were observed in the weight of the primal cuts when expressed as a percentage of the chilled carcass between marbling groups at each of the five end points. As HCW increased across harvest groups, primal weight increased without a change in the percentage of the carcass represented by the middle meats (sirloin, shortloin, rib).

Introduction

Excess carcass fat and inadequate marbling have been identified as common defects in beef (NBQA, 1995). It is known that these traits are inversely related, (Arnold et al., 1991) (Lamb et al., 1990) (Wilson, 1987) creating difficulty in resolving the problem. Evidence exists that the genetic correlation between these traits is minimal, (Wilson, 1987) thereby opening the opportunity to use breeding to correct these defects. The development of Expected Progeny differences **(EPD)** for marbling represents a technology available today that may speed progress in this area.

Research (Vieselmeyer et al., 1996 and Gwartney et al., 1996) has shown that progeny of sires with high marbling EPDs produce beef with a greater degree of marbling. What researchers have not been able to identify is whether cattle that have greater genetic potential to deposit intramuscular fat do so via an earlier onset of intramuscular (IM) fat deposits or a more rapid accumulation of IM fat deposits throughout the feeding phase.

Marbling and cutability account for only part of carcass value. The proportion of the chuck and round to the higher-priced middle meats and total retail weight also affect the total retail value of the carcass. Consequently monitoring it is important to the change in carcass weight and the proportion of wholesale cuts in the carcass throughout the feeding phase, while seeking the most desirable endpoint associated with quality grade.

Materials and Methods

This was a two year study that used Angus steers of know genetic background and age (n=40, year 1; n=46, year 2), selected from one breeder. In both years of the study, steers were handled and allocated to trial in the same

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fashion. Steers were received in October and backgrounded on a receiving trial from weaning until the end of December. Steers were then sorted by paternal grandsire marbling EPD into high (**HIGH**) and low (**LOW**) marbling groups and assigned to one of 5 harvest groups. The five harvest groups (Table 1) were targeted at carcass weights of 1) 450; 2) 550; 3) 650; 4) 750; and 5) 850 lbs. Live weights of 1) 900; 2) 1040; 3) 1146; 4) 1258; and 5) 1403 lb. prior to a 4 % shrink were targeted based from dressing percentages of 52, 55, 59, 62 and 63 %, respectively. In year one of the study, 4 paternal grandsires were represented in the high marbling group and 2 paternal grandsires represented in the low marbling group. The average EPD of the paternal grandsires for marbling +.21 for HIGH and -.19 for LOW. More sires were used in the second year of the study. Both the HIGH and the LOW group used five paternal grandsires each with average EPD for marbling of +.28 for HIGH and -.02 for LOW.

Steers were weighed on test on 12/27/96 (year 1) and 12/23/97 (year 2). Pens contained 4 or 5 steers each and were penned by marbling group and harvest group. Steers were fed a typical feedlot finishing diet which consisted of a corn based 90% concentrate diet formulated to meet all nutrient requirements (NRC, 1996). (Table 3) Steers were fed once daily in the afternoon. Steers were weighed approximately every 28 d to monitor weight gain and to schedule appropriate harvest dates. There was no restriction of feed or water availability prior to weighing the steers. When the mean weight of the harvest group reached the desired weight, feed was removed the afternoon prior to harvest. Steers were individually weighed and transported to the SDSU Meat Lab on campus for harvest the following morning. After harvest, the carcasses were chilled for 48 h. Carcass data collected included hot carcass weight, longissimus area (REA), backfat thickness (BF) and percent kidney, pelvic and heart fat (KPH) depots. Estimates of bone maturity and marbling score (to the nearest 1/10) were recorded. Yield grade (YG) was calculated from carcass measurements obtained. Wholesale primals were cut according to The Meat Buyers Guide by the National Association of Meat Purveyors (NAMP, 1988) and weighed.

To better understand the rate and development of marbling, muscle samples were obtained from the longissimus muscle at the12th rib, and analyzed for lipid content by ether extract (AOAC, 1990). Samples were obtained and frozen for storage at –20° C. The 9-10-11 rib section was removed from the right side of the carcass and chemical analysis of the soft tissue was conducted to determine nitrogen, water and ether extract (fat) content. The composition of the 9-10-11 rib section was used to estimate total carcass fat and protein content (Hankins and Howe, 1946).

Carcasses were broken down into the following five wholesale cuts as outlined by the National Association of Meat Purveyors (1998); rib, shortloin, sirloin, round and chuck. Cuts were removed and weighed without trimming excess fat. Weights were compared to analyze differences in percentages of wholesale cuts relative to HIGH and LOW marbling groups.

Statistical Analysis. Statistical analysis of data were performed using analysis of variance generated using the General linear Models procedure of SAS (SAS, 1985). An individual steer was used as the experimental unit and the model sum of squares was partitioned into year (1 or 2), marbling group (High or Low), harvest group (1, 2, 3, 4,or 5), and the year x harvest group x marbling group interactions (Dammon and Harvey, 1987). The means presented for marbling group and harvest group are presented here to demonstrate the magnitude as well as direction of change in the measured traits.

Regression equations were developed for the relationship of carcass traits to live weight, hot carcass weight and percent carcass fat. Data were compared for linear, quadratic and cubic relationships as outlined by Steel and Torrie, 1960.

Results

One steer was removed from the trial in year 2 due to structural unsoundness. The harvest schedule and production traits are reported in Table 1 by year. Body weight within harvest group was not different between high or low marbling groups. Body weight for harvest groups 1, 2, 3, 4 and 5 were heavier in year 1 than in year 2 ($P<.10$, Table 1). Average daily gains decreased as anticipated with progressing harvest group. Mean hot carcass weights (HCW) increased linearly and in a quadratic fashion due to the desired endpoints and differed ($P<.01$) between harvest groups (Table

2). Regression equations were developed to quantify the change in carcass characteristics and composition throughout the feeding phase. A quadratic equation described the increase (P<.10) in BF, KPH, and calculated YG between harvest groups and followed the anticipated upward trend in a quadratic fashion. Hot carcass weight, REA, %KPH, marbling score and percent intramuscular fat (PIMF) content of the 12th rib were all found to be linear. No differences were found for carcass traits when comparing HIGH vs. LOW (Table 3).

Changes in carcass composition are shown in Table 4. Carcass fat (%) increased (P<.10) with progressing harvest groups. As anticipated, carcass protein (%) and water (%) were inversely related to carcass fat (%) and decreased (P<.10) in a quadratic fashion with each harvest group. Bone as a percent of the carcass was higher (p<.10) at the first harvest group, but remained the same in harvest group 2, 3 and 4, but decreased (P<10) at harvest group 5 relative to proceeding groups.

Marbling group (H or L) averaged over both years (1 and 2), had no affect on the carcass variables measured (Table 3). Measurements of quality indicators were not different between the high and low marbling lines (Table 3). However, a year by marbling EPD group interaction existed for PIMF (Table 5). In year 1 of the study the HIGH group had greater (P<.10) PIMF content at the 12th rib than the LOW group. In year 2 of the study there was no difference between HIGH or LOW groups. The HIGH group was also greater (P<.10) in year one of the study than in year 2. While there was no difference between years 1 and 2 for the PIMF content of the 12th rib for the L OW marbling group.

The Nutrient Requirements for Beef Cattle (NRC, 1996) assumes that cattle reach the choice grade when percent body fat reaches 28% on an empty body weight basis. A level of 4% PIMF content of the 12th rib slices is indicative of small^0 degree of marbling (Rouse and Wilson, 1994). Equations were developed for HCW relative to PIMF content of the 12th rib for both the HIGH and LOW groups (Figure 1). The LOW group reached 4% PIMF content at a HCW of 565 pounds versus 600 pounds for the HIGH group. Because there was no interaction between marbling groups and harvest group there was no difference in the rate or onset of the PIMF content of the 12th rib. Thus based on the equations developed from the regression analyses of the combined data set carcasses reached 4% PIMF content carcass fat at 570 pounds (Figure 2). This would be representative of a shrunk live body weight of Carcasses with a 4% PIMF content of the 12th rib had a % body fat content of 24.5%. The research used to establish the 28% empty body fat (EBF) level was based on an accumulation of trials (Harpster 1978, Danner et al., 1980; Lomas et al., 1982: Woody et al., 1983). Serial harvest was not a component of those experiments, which limited researchers to analyze the data in a linear fashion. Results of this experiment indicate a need to further research the current concept of cattle reaching small^0 at 28% carcass fat.

A better understanding of the change in the proportionality of the carcass can be obtained by evaluation of the cuts as a percent of carcass weight. Table 6 depicts the changes in the percentage of each cut at each harvest group. The percentage of shortloin and chuck relative to carcass weight did not change across harvest groups. The percentage of rib responded in a quadratic fashion with the greatest percentage of rib at Harvest group 4. The percentage of sirloin, when tested against harvest group decreased in a linear fashion (P<.01). The proportion of the round decreased (P<.10) linearly at each harvest group. Thus the round made up 4.39% less of the total carcass weight at harvest group 5 compared to harvest group 1.

Implications

Recent serial slaughter trials (Gwartney, et al., 1996; Vieselmeyer, et al., 1996) involving cattle of known genotype have only focused on a two endpoint harvest model. Researchers assumed development of tissues was linear and did not quantify the accumulation of fat depots. This experiment provides a better understanding of the manner in which fat depots are developed. Further research is needed on the effects of carcass quality when manipulating the growth curve with exogenous agents, genetics as well as level of nutrition.

Literature Cited

American Angus Association. 1997. Sire Evaluation Report – Fall 1997. American Angus Association. St. Joseph Mo.

AOAC. 1990. Official Methods of Analysis (15th Ed.). Association of Official Analytical Chemists, Arlington, VA.

Arnold, J.W., J.J. Bertrand, L.L. Benyshek, and C. Ludwig. 1991. Estimates of genetic parameters for live animal ultrasound, actual carcass data, and growth traits in beef cattle.

Dammon, Jr., R.A. and W.R. Harvey. 1987. Experimental Design, ANOVA, and Regression. Harper and Row, Publisher, Inc., New York.

Danner, M.L., D.G. Fox, and J.R. Black. 1980. Effect of feeding system on performance and carcass characteristics of yearling steers, steer calves and heifer calves. J. Anim. Sci. 50:394-404.

Gwartney, B.L., C.R. Calkins, R.J. Rasby, R.A. Stock, B.A. Vieselmeyer, and J.A. Gosey. 1996. Use of expected progeny differences for marbling in beef: II. Carcass and palatability traits. J. Anim. Sci. 1996. 74:1014.

Hankins, O.G., and P.E. Howe. 1946. Estimation of the composition of beef carcasses and cuts. USDA Tech. Bull. 926:20.

Harpster, H.W. 1978. Energy requirements of cows and the effect of sex, selection, frame size, and energy level on performance of calves of four genetic types. Ph.D. Dissertation Michigan State University, East Lansing, Michigan.

Hassen, A., M.M. Izquierdo, G.H. Rouse, D.E. Wison, R.L. Willham. 1997. Prediction of marbling scores from percentage intramuscular fat. 1997 Beef Research Report – Iowa State Universtiy. A.S. Leaflet R1434. Ames.

Lamb, M.A., O.W. Robinson, and M.W. Tess. 1900. Genetic parameters for carcass traits in Hereford bulls. J. Anim. Sci. 68:64.

Lomas, L.W., D.G. Fox, and J.R. Black. 1982. Ammonia treatment of corn silage. I. Feedlot performance of growing and finishing cattle. J. Anim. Sci. 55:909.

National Association of Meat Purveyors, 1998. The Meat Buyers Guide. Printed by the National Association of Meat Purveyors. Virginia.

Neter, J., W. Wasserman, M.H. Kutner. 1985. Applied Linear Statistical Models. Irwin Company, Homewood, Illinois.

NRC. 1996. Nutrient Requirements of Beef Cattle (7th Ed.) National Academy Press, Washington, DC.

SAS. 1985. SAS User's Guide. Statistics. Statistical Analysis Systems Institute, Inc., Cary, NC.

Steel, G.D., and J.H. Torrie. 1960. Principle and Procedures of Statistics. McGraw-Hilll book Company, Inc., New York.

Vieselmeyer, B.A., R.J. Rasby, B.L. Gwartney, C.R.Calkins, R.A. Stock, and J.A. Gosey. 1996. Use of expected progeny differences for marbling in beef: I. Production traits. J. Anim. Sci. 74:1013.

Wilson, D.E. 1987. Genetic evaluation of Angus sires for carcass traits. Iowa State Univ. Beef Cattle Research Rep. AS-581.

Woody, H.D., D.G. fox, and J.R. Black. 1983. Effect of diet grain content on performance of growing and finishing cattle. J. Anim. Sci. 57:717

Table 1. Harvest Data By Year

Harvest Group	Yr	Date	DOF	High Marbling EPD n	High Marbling EPD Avg EPD	High Marbling EPD Live Wt.	High Marbling EPD ADG lb	Low Marbling EPD n	Low Marbling EPD Ave. EPD	Low Marbling EPD Live Wt.	Low Marbling EPD ADG lb	SEM Live Wt.	SEM ADG
1	1	2/04/97	66	4	.22	861	3.34	4	-.19	869	4.25	8.5	.11
2	1	4/08/97	101	4	.22	1043	4.19	4	-.19	956	3.82	7.3	.14
3	1	6/03/97	157	4	.22	1160	3.56	4	-.19	1092	3.41	15.7	1.57
4	1	7/15/97	199	4	.16	1268	3.42	4	-.19	1289	3.49	13.0	.08
5	1	9/02/97	248	4	.23	1411	3.26	4	-.19	1284	2.84	18.3	.12
1	2	2/10/98	48	4	.30	804	3.54	4	.02	814	3.30	20.7	.15
2	2	3/10/98	76	4	.23	932	3.55	4	.02	921	3.44	29.2	.17
3	2	4/28/98	125	5	.30	1056	3.00	5	-.01	1051	2.95	9.2	.07
4	2	6/16/98	174	5	.25	1221	3.54	4	-.02	1281	3.49	24.7	.21
5	2	9/02/98	252	5	.30	1341	2.76	5	-.10	1296	2.55	24.3	.09

Table 2. Carcass Data by Harvest Group – Combined Years 1 & 2

	1	2	3	4	5	SEM	Contrasts Linear	Contrasts Quad
Hot Carcass Wt, lbs.	459	542	652	778	840	6.9	.0001	NS
Back fat, in	.19	.26	.37	.56	.75	.02	.0001	.02
Ribeye, in^2	9.1	9.7	10.7	11.7	11.5	.16	.0001	NS
KPH, %	2.1	2.6	3.1	3.8	4.7	.09	.0001	.02
Yield Grade	2.2	2.6	3.1	3.8	4.7	.09	.0001	.02
Marbling Score	412	453	544	636	712	9.8	.0001	NS
12^{th} Rib lipid Content, %	2.57	3.65	5.02	6.50	8.44	.24	.0001	NS

Table 3. Carcass Data by Marbling Group – Year 1 & 2 Combined

	High	Low	SEM	P ≤
Hot Carcass Wt, lb	657	651	9.8	.39
Back fat, in	.41	.44	.03	.58
Ribeye Area, in^2	10.4	10.7	.22	.31
KPH, %	3.0	3.1	.11	.05
Yield Grade	3.3	3.3	.12	.73
Marbling Score	557	545	14.0	.5
% 12^{th} Ribfat	4.21	4.74	.34	.15

Table 4. Composition Data by Harvest Group – Combined Years 1 & 2

Percent Carcass Componet	1	2	3	4	5	SEM	Contrasts Linear	Contrasts Quad
Fat	17.7	22.6	28.1	30.3	34.0	.99	.0001	.06
Protein	14.5	13.9	12.6	12.0	11.6	.27	.0001	NS
Water	51.3	48.0	43.9	42.3	40.1	.70	.0001	.03
Bone	16.4	15.4	15.4	15.3	14.3	.22	.0001	NS

Table 5. Intramuscular Fat Content at 12^{th} Rib by Year and Marbling Group

	Year		
EPD Group	1	2	Mean (Combined Years)
High	6.5^{ac}	4.2^{bc}	5.35^{c}
Low	5.5^{ad}	4.7^{ac}	5.12^{c}

Year Effect: ^{a,b}means without common superscripts differ (P<.10)
EPD Effect: ^{c,d}means without common superscripts differ (P<.10)

Table 6. Percent Primal Cut Weight for the 5 High Priced Cuts for Harvest Group – Combined Year 1 & 2

	1	2	3	4	5		Contrasts	
	% weight of fabricated side (lbs.)					SEM	Linear	Quad
Rib	9.08	9.29	9.70	9.80	9.49	.22	.01	.02
Shortloin	6.28	5.96	5.90	5.58	6.10	.21	.09	.01
Sirloin	7.98	7.40	7.57	7.22	7.26	.21	.003	NS
Round	27.00	25.96	24.08	23.65	22.61	.31	.0001	.08
Chuck	26.04	26.35	26.30	26.07	26.26	.35	NS	NS
% Middle Meat	23.35	22.65	23.18	22.62	22.86	.31	.10	NS

Figure 1. Percent Intramuscular Fat and Hot Carcass Wt.

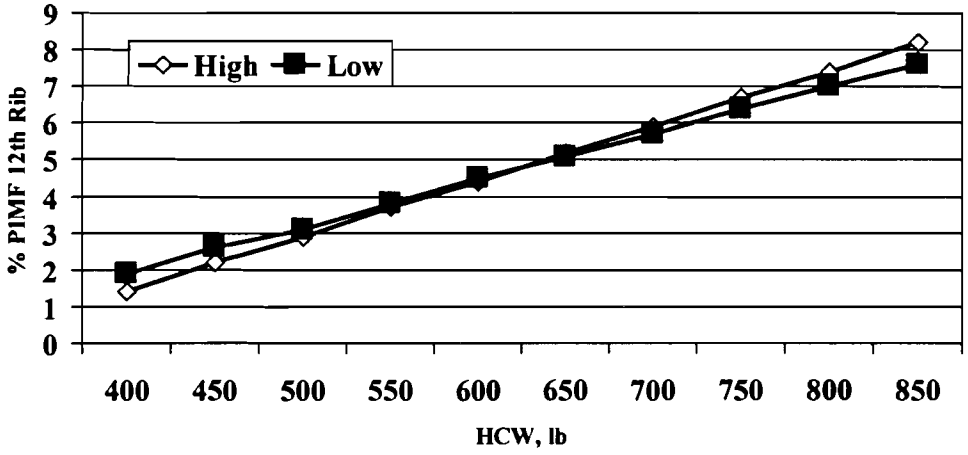
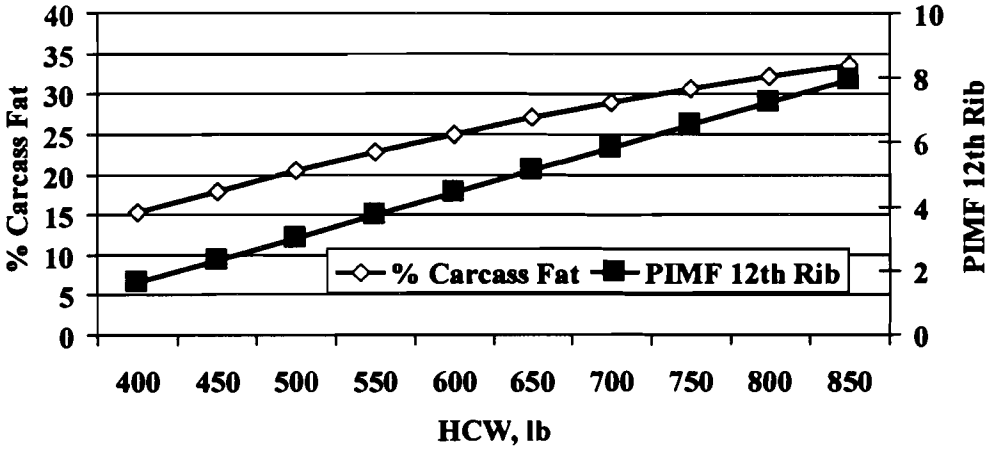


Figure 2. Accretion of Carcass Fat and PIMF 12th Rib



Steps for Warner-Bratzler Shear Force Assessment of Cooked Beef Longissimus Steaks at South Dakota State University.

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CATTLE 00-14

Background

The Warner-Bratzler shear force (Warner, 1928, 1952; Bratzler, 1932, 1949, 1954) is the most popular (Culioli, 1995) method of measuring the tenderness of meat. Szcesniak and Torgeson (1965) documented it as the most accurate method available for quantifying the tenderness of meat. However, some authors (Hurwicz and Tisher, 1954; Voisey, 1976; and Culioli, 1995) have questioned the accuracy of the method. The National Beef Tenderness Plan Conference (NCA 1994) identified the need for a standardized protocol of the Warner-Bratlzer procedure. The need for standardization was demonstrated by Wheeler et al. (1994, 1996, and 1997). Wheeler et al. (1997) reported that different methods can result in a great amount of variation in shear values among institutions.

This research raises the question on the feasibility of comparing Warner-Bratzler shear values among different institutions. Error was reduced when the institutions were given a standardized protocol to follow (Wheeler et al., 1995, 1997). Newer and more precise methods of cooking have been developed which may reduce the amount of variation due to cooking. Wheeler et al. (1998) outlined methods for cooking steaks to a constant temperature and time using belt cookery methods. Various institutions are currently using the method of cooking steaks to a constant time and temperature. By doing this they are not following the protocol outlined by Savell et al. (1994). But the advantages in holding the variable of temperature and time constant may reduce variation and improve accuracy.

This article outlines the current protocol for measuring tenderness of cooked beef longissiumus steaks at South Dakota State University using a Warner-Bratzler shear machine.

[1]Instructor
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Protocol

Muscle Acquisition

1. A portion of the Longissimus Dorsi (LD) is removed starting where the carcass is ribbed (between the 12th and 13th ribs) to an anterior point 7-8 cm from the initial starting point (Figure 1).

2. The LD is separated from the rib and chine bone as well as other muscle groups with all external/subcutaneous and seam fat removed (Figure 2 and 3).

3. Samples are vacuum packaged and held at 2° to 5° C until aged for 14d postmortem.

4. After aging, individual packages are frozen at -20°C. Packages are placed individually on a flat surface and are not stacked during freezing.

Figure 1.

Figure 2.

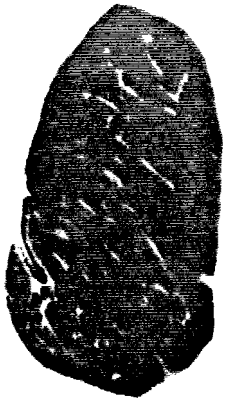

Figure 3.

Steak Preparation

To ensure the steaks are cooked to a uniform degree of doneness, samples must be cut to a uniform thickness.

1. Frozen muscle sections are removed from storage (-20°C) and immediately removed from their package and placed on a band saw (Figure 4).

2. A 2.54 cm (1 inch) steak is removed from the center of the muscle sample. A portion of the outside of the muscle is removed prior to cutting the sample steak. The saw is then set at 2.54 cm (1 inch) and the sample steak is then removed from the center of the whole muscle to ensure a uniform sample is taken (Figure 5,6 and 7).

3. The sample steaks are then immediately vacuum packaged (Figure 8).

4. The packaged samples are stored at -20°C.

Figure 4.

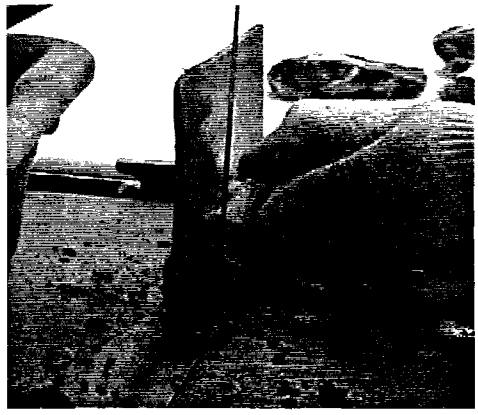

Figure 5.

Figure 6.

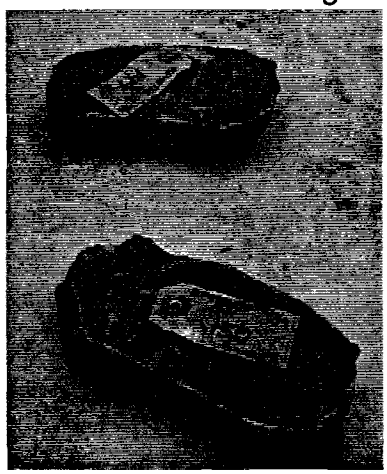

Figure 7.

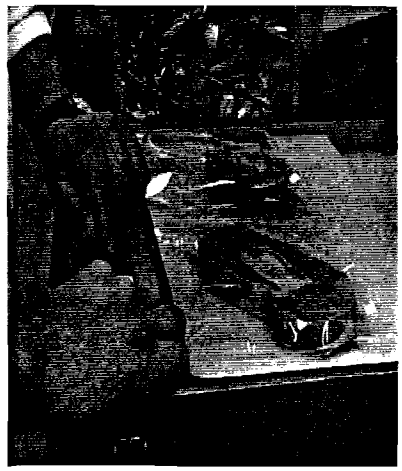

Figure 8.

Pre-Cooking Preparation

1. Frozen samples are thawed at 2° to 5°C for 24 h. Frozen samples are laid individually on a flat surface to ensure consistency of the thawing process.

2. Samples are taken directly from the refrigerator and placed on the oven to minimize the time they are at room temperature.

Sample Cooking

1. Samples are cooked at a constant temperature of 190°C (375°F) for a constant time of 12 min using a belt-fed impingement oven (Lincoln Impinger) (Figure 9). The oven should be operated by the following method: preheat for 30 minutes, Temperature 190°C (375°F), cooking time 12 min. the time and temperature parameters were determined by previous trials (Wulf, unpublished data) to obtain an internal temperature target of 71° C (160°F) (Figure 10). Subsequent trials have shown that these procedures result in cooked steaks with an average internal temp of 71°C (160°F) with a standard deviation of 3.2°C (6.0°F).

2. Immediately after samples exit the belt oven, an internal temperature is taken and recorded (Figure 11).

3. After cooking, steaks are allowed to cool to room temperature (Figure 12)

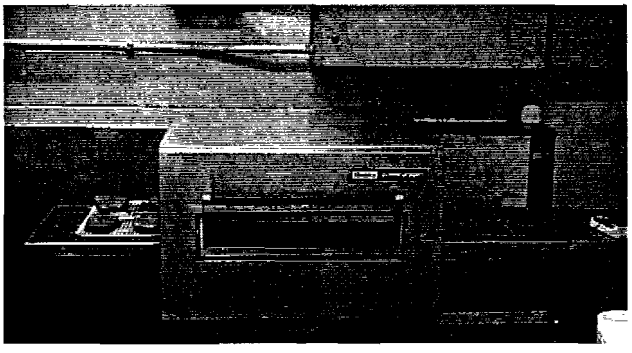

Figure 9.

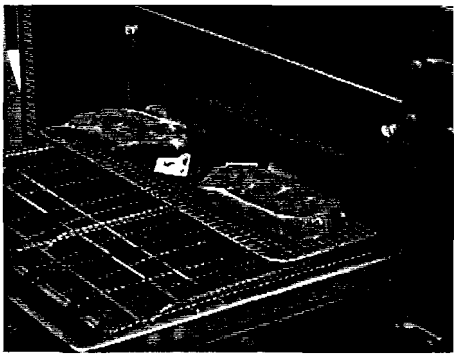

Figure 10.

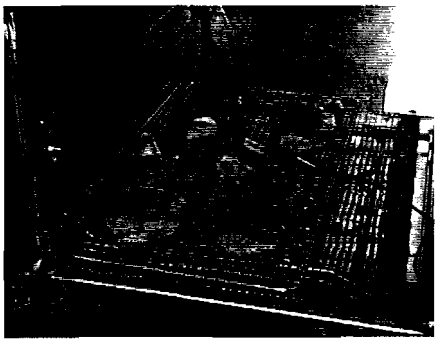

Figure 11

Figure 12.

Core Removal

1. Six cores, .27 cm (.5 in) in diameter are removed from each sample (Figure13). Cores are removed parallel to the longitudinal orientation of the muscle fibers using a hand-held coring device(Figure 14 and 15). Five cores are taken from the lateral side of the connective tissue intrusion and one core is from the medial side (Figure16).

2. Cores that are not uniform in diameter or have obvious connective tissue are discarded and not used in the analysis.

Figure 13.

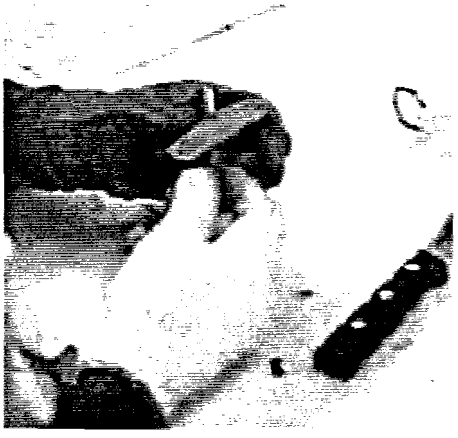

Figure 14.

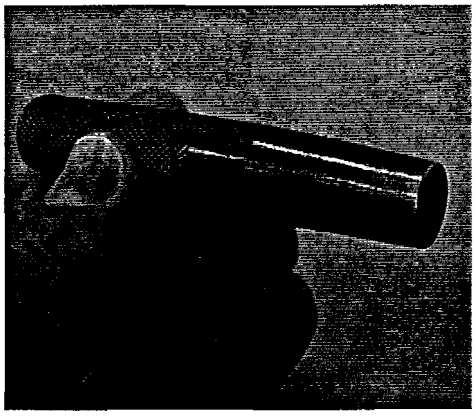

Figure 15.

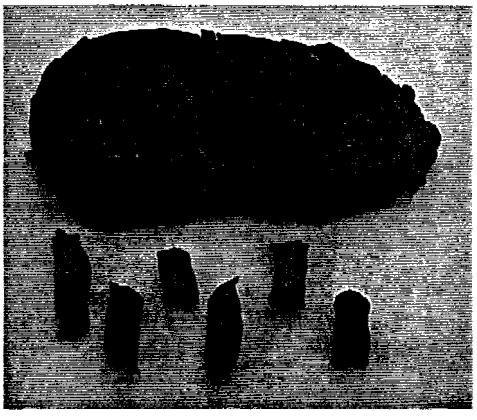

Figure 16.

Shearing

1. Shearing is conducted by using a Warner-Bratzler shear machine (Figure 17). Shearing is done perpendicular to the longitudinal orientation of the muscle fibers. Each core is sheared once in the center of the core to avoid hitting the hardened part on the outside of the steak (Figure 18).

2. Values are recorded for each core tested.

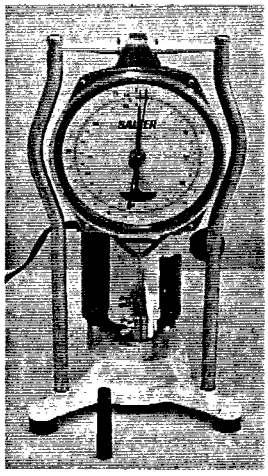

Figure 17.

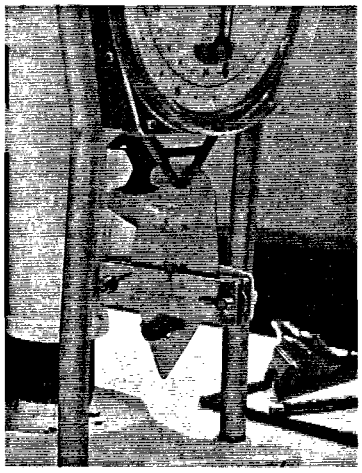

Figure 18.

Summary

Following a standard protocol should reduce the retention of Warner-Bratzler shear force for values within and amongst institutions. For producers who are interested in how shear force values relate to consumer preference Wulf et al. (1998) out lived three broad categories that steaks can fall under:

1) tender - shear force values less than 3.5 kg; 2) acceptable - shear force values from 3.6 - 4.9 kg; and 3) tough greater than 5.0 kg.

Warner-Bratzler shear force is an effective tool to quantify variation on the degree of toughness within beef steaks, however further research needs to be conducted to reduce variation found between institutions.

Literature Cited

Bratzler, L.J. 1932. Measuring the tenderness of meat by means of a mechanical shear. M.S. Thesis. Kansas State University, Manhattan.

Bratzler, L.J. 1949. Determining the tenderness of meat by use of the Warner-Bratzler method. Proc. Recip. Meat Conf. 2:117-121.

Bratzler, L.J. 1954. Using the Warner-Bratzler Shear. Proc. Recip. Meat Conf. 7:154 160. Culioli, J. 1995. Meat tenderness: Mechanical Assessment. In: A. Ouali, D.I. DeMeyer, and F.J.M. Smulders (Ed.) Expression of Tissue Proteinases and Regulation of Protein Degradation as Related to Meat Quality. Pp 239-263. ECCEAMST, Utrecht, The Netherlands.

Hurwicz, H., and R.G. Tischer. 1954. Variation in determinations of shear force by means of the "Bratzler-Warner Shear." Food Technol. 8:391-393.

NCA. 1994. National Beef Tenderness Conference Executive Summary. National Cattlemen's Assoc., Englewood, CO.

Savell, J., R. Miller, T. Wheeler, M. Koohmaraie, S. Shackelford, B. Morgan, C. Calkins, M. Miller, M. Dikeman, F. McKeith, G. Dolzal, B. Henning, J. Busboom, R. West, R. Parrish, and S. Williams. 1994. Standardized Warner-Bratzler shear force procedures for genetic evaluation [online]. Available at: http://savell-j.tamu.edu/shearstand.html.

Szczesnizk, A.S., and K.W. Torgeson. 1965. Methods of meat texture measurement viewed from the background of factors affecting tenderness. Adv. Food. Res. 14:33-165.

Voisey, P.W. 1976. Engineering assessment and critique of instruments used for meat tenderness evaluation . J. Texture Stud. 7:11-48.

Warner, K.F. 1928. Progress report of the mechanical tenderness of meat. Proc. Am.Soc. Anim. Prod. 21:114.

Warner, K.F. 1952. Adventures in testing meat for tenderness. Proc. Recip. Meat Conf. 5:156 160.

Wheeler, T.L., M. Koohmaraie, L.V. Cundiff, and M.E. Dikeman. 1994. Effects of cooking and shearing methodology on variation in Warner-Bratzler shear force values in beef. J. Anim. Sci. 72:2325-2330.

Wheeler, T.L., M. Koohmaraie, and S.D. Shackelford. 1995. Standardized Warner-Bratzler shear force procedures for meat tenderness measurements [online]. Available at: http://192.122.74.26/MRU_www//protocol/WBS.html.

Wheeler, T.L., S.D. Shackelford, and M. Koohmaraie. 1996. Sampling, cooking, and coring effects on Warner-Bratzler shear force values in beef. J. Anim. Sci. 74:1553-1562.

Wheeler, T.L., S.D. Shackelford, L.P. Johnson, M.F. Miller, R.K. Miller, and M. Koohmaraie. 1997. A comparison of Warner-Bratzler shear force assessment within and among institutions. J. Anim. Sci. 75:2423-2432.

Wheeler, T.L., S.D. Shackelford, and M. Koohmaraie. 1998. Marc Beef Classification System [online]. Available at: http://meats.marc.usda.gov/.

Wulf, D. M., J. K. Page, T. R. Schwotzer, and G. R. Dunlap. 1998. Final report to National Cattlemen's Beef Association: Using measurements of muscle color/pH/water-holding capacity to augment the current USDA beef carcass quality grading standards and improve the accuracy and precision of sorting carcasses into palatability groups. The Ohio State University, Columbus, Ohio.

Defining Failure of Passive Transfer in South Dakota Beef Calves

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Departments of Veterinary Science, Mathematics & Statistics and Animal and Range Sciences

CATTLE 00-15

Summary

Failure of calves to ingest and absorb immunoglobulin from colostrum is a risk factor for illness and decreased performance. Blood samples were taken from 752 calves at three SDSU research units. Total protein in blood, closely correlated to colostral immunoglobulin absorption, was determined and calf health records were collected. Using this data, a classification table of sensitivity and specificity was constructed to determine the relationship between total protein and calf illness and to classify calves as having adequate colostral absorption or inadequate colostral absorption (failure of passive transfer). Along with sensitivity and specificity, positive and negative likelihood ratios were calculated to identify a suitable cutoff point to separate calves that would become ill from those that would remain healthy. The cutoff point selected was a serum total protein level of 5.5 g/dL, which produced a sensitivity of 30% and specificity of 87%. Calves with total protein levels below 5.5 g/dL were 3.07 (95% CI 1.73-5.43, p=0.0002) times as likely to become ill as calves with total protein levels above 5.5 g/dL. In beef production situations similar to those in these herds, producers should be able to limit disease if calves' total protein at 24 hours following birth is equal to or greater than 5.5 g/dL.

Keywords: Colostrum, Total Protein, Calf Illness

Introduction

Calves are born with little immunoglobulin (antibody), which is important to limit infection and maintain health (1). To acquire antibody, calves must absorb immunoglobulin by passive transfer from colostrum, the first milk produced by their dam. After twenty-four hours, calves' ability to absorb immunoglobulin decreases dramatically, so it is important that calves ingest and absorb an ample amount of colostrum soon after birth (2). If a calf does not ingest enough colostrum the calf has a high risk of illness and subsequent poor performance (3).

Total protein in blood is well correlated with immunoglobulin levels, so it is directly related to successful absorption (passive transfer) of colostrum (4). Identifying herd problems of inadequate colostral absorption, termed failure of passive transfer **(FPT)**, can help focus management effort. The purpose of this study was to establish a serum total protein cutoff point that would define FPT and predict illness in beef calves under South Dakota conditions.

Materials and Methods

The data for this study were taken from beef cattle herds on three South Dakota State University research units--the Beef Breeding Unit **(BBU)** and Cow/Calf Research & Teaching Unit **(CCU)** located in Brookings, and the Range & Livestock Station located near Cottonwood, South Dakota.

Beginning in 1996, ranch personnel obtained blood samples from calves when they were approximately 1-3 days old. The date and time of blood sample collection and calving were recorded. Blood samples were centrifuged and stored frozen as serum or plasma. After the

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[5]Professor, Animal Science

calving season, refractometry was used to measure plasma and serum total protein. Refractometry has been shown to be an accurate measure of total protein, and total protein has been shown to closely correlate with the amount of immunoglobulin in serum and plasma (4). Plasma differs from serum in that plasma contains the protein fibrinogen, which increases total protein readings. Fibrinogen averaged 0.3 g/dL in 45 plasma samples, so the total protein result from plasma was decreased by 0.3 g/dL to make plasma protein readings equivalent to serum protein readings. Only observations for calves that had a blood sample taken between 20 and 168 hours (7 days) after birth were used in this analysis.

Comprehensive calf health records from birth to weaning were available for 1998 from BBU and for 1996-1998 and through June 1999 from CCU and Cottonwood. Only total protein values from calves born at these ranches during the specified years were used. All illness events were diagnosed by ranch personnel.

A classification table was created to establish the relationship between total protein and calf illness. Specificity and sensitivity at each protein level was calculated. Sensitivity is the probability of a positive test result (a total protein level lower than the cutoff point) in those calves that became ill. Specificity is the probability of a negative test result (total protein level higher than the cutoff point) in calves that did not become ill. Sensitivity was calculated as:

$$\frac{\text{\# of ill calves with total protein < the cutoff point.}}{\text{total \# of ill calves}}$$

Specificity was calculated as:

$$\frac{\text{\# of non-ill calves with total protein} \geq \text{the cutoff point.}}{\text{total \# of non-ill calves}}$$

Positive and negative likelihood ratios **(PLR, NLR)** were calculated for several total protein points. PLR is a ratio of the probability of a positive test in calves that become ill compared to the probability of a positive test in calves that did not become ill. Conversely, NLR is the ratio of the probability of a negative test in calves that become ill compared to the probability of a negative test in calves that did not become ill. The ideal cutoff value would have a PLR of infinity (100/0) and a NLR of zero (0/100). Likelihood ratios give an indication of relative confidence in cutoff points, and are useful when assessing a test (5).

This study was a prospective, longitudinal study. The individual calf was the experimental unit. Data was compiled using an electronic spreadsheet (Microsoft® Excel 97, Microsoft Corp., Redmond, WA). A statistical package (SAS v6.12, SAS Institute, Cary, NC) was used to calculate summary statistics and create tables to calculate sensitivity and specificity. Another statistical package (EpiInfo 6.04b, CDC, Atlanta, GA) was used to calculate the odds ratio and confidence intervals.

Results and Discussion

A total of 84 of 752 calves became ill (11.2%). Of the 84 calves, 19 (22.6%) had two reported illnesses. The most common illnesses were fever of unknown origin, diarrhea, respiratory disease, and foot rot (Table 1). Ill calves had an average total protein level of 6.19 g/dL, while calves that did not become ill had a significantly higher total protein level of 6.74 g/dL ($p<0.0001$). Total protein results for all calves ranged from 3.5 g/dL to 9.8 g/dL.

Since it was the goal to determine the best total protein cutoff point that separates calves that would be healthy, and who presumably obtained adequate colostral antibody, from those calves that would get sick and presumably did not receive adequate colostrum (i.e. calves with FPT), a classification table was constructed (Table 2). As the cutoff point in the table is increased, the sensitivity (ability of the test to accurately identify ill calves) increases, while specificity (ability of test to accurately identify healthy calves) decreases, which naturally occurs when the total protein levels of ill and healthy calves overlap (Fig. 1).

Moving to a lower cutoff point does not drastically change specificity, but sensitivity decreases relatively quickly, since calves becoming ill are being classified incorrectly. If a producer had a purebred operation or a high-value calf, a higher total protein cutoff point might be considered. This would increase sensitivity and decrease specificity, thereby classifying more calves that would become ill as having FPT. However, more healthy calves would be incorrectly classified as having FPT, resulting in these calves receiving unnecessary attention and/or treatment.

Likelihood ratios can be used to determine an appropriate cutoff value. The PLR and NLR for several total protein values were calculated (Table 3). A higher PLR reflects a relatively larger degree of test accuracy in describing calves that become ill, while a lower NLR reflects better accuracy in describing calves that do not become ill.

In this data, a high specificity and high PLR are desired, since the goal is to identify calves with FPT that are at increased risk of illness. However, identifying an excessive number of calves as having FPT that do not become ill (false-positives) wastes valuable resources. Given this, 5.5 g/dL was chosen as the cutoff value. Using this cutoff point, calves with total protein levels below 5.5 g/dL are defined as having failure of passive transfer. At the 5.5 g/dL point, sensitivity was 30%, which means 30% of the calves that become ill are correctly identified as having FPT. Specificity was 87%, which means 87% of the calves that do not become ill are correctly identified as not having FPT. The 5.5 g/dL cutoff point still has relatively low sensitivity, but this is not atypical when a single test is used to predict disease.

At the 5.5 g/dL point, 96 calves (12.8%) in this study had FPT. A calf with a total protein level below the 5.5 g/dL cutoff point was 3.07 (95% CI 1.73-5.43, p=0.0002) times more likely to become ill than calves with a total protein level equal to or above 5.5 g/dL.

A study of 263 crossbred dairy and beef calves proposed an FPT cutoff level of 4.8 g/dL in plasma samples (6). Another study of dairy calves classified calves as having at least partial FPT if their serum total protein level was below 5.2 g/dL (7). A study of beef calves proposed a serum total protein of 4.2 g/dL as the cutoff value for FPT (8). In that study, calves were grouped as having failure of passive transfer, partial failure of passive transfer, and normal passive transfer. To be classified as having normal passive transfer, calves needed a total protein level of 5.5 g/dL or greater, as proposed here (8).

It is important to note that the cutoff level for determining FPT is relative and only one of a series of risk factors in disease. Calves exposed to high levels of stress and disease-causing organisms on a given ranch could become ill regardless of their total protein level. On such operations, it would be appropriate to increase the cutoff point used to determine FPT and the risk of subsequent illness. Likewise, calves in herds with little disease challenge would not necessarily have a high risk of becoming ill, even with a low total protein level. Total protein, though an important part of calf health and related to calf disease, is not the sole determinant of illness.

Monitoring calves for FPT may allow producers to better assess nutrition and calving time management of the herd. By monitoring FPT and taking steps to lower the rate of FPT, producers may reduce calf illness and death.

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References

1. Besser, T.E., Gay C.C. The importance of colostrum to the health of the neonatal calf. *Vet Clin North Am Food Anim Pract* 1994; 1:107-117.
2. Perino L.J. A guide to colostrum management in beef cows and calves. *Vet Med* 1997;92:75, 78-82.
3. Wittum, T.E., Salman, M.D., King, M.E., et al. The influence of neonatal health on weaning weight of Colorado, USA beef calves. *Prev Vet Med* 1994; 19:15-25.
4. Odde, K.G. Survival of the neonatal calf. *Vet Clin North Am Food Anim Pract* 1988; 4:501-508.
5. Smith R.D. *Veterinary Clinical Epidemiology*. Boston, MA: Butterworth-Heinemann, 1991.
6. Perino L.J., Wittum T.E., Ross G.S. Effects of various risk factors on plasma protein and serum immunoglobulin concentrations of calves at postpartum hours 10 and 24. *Am J Vet Res* 1995; 6:1144-1148.
7. Rea D.E., Tyler J.W., Hancock D.D., et al. Prediction of calf mortality by use of tests for passive transfer of colostral immunoglobulin. *J Am Vet Med Assoc* 1996; 12:2047-2049.

8. Perino, L.J., Sutherland, R.L., Woollen, N.E. Serum γ-glutamyltransferase activity and protein concentration at birth and after suckling in calves with adequate and inadequate passive transfer of immunoglobulin G. Am J Vet Res 1993,54:56-59.

Figure 1 – Distribution (%) of Total Protein in Ill and Healthy Calves

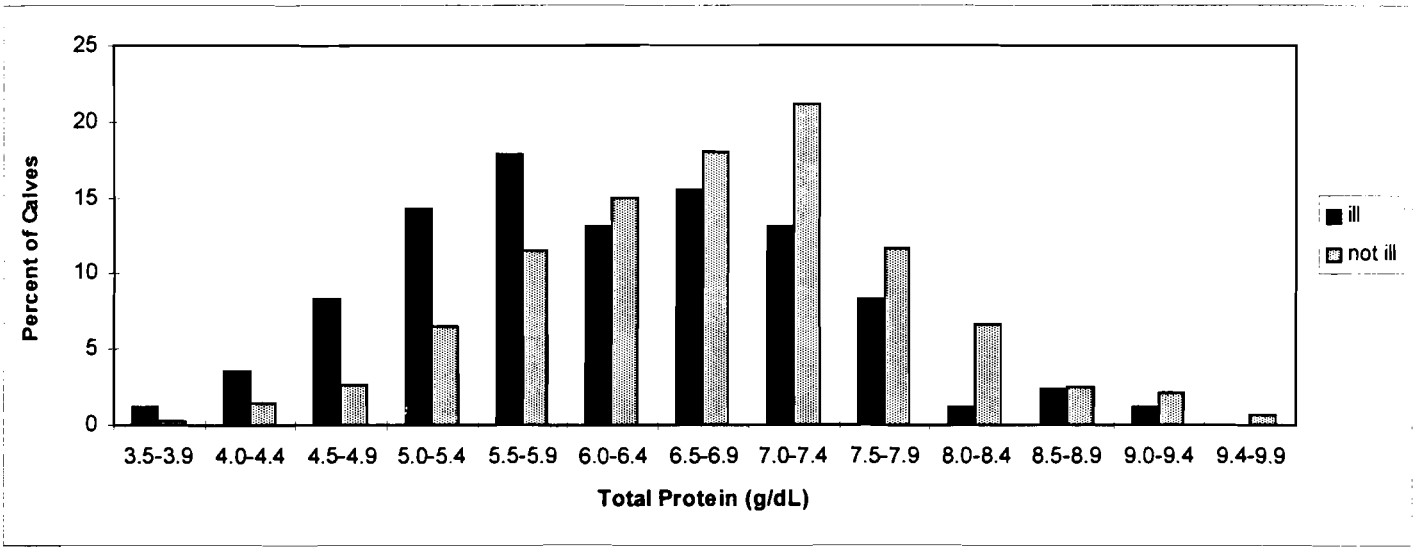

Table 1 – Frequency of Reported Illnesses

Type of Illness	# cases as 1st illness	% cases as 1st illness	# of total illnesses	%of total illnesses
Diarrhea	21	25.0%	22	21.4%
Fever of unknown origin	19	22.6%	23	22.3%
Respiratory	12	14.3%	16	15.5%
Foot Rot	10	11.9%	15	14.6%
Navel Ill	9	10.7%	11	10.7%
Injury	6	7.1%	7	6.8%
Other	7	8.3%	8	7.8%
Total	84	100.0%	102	100.0%

Table 2 – Sensitivity and Specificity Classification Table

Cutoff (g/dL)	Sensitivity (%)	Specificity (%)	Cutoff (g/dL)	Sensitivity (%)	Specificity (%)
5.0	11	93	7.1	78	37
5.1	12	93	7.2	80	32
5.2	15	92	7.3	85	28
5.3	17	90	7.4	86	25
5.4	23	89	7.5	90	21
5.5	30	87	7.6	90	18
5.6	33	85	7.7	91	16
5.7	35	83	7.8	93	14
5.8	40	80	7.9	95	12
5.9	43	78	8.0	96	10
6.0	47	74	8.1	96	9
6.1	49	72	8.2	96	7
6.2	51	70	8.3	96	6
6.3	53	67	8.4	96	5
6.4	57	64	8.5	98	4
6.5	64	59	8.6	98	4
6.6	68	55	8.7	98	3
6.7	72	52	8.8	99	3
6.8	72	47	8.9	99	3
6.9	73	45	9.0	99	2
7.0	78	40			

Table 3 – Positive (PLR) and Negative (NLR) Likelihood Ratios for Various Total Protein Cutoff Levels

Total Protein (g/dL)	PLR	NLR
5.0	1.6	0.95
5.2	1.8	0.93
5.4	2.2	0.86
5.5	2.3	0.81
5.6	2.0	0.82
5.7	2.1	0.78
5.8	2.0	0.75
6.0	1.8	0.72
6.5	1.6	0.60
7.0	1.3	0.55
7.5	1.1	0.47

A Pilot Study of the Impact of Metaphylactic Treatment at Processing on Lung Lesions at Slaughter

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CATTLE 00-16

Summary

The utility of metaphylactic antibiotic/anti-inflammatory treatment in prevention of cattle lung lesions was examined. Sixty-nine, single source, ranch direct, fall weaned steers were allocated to treatment or no treatment groups at feedlot arrival in February, 1999. Treatment consisted of single subcutaneous administration of Nuflor™ (florfenicol, Schering-Plough Animal Health) at 18 mg/lb bodyweight and Banamine™ (flunixin meglumine, Schering-Plough Animal Health) at 1 mg/lb bodyweight. All steers were weighed, vaccinated with a modified live IBR/PI_3 vaccine, implanted, and identified by ear tag. Cattle were fed for maximum gain on a corn-based diet. At harvest, after 133 days on feed, lungs were observed for lesions indicative of previous pneumonia and scored using an established system. Hot carcass weight, quality grade, and yield grade was collected on each carcass. Results indicate that while lung lesions were prevalent (43.3% of cattle affected), treatment had no effect on the prevalence of lung lesions at slaughter. In addition, lung lesions were not associated with feedlot average daily gain or quality grade. This small study suggests that prevalence of lung lesions in low risk cattle will not be affected by administration of metaphylactic treatment with Nuflor/Banamine at processing.

Introduction

Bovine respiratory disease continues to be an important disease problem in feedlot cattle (1). The incidence of clinical respiratory disease is variable, and is marginally decreased by certain management practices, including appropriate vaccination and stress reduction programs near weaning and transport (2). Many cattle may have lung lesions at slaughter, even though they have no history of clinical illness (3). In some, but not all studies, these lesions have been linked to decreased cattle performance and decreased quality grade (3,4,5).

Since the incidence of clinical respiratory disease, and presumably the inciting event that initiates lung lesion formation, occurs in the early feeding period, procedures that are known to limit clinical respiratory disease in the early feeding period may also limit the formation of lung lesions. This study was initiated to investigate the impact of antibiotic administration at arrival on the prevalence of lung lesions observed at harvest.

Materials and Methods:

A pen (69 head) of single source Angus steers placed in a commercial feedlot (Haverhals Feedlot Inc, Hudson, SD) was used for this study. The cattle were spring born (late April-May 1998) calves from heifer dams, and originated from a ranch in south central South Dakota. Cattle had been managed at the ranch of origin as a single group since weaning (August 25, 1998) and had been programmed to gain about 2 lbs/hd/d in the weaning-feedlot arrival period. Cattle were transported directly from the ranch to the feedlot, arriving at noon on February 12,1999. At 4:00 PM, cattle were administered a modified live IBR/PI_3 vaccine, implanted (Synovex-S), ear tagged with a unique ID number, and weighed. The experimental treatment, which consisted of a single subcutaneous injection of Nuflor™ (florfenicol, Schering-Plough Animal Health) at a dose of 18 mg/lb and a single subcutaneous injection of Banamine™ (flunixin meglumine, Schering-Plough Animal Health) at 1 mg/lb, was administered to 34 steers. Cattle were assigned to either treatment or control groups sequentially as they came through the chute, with the first animal assigned by flip of a coin.

Cattle were placed in a single pen with no other animals and fed for maximum gain on a

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diet consisting of corn, corn gluten feed, liquid protein supplement, and ground hay. They were monitored daily and managed as customary in open pen midwest feedlots. Cattle were harvested on June 25,1999 (133 days on feed) at IBP, Inc, Dakota City, Nebraska. Individual ear tag and slaughter tag numbers were collected as the cattle were processed. On the viscera table, lungs were observed for abnormalities (4). A third party contract individual was present to retrieve individual carcass data, including hot carcass weight, fat thickness, ribeye area, marbling score, and kidney-heart-pelvic fat.

The outcome of primary interest was the association between treatment and prevalence of lung lesions at slaughter. In addition, the association of lung lesion with average daily gain during feeding period (133 days) and quality grade were examined. ADG was computed as (((hot carcass weight/0.62)-initial weight)/133). Observed lung lesions were scored using a system previously described, but for analysis were simplified to a dichotomous outcome – presence or absence of lesions (6). Quality grades were considered nominal categorical variables. The individual was the experimental unit in a randomized design. Simple t-tests and chi-square tests were used to evaluate the data. All statistics were computed using SAS version 6.14. Statistical power calculations were made using a software program (PEPI – Computer Programs for Epidemiologists v 3.0).

Results

Average initial bodyweight was 750 lbs (± 57.9). One animal died in the feedlot after receiving repeated treatment for respiratory disease. That was the only health abnormality detected. Of the 69 original cattle, 68 were presented for harvest. Lungs were observed on 67 animals (1 missed observation at the viscera table) and carcass data was captured on 66 (2 carcasses missed). Estimated final live weight, using hot carcass weight and based on a 62% dressing percentage, was 1173 lbs (± 94.7 lb), producing an ADG of 3.16 lbs. Average 10^{th} rib backfat was 0.57 inches (± 0.12, range 0.32-0.84). All cattle graded low choice or better, with 17 (25%) grading prime.

Lung lesions were noted in 29 of 67 (43.3%) cattle observed. Lung lesion prevalence was not associated with treatment, ADG, or quality grade in this group of cattle. ($p>0.20$, Table 1).

Discussion

In this study, lungs were visually observed at commercial chain speed (325 head/hour) while other studies have removed lungs from the plant for intensive observation. However, visual observation at chain speed has resulted in good correlation with intensive examination (8).

This study observed lung lesions at slaughter in 43.3% of cattle. Other studies have documented lung lesion prevalence of 72%, 33%, 50%, and 33.6-76.5% of cattle examined, so the 43% found in this study is consistent with other studies (3,4,5,7). Factors such as season of birth (fall born calves have more lung lesions), feedlot pen effects, and weaning weight (increased weaning weight has been associated with more lung lesions) affect the prevalence of lung lesions (3).

Lung lesions have been associated with variable decreases in feedlot average daily gain of 0.046 - 0.167 lbs, and with decreased meat tenderness (3,4,5). This study failed to confirm these associations. This was a small pilot study with a low power to detect differences in ADG loss from lung lesions. Given the sample size, we would detect a 0.20 ADG difference between treatment and control in only 11-32% of the experiments. This underscores the importance of placing limited weight on this study alone, with respect to defining the relationship between lung lesions and ADG. The power to detect a treatment effect was slightly better. It was assumed that Nuflor/Banamine treatment might decrease lung lesion prevalence by 50%, so with a baseline lung lesion prevalence of 44% the power of this study was 48%. This is still rather low power, but is not abnormal for studies focusing on risk factors in disease.

It was disappointing that treatment did not tend to be associated with lung lesion reduction. It is not known when lung lesions occur, though it has been speculated that most lung lesions form early in the feeding period. If lesions were not initiated in the first 3 days following antibiotic administration, then antibiotic treatment at processing would not be expected to have a positive effect. Animals in this study were

considered "low risk" for respiratory disease, since they were ranch direct and backgrounded at the ranch of origin following weaning. Additionally, they comprised a small pen population and were not commingled with cattle from other sources. These attributes were different than previous studies and may have modulated lung lesion formation. It could be argued that lung lesions might occur as a sequel to respiratory disease but that pen and/or feedlot conditions may modify the severity of the lesions.

Work investigating the association of lung lesions with feedlot performance and vaccination programs at the ranch of origin is continuing. The long-term objectives are to characterize the lifetime significance of lung lesions and describe the risk factors for their occurrence.

References:

1. Griffin D. 1998. Diagnosis, treatment, and management of respiratory disease in feedlot cattle. Nebraska Vet. Biomed. Sci. Newsletter 27(10);1-2.
2. Cole NA. 1985. Preconditioning calves for the feedlot. Vet. Clinics of N. Am. 1(2);401-411.
3. Wittum TE, Woollen NE, Perino LJ, et al. 1996. Relationships among treatment for respiratory tract disease, pulmonary lesions evident at slaughter and rate of weight gain in feedlot cattle. J Am Vet Med Assoc. 209:814-818.
4. Bryant LK. 1997. Lung lesions in feedlot aged beef calves at slaughter. Masters thesis, University of Nebraska - Lincoln.
5. Gardner BA, Dolezal HG, Bryant LK, et al. 1998. Health of finishing steers: Effects on performance, carcass traits and meat tenderness. OSU An. Sci. Res. Rep. P-965:37-47.
6. Griffin D. Personal Communication. May, 1999.
7. Griffin D, Perino L, Wittum T. 1995. Feedlot respiratory disease: Cost, value of preventives and intervention. Proc. of the Am. Assoc. Bovine Pract. Ann. Mtg. 27:157-160.
8. Bryant LK, Perino LJ, Griffin DD, et al. 1996. Lung lesions in feeder cattle at salughter: a proposed method for lesion recording, and lesion effects on calf growth and carcass traits. Proc. of the Am. Assoc. Bovine Pract. Ann. Mtg. 29:147-151.

Table 1 – Summary of Associations with Lung Lesions

	Lung Lesions at Slaughter	
	Absent	Present
Treatment Group	N (%)*	N (%)*
Control	15 (22.4%)	18 (26.9%)
Treated	14 (20.9%)	20 (29.9%)
Quality Grade		
Prime	9 (13.6%)	8 (12.1%)
Choice 0/+	23 (34.9%)	18 (27.3%)
Choice-	5 (7.6%)	3 (4.6%)
ADG	3.14, SD=0.58	3.21, SD=0.49

*Total percentage of the 67 head (66 for quality grade and ADG data)

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