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Contribution No. 89-567-S from the Kansas Agricultural Experiment Station.

POLLED HEREFORD AND SIMMENTAL MILK PRODUCTION

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K.O. Zoellner, and D.D. Simms

Summary

The weigh-suckle-weigh method was used to measure milk consumption by 265 calves from 159 Polled Hereford and Simmental cows over 3 years. Calves nursing Polled Hereford cows consumed an average of 11.2 lbs of milk per day, with a peak of 15 lbs at 50 days post-calving. Calves nursing Simmental cows consumed an average of 16.8 lbs of milk per day, with a peak of 20 lbs at 58 days after calving. An increase of 1 lb in daily milk consumption produced approximately 20 lbs increase in weaning weight.

Introduction

Milk production of beef cows has been discussed for years, with little knowledge of the amount of milk actually produced. Some producers feel that high levels of milk are desirable, although high milking cows are culled because they do not fit the feeding levels. The purposes of this study were to measure milk production levels and determine the relationship between dam milk production and calf weaning weight.

Experimental Procedures

Seventy-six Simmental and 83 Polled Hereford cows were test-milked over a 3 year period, with an average of 1.7 lactations per cow. Cows were grazed on native bluestem pastures all year with supplemental feeding of alfalfa hay and milo from January through April. Cows calved in March and April, and calves were weaned in the first week of October. Cows were milked monthly from late April through late August, using the weigh-suckle-weigh method. In April, calves were separated from the cows in the afternoon and placed back with the cows 2 to 3 hours later, so the cows would be nursed dry. Calves were then separated from the cows for 8 hours. The following morning, the calves were weighed, allowed to nurse, and weighed again. The increase in weight was assumed to be due to milk consumed. The same procedure was repeated 2 days later. Groups of 10 to 15 calves were worked at a time to minimize the time between completion of nursing and re-weighing. The same procedure was used in the later months, except calves were removed from their dams for 12 hours, and the procedure was repeated three times on alternate days. This provided 14 measures of milk production for each cow each year. Data for each cow were fit to a lactation curve, as described by Jenkins and Ferrell (Anim. Prod. 39:479, 1984); $Y(n) = n / Ae^{kn}$, where n = week of lactation, Y = milk production in Kg., e = base of natural logarithms, and A and k define the shape of the lactation curve.

Results and Discussion

The average milk consumption (Figure 1.1) of calves nursing Polled Hereford cows over 205 days was 11.2 lbs per day, whereas the calves nursing Simmental cows consumed an average of 16.8 lbs per day. Peak milk production in the Polled Herefords occurred 50 days after calving, at 15 lbs per day. Peak lactation in the Simmental cows occurred 58 days post-calving, at 20 lbs per day. There was a 1161 lb difference between breeds in total milk production over the 205 days. The repeatability of milk production between lactations was 0.33, which is similar to the repeatability of calf weaning weight by a cow and is slightly lower than the 0.45 repeatability of lactation in dairy cows. The average daily milk consumption was significantly different among years, with 16 lbs the first year, 14 lbs the second, and 12 lbs the third.

Calf weaning weights reflected the differences in milk consumption. Polled Hereford calves had an average 205-day weight of 450 lbs, and the Simmental calves averaged 569 lbs. For each pound increase in daily milk consumption, Polled Hereford calves increased their 205-day weight by 23 lbs, and Simmental calves increased their 205-day weight by 19 lbs. About 0.35 lbs of TDN is required to produce a lb of milk. Therefore, it took about 72 lbs of additional TDN to produce a 20 lb increase in weaning weight. There was a significant difference in weaning weights among years.

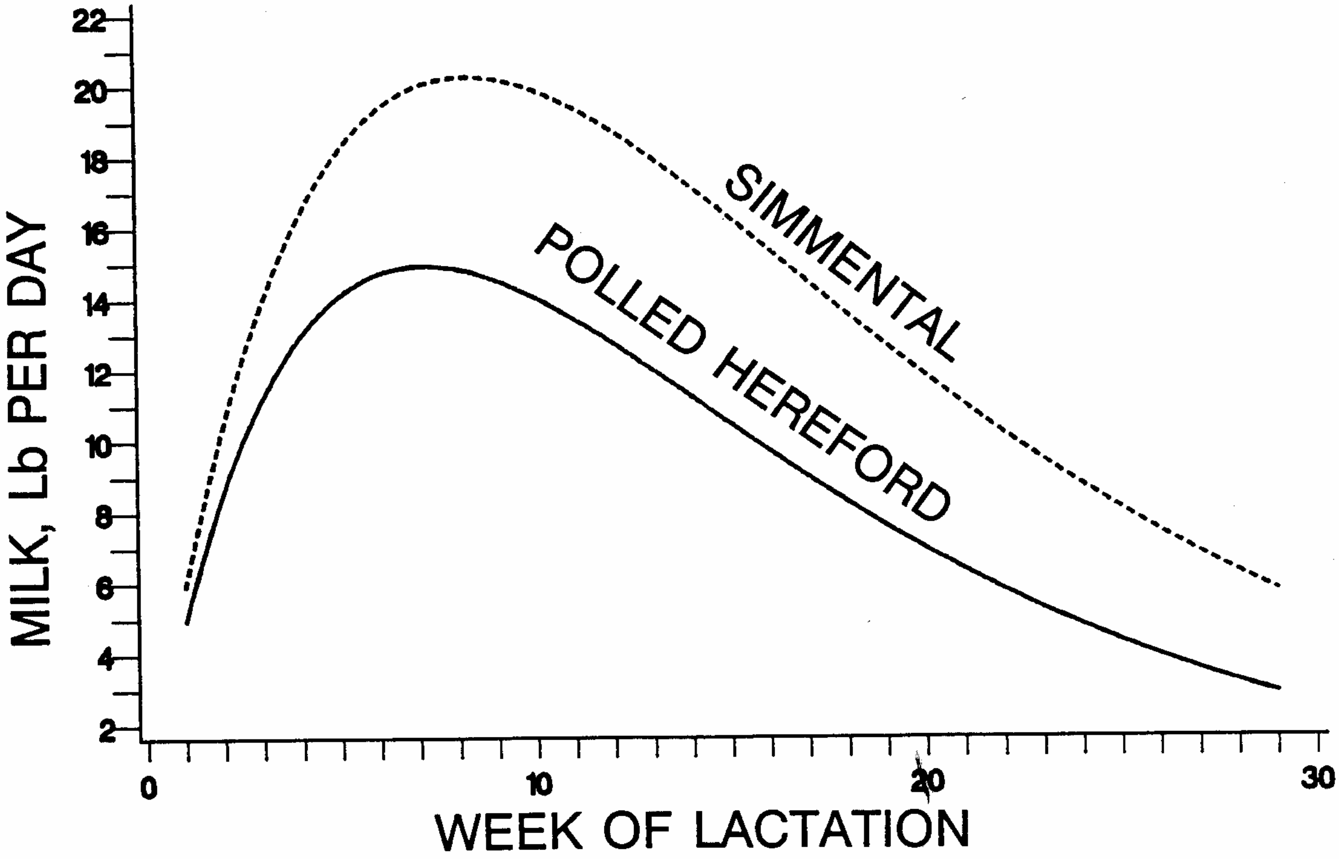

Figure 1.1. Daily Milk Production (lbs) vs. Week of Lactation for Polled Hereford and Simmental Cows.

RELATIONSHIP OF MILK EXPECTED PROGENY DIFFERENCES (EPD's) TO MILK PRODUCTION AND CALF WEANING WEIGHT

T.T. Marston, D.D. Simms, R.R. Schalles,
K.O. Zoellner, L.S. Clarke, and G.M. Fink

Summary

Spring-calving Angus (n=37) and Simmental (n=28) cows were used to evaluate the relationship between milk expected progeny difference (EPD), milk production, total milk energy, and weaning weight. There were positive correlations between milk EPD's and milk produced during lactation, total milk energy per lactation, and calf weaning weight. On average, a 1 lb increase in milk EPD predicted a 1.8 lb increase in calf weaning weight and an increase of 56.6 (Angus) and 70.2 (Simmental) lb in total milk per lactation. Our results suggest that producers can use milk EPD's as selection tools to influence the milk production of their cows and subsequent weaning weights of their calves.

Introduction

Variation in milk production of beef cows accounts for much of the variation in calf weaning weights. Unfortunately, it has been difficult to select for this factor because milk production of beef cows is difficult to measure. Development of Expected Progeny Differences (EPD's) for milk production have provided purebred and commercial breeders with the opportunity to increase selection pressure on milk production. However, many cattle breeders continue to question the validity of milk EPD's. This study was initiated to determine the relationship between milk EPD's and actual milk production and calf weaning weights.

Experimental Procedures

Spring-calving, purebred Angus (n=37) and Simmental (n=28) cows were milked at approximately 60, 120, and 180 days postpartum to establish individual lactation curves. At each milking, the cows and calves were separated for approximately 4 hours, placed together until all calves completed nursing, and separated again. Cows were injected I.M. with 40 I.U. oxytocin to stimulate milk letdown and machine milked 12 hours following this separation. Samples from each milking were analyzed by Kansas Dairy Herd Improvement Association to determine the relationship of milk components (butterfat, protein, lactose, and total solids) to weaning weight and milk EPDs.

Twenty-four hour milk production was estimated by doubling the 12 hour production, after adjusting for time of separation from the calf. Daily milk production values were used to calculate lactation curves, using the procedure described by Schalles and co-workers in the preceding paper. Then, total milk production per lactation was determined from those curves.

Total milk energy per lactation was calculated by multiplying the daily milk production from the lactation curve by the appropriate energy values of protein, butterfat, and lactose.

Calves were born from late February to early April, and the cow/calf pairs were grazed on native bluestem pasture throughout the summer with no creep. Calves were weaned at approximately 205 days of age.

Expected Progeny Differences (EPD's) were provided by the American Angus Association, St. Joseph, MO and the American Simmental Association, Bozeman, MT.

Results and Discussion

Correlations between milk EPD, milk production, milk energy, and weaning weight are presented in Table 2.1. The positive correlation between milk EPD's and milk production indicates that EPD's successfully predict milk production. Similarly, cows with higher milk EPD's produced heavier calves at weaning. Since the total amount of milk produced is the major factor in the total milk energy produced, correlation coefficients of total milk energy with weaning weight and milk EPD with total milk production were almost identical. Correlations between traits were similar for both breeds.

An increase of 1 lb in a cow's milk EPD was related to 1.8 lb (SE=0.7) of additional weaning weight and additional milk production of 56.6 lb in Angus and 70.2 lb in Simmental cows.

In this study, an increase of 26.8 lb of milk produced an additional pound of weaning weight, which is more than in most previous research trials. In conclusion, milk EPD's are good predictors of milk production and consequent weaning weight.

Table 2.1. Relationship between Milk Production, Weaning Weight, Milk EPD, and Total Milk Energy

Comparison	Correlation Coefficient	
	Angus	Simmental
Total Lactation Milk Production and Weaning Weight	.62	.62
Total Lactation Milk Production and Milk EPD	.41	.55
Total Lactation Milk Energy and Weaning Weight	.64	.50
Total Lactation Milk Energy and Milk EPD	.44	.52
Milk EPD and Weaning Weight	.30	.47

FEED UTILIZATION DURING LATE GESTATION BY POLLED HEREFORD AND SIMMENTAL COWS

R. R. Schalles, G. H. Kiracofe, and J. W. Wright

Summary

Thirty-one Polled Hereford and 29 Simmental cows were individually fed two energy levels for about the last 4 months before calving. Weight, condition score, backfat thickness, and reproduction were evaluated. No differences were found in efficiency of feed utilization between breeds or between energy levels. These cows started the experiment in moderate body condition, and a 10% reduction in dietary energy level during late gestation did not affect their reproductive performance.

Introduction

Profitable beef production depends on the efficiency of feed utilization as well as the level of production. Very little information is available on the interaction between cow production level and production efficiency. Most studies have indicated that efficiency increases as production level increases. One study by Jenkins and Ferrell (Roman L. Hruska US Meat Animal Research Center, Clay Center, NE) indicated that large cows with high milk production had lower efficiency of maintenance than other groups.

In this study, efficiency of cow maintenance, fetal growth during the last trimester of pregnancy, and subsequent cow reproduction and calf growth were evaluated.

Experimental Procedures

Thirty-one Polled Hereford and 29 Simmental cows were fed individually from Oct. 30 to approximately 2 weeks before calving in March. The Polled Hereford cows started the trial with an average condition score of 6.2 and an average weight of 1308 lbs; the Simmental cows started the trial with an average condition score of 5.3 and an average weight of 1314 lbs. Half the cows were fed an energy level that met their requirements,whereas the other half were fed 10% below their requirements. Energy requirements for each cow were calculated, based on her weight, condition, age, and days of gestation. Protein, vitamins and minerals were fed to meet NRC requirements.

Approximately 2 weeks before calving, cows were moved to native bluestem pasture, where they were group fed by breed. Alfalfa hay and milo were fed to meet the energy and protein needs, based on the group average. Supplemental feeding continued until late April, when sufficient grass was available. Cows were exposed to fertile bulls after calving and were allowed to mate at every estrus. Bulls were equipped with chin ball markers, and observations for estrus and/or breeding activity were made twice daily for 107 days after the last cow calved.

Weekly blood progesterone levels were obtained to aid in determining estrus. Conception dates were determined by progesterone levels, palpations, and calving dates the following year.

Results and Discussion

Results are shown in Table 3.1. At the end of the feeding period, all groups of cows had very similar pre-calving condition scores and body weights, averaging 5.8 and 1349 lbs. No differences were detected between breeds or energy levels. There was no difference in lbs of energy (TDN) per lb of gain during the last 4 months of gestation between breeds or energy levels. The 10% reduction in energy level was not enough to cause significant performance differences with these cows, since they started in good condition (condition scores 6.2 and 5.3). The cows averaged 42 days from calving to first estrus and 60 days to conception, with no differences between breeds or energy levels. Calf birth weights averaged 94 lbs, with no differences between breeds or energy levels. The Polled Hereford cows gained 2.06 lbs per day during the following summer grazing, whereas the Simmentals gained significantly less, 1.22 lbs per day. The average weaning weights of the Polled Hereford calves was 540 lbs, and the Simmental calves averaged 610 lbs.

Table 3.1. Least Squares Means for Traits by Breed and Dietary Energy Level

	Polled Hereford		Simmental	
Trait	Low	High	Low	High
Starting Oct. Cond.[1]	6.20^{a}	6.12^{a}	5.43^{b}	5.22^{b}
Starting Oct. Wt. lb	1284^{a}	1333^{a}	1319^{a}	1310^{a}
Pre-calving ADG, lb	0.56^{a}	0.83^{b}	0.56^{a}	0.68^{ab}
Pre-calving Cond.[1]	5.84^{a}	5.89^{a}	5.83^{a}	5.82^{a}
Pre-calving Wt., lb	1319^{a}	1376^{a}	1357^{a}	1342^{a}
Pre-calving Daily TDN, lb	11.4^{a}	12.6^{b}	13.0^{b}	14.0^{c}
Gain/TDN, lb	0.04^{a}	0.06^{a}	0.05^{a}	0.05^{a}
Grazing ADG, lb	2.17^{a}	1.95^{ab}	1.44^{bc}	1.00^{c}
First Estrus, days postpartum	46.4^{a}	51.9^{a}	31.9^{a}	39.2^{a}
Conception, days postpartum	63.2^{a}	70.6^{a}	54.2^{a}	54.1^{a}
Calf Birth Wt., lb	93.8^{a}	91.2^{a}	97.7^{a}	93.2^{a}
Calf 205-day Wt., lb	535^{a}	544^{a}	626^{b}	595^{ab}
Ending Oct. Wt., lb	1378^{a}	1313^{b}	1300^{b}	1340^{ab}

[abc] Means with different superscripts are different ($P<.05$).

[1] Condition score scale: 1 = extremely thin to 9 = extremely fat.

INFLUENCE OF MILK LEVELS OF BEEF COWS ON RETURNS: A SIMULATION APPROACH

R.R. Schalles, K.O. Zoellner,
and L.S. Clarke

Summary

Results of four simulated production systems indicated that high levels of milk produced calves that were heavier at weaning, primarily because of an increase in body fat. High levels of milk production, however, were a disadvantage when calves went directly to the feedlot. With slow-growing calves, the fat either had to be depleted postweaning, or the calves had to be slaughtered at less-than-desirable weights in order to maintain desirable carcass fat. High milk intake is more tolerable for calves with fast growth rates, whereas low milk intake is a an economic necessity for calves with slow growth rates. The moderate size (1250 lbs), moderate milking (average of 16.6 lbs per day) cows produced the greatest return over feed cost.

Introduction

The optimum milk production level for beef cows has been discussed by cattlemen for years. Until recently, when milk EPD's (expected progeny differences) became available, selection was based on a combination of milk and early calf growth rate. Today, cattlemen can select for both traits separately by using both weaning weight and milk EPD's. Thus, it becomes important to determine the optimum combination for each production system.

Experimental Procedures

Two levels of milk production for two rates of calf growth were evaluated by using the Manhattan, Kansas, environment and native bluestem pasture data as inputs for the Colorado State University cow herd simulation program. Two herds of cows were simulated with a mature cow weight of 1050 lbs, in body condition score of 5. One herd was simulated with an average daily milk production of 15.8 lbs and the other with an average daily milk production of 19.1 lbs These levels of milk production are higher than those reported for Polled Hereford cows in a preceding paper (Polled Hereford and Simmental milk production), with the lower level being close to that obtained from the Simmentals. Two more herds were simulated with a mature cow weight of 1250 lbs; one producing an average of 16.6 lbs of milk per day, the other averaging 21.9 lbs per day. The lower level is similar to that reported for the Simmentals in the preceding paper. The levels of milk production were chosen so the calves from the high-milking, small cows and high-milking, moderate size cows would have similar condition scores at weaning, and the same would be true for the moderate milking cows of the two sizes. The relative growth rate was the same for all calves, with genetic yearling weight of 64.3% of mature size. A 60-day June-July breeding season was used, with calves weaned on October 1.

Cows were grazed on native bluestem pasture all year, with supplemental feeding from December through April designed to allow cows to have a body condition score of 5 on May 1. The supplement was alfalfa hay, with a grain mix added when energy was needed.

At weaning, calves were fed in drylot for a month, at which time replacement heifers were selected. Non-replacement heifers and steers were placed in a feedlot on December 1, and replacement heifers were put on pasture but were fed hay and grain to meet their requirements. All open and unsound cows were culled and sold at weaning. Open and unsound long-yearling heifers were also put in the feedlot. Cattle were sold from the feedlot when 80% of the group would be expected to grade low choice. Two feedlot rations were used. The starting ration had 72% TDN (total digestible nutrients). The finishing ration had 85% TDN. Both contained 12% crude protein.

Economic comparisons were made, assuming the following prices: grass, $10.30 per A.; energy supplement, $5.90 cwt.; alfalfa hay, $100 per ton; starting feedlot ration, $5.90 cwt; and finishing feedlot ration, $6.00 cwt. Slaughter steers were priced at $71.50 per cwt., and slaughter heifers at $70.50 per cwt., with a $5 per cwt. discount for carcasses under 650 lbs, and cull cows priced at $43 per cwt. Simulated economic scenarios compared were 1) doubled calf slaughter prices, 2) doubled cull cow prices, 3) doubled pasture cost, 4) half the pasture cost, 5) half the hay cost, and 6) half the grain cost. All economic comparisons were made with cow numbers that would remove the same amount of dry matter (DM) from the range (approximately 425 ton per year), when the cow, her calf, and her share of the replacement heifers were considered.

Results and Discussion

Results of the simulation are shown in Table 4.1. High-milking and moderate-milking cows consumed similar amounts of grass during the summer, i.e., all they could eat. High-milking cows were thinner in the fall than moderate-milking cows and required more supplemental feed during the winter. As the level of supplemental winter feed increased, the amount of dead winter grass consumed decreased. Thus the high-milking cows consumed less total grass dry matter than the low-milking cows, but required more winter supplementation.

Steer calves weaned from the high-milking cows were approximately 60 lbs heavier in both cow size groups. Weaning condition scores ranged from a high of 5.7 and 5.9 from the moderate milk level and a low 7.2 and 7.1 from the high milk level. The 60 lbs difference in weight was primarily due to body fat.

In a preliminary analysis, calves weaned from small cows with high milk production, were fed a low energy feed for 3 months, which required the calves to deplete their fat stores prior to being finished on a high energy ration. Although this was very inefficient, it was necessary to keep these calves on the starting feedlot ration for 2 months in order for them to be heavy enough at slaughter to avoid penalty for light carcasses.

Steers produced by the larger cows were placed on the high energy feedlot ration within a month after entering the feedlot. Steers from the lower milk producing cows weighed 1323 lbs at slaughter, which is near the upper end of the acceptable weight range. Those from the high-milking cows had a more desirable weight, 1238 lbs.

Calves from the high-milking cows were younger when they reached slaughter condition than those from the low-milking cows. Calves from the moderate size cows were about 2 weeks older and 245 lbs heavier at slaughter than those from the small cows. This management system for calves was similar to the one used for the steers in a preceding paper (Managing Fast vs. Slow Growth Genotypes to Optimize Quality and Yield Grades). The greatest biological efficiency (pounds of product per pound of TDN) was obtained from the moderate size (1250 lbs), low-milking cows. Least efficient were the small, high-milking cows. The biological efficiency of the small, low milking cows and the moderate sized high-milking cows was very similar.

Economic efficiency is difficult to evaluate because of continuously changing feed and cattle prices. With all scenarios compared, the small, high-milking cows were the least profitable, and the moderate size (1250 lbs), moderate-milking cows were the most profitable. The small size, moderate-milking and moderate size, high-milking cows yielded similar returns over feed cost. In order to maximize profit on a fixed grazing area, it is necessary to reduce the stocking rate for moderate size cows by 4 to 11%, compared to the small cows. Using the price assumption noted previously, 89 moderate size, low-milking cows would produce $6,500 more return over feed cost than 100 small size, high-milking cows. This advantage was the least ($4,500) when hay price was half the assumed price ($50 vs. $100 per ton). The greatest advantage ($11,900) for the 89 moderate size, moderate-milking cows was when slaughter calf prices were doubled.

The economic results are different if calves are sold at weaning. Those results were reported in the 1986 Cattlemen's Day Report (Cow Size and Milk Level: Results of a Simulation Program), where 1300 lb cows producing an average of 24 lb of milk daily gave the greatest return per unit of grass.

Table 4.1. Comparison of Cattle Genotype at Different Price Relationships

	Cattle Size			
	Small		Moderate	
Traits	Moderate Milk	High Milk	Moderate Milk	High Milk
Cow Weight (lb)	1050	1050	1250	1250
Avg. Daily Milk (lb)	15.8	19.1	16.6	21.9
Calf Weaning Cond. Score	5.7	7.2	5.9	7.1
Calf Wean Wt (lb)	480	541	584	640
Cow May Cond.	5.1	5.0	5.2	4.9
Heifer Slaughter Wt (lb)	898	815	1032	1003
Steer Slaughter Wt (lb)	1079	991	1323	1238
Steer Slaughter Age (days)	429	383	444	406
Grass DM Removed per Cow (lb)	8508	7887	9559	8815
Grass TDN Removed per Cow (lb)	4286	4041	4803	4516
Supplemental TDN Fed per Cow (lb)	1851	2285	2321	2828
Number of Cows[1]	100	108	89	96
Economic Scenarios (Return over Feed Costs on Set Pasture Size and Retained Ownership Through the Feedlot)				
Current Prices[2]	20,300 (3)[3]	16,700 (4)	23.200 (1)	20.500 (2)
Double Slaughter Prices	74,200 (3)	69,300 (4)	81,200 (1)	79,300 (2)
Double Cull Cow Prices	27,700 (3)	24,200 (4)	31,300 (1)	28,800 (2)
Double Pasture Cost	10,000 (3)	6,300 (4)	12,900 (1)	10,000 (2)
Half Pasture Cost	25,400 (3)	22,000 (4)	28,300 (1)	25,700 (2)
Half Hay Cost	28,200 (3)	27,000 (4)	31,500 (2)	31,600 (1)
Half Grain Cost	27,700 (2)	22,900 (4)	31,300 (1)	27,600 (3)

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[1] Number of cows is determined by a set pasture size (425.4 ton of dry matter removed, approximately 1000 A.)

[2] Assumed prices used were: Grass $10.30/A.; Energy supplement $5.90 cwt.; alfalfa hay $100/ton; feedlot starting ration, $5.90 cwt.; feedlot finishing ration, $6.00 cwt.; slaughter steers, $71.50/cwt.; slaughter heifers, $70.50/cwt.; $5 discount for carcasses under 650 lbs; cull cows, $43.00 cwt.

[3] Number in parentheses is the genotype ranking scenario.

SPLAY-FOOT IN CATTLE

R.R. Schalles, R.W. Markham[1],
H.W. Leipold[1], and M.F. Spire[2]

Summary

Angular limb deformity, observed in several breeds of cattle, results in a knock-kneed and splay-footed condition in the front legs. This study shows that angular limb deformity is a congenital structural defect, inherited as a simple, autosomal, recessive trait.

Introduction

Structural conformation has been an important consideration in cattle evaluation and selection for several hundred years. Leg structure is a major part of conformation and can influence function. One undesirable trait of the front legs is splay-foot, an angular limb deformity that has been observed in several breeds of cattle, both beef and dairy. It occurs in various degrees, but has always been discriminated against. The purpose of this study was to determine the cause and inheritance of this type of angular limb deformity in cattle.

Experimental Procedures

Based on reports of front leg deformities from veterinarians, breed associations, and herd owners, herds were visited, and information was gathered. Affected Jersey cattle were obtained for a breeding trial and detailed studies, including pedigree analysis, radiographic evaluation, mineral and hormone evaluation, and measurements of histopathological characteristics. All affected animals (Figure 5.1) were compared to normal animals of the same sex, age, and breed.

Results and Discussion

Pedigree analysis of 41 cattle affected with angular front limb deformity showed a significantly higher relationship to seven bulls and four cows of the Jersey breed than 100 randomly selected pedigrees of Jerseys of the same time period. One bull sired nine of the affected animals and was grandsire of an additional 10. Four cows with the angular limb deformity were mated to an affected bull to produce seven affected calves and no normal calves. From field data, no matings of affected to affected animals have produced normal calves. These are the results expected when a trait is inherited as a simple, autosomal recessive.

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[1] Department of Pathology.

[2] Department of Surgery and Medicine.

Detailed evaluation indicated that the major deformity involved the distal radial epiphysis. Affected animals showed various degrees of knock-kneed and splay-foot conditions. The condition improved as they got older. Two calves that were unable to stand at birth improved greatly with proper care and leg splints, to the point that they could have entered a milking herd by the time they were two years old. Very severely affected calves did not improve.

No differences were found between the affected and normal calves in serum calcium, phosphorus, zinc, copper, magnesium, manganese, or the hormone, thyroxine. Histopathological lesions were found only in the distal radius, which showed signs of osteochondrosis (improperly developed bone).

This trait can be controlled with a breeding program that does not allow the mating of cattle with angular limb deformity. Since calves can improve with age, notes of the condition must be made at birth, and those animals must not used for breeding. The responsibility for controlling this, as all other genetic defects, lies with the seedstock producer. Commercial cattlemen should take note if affected calves occur and change sources of bulls.

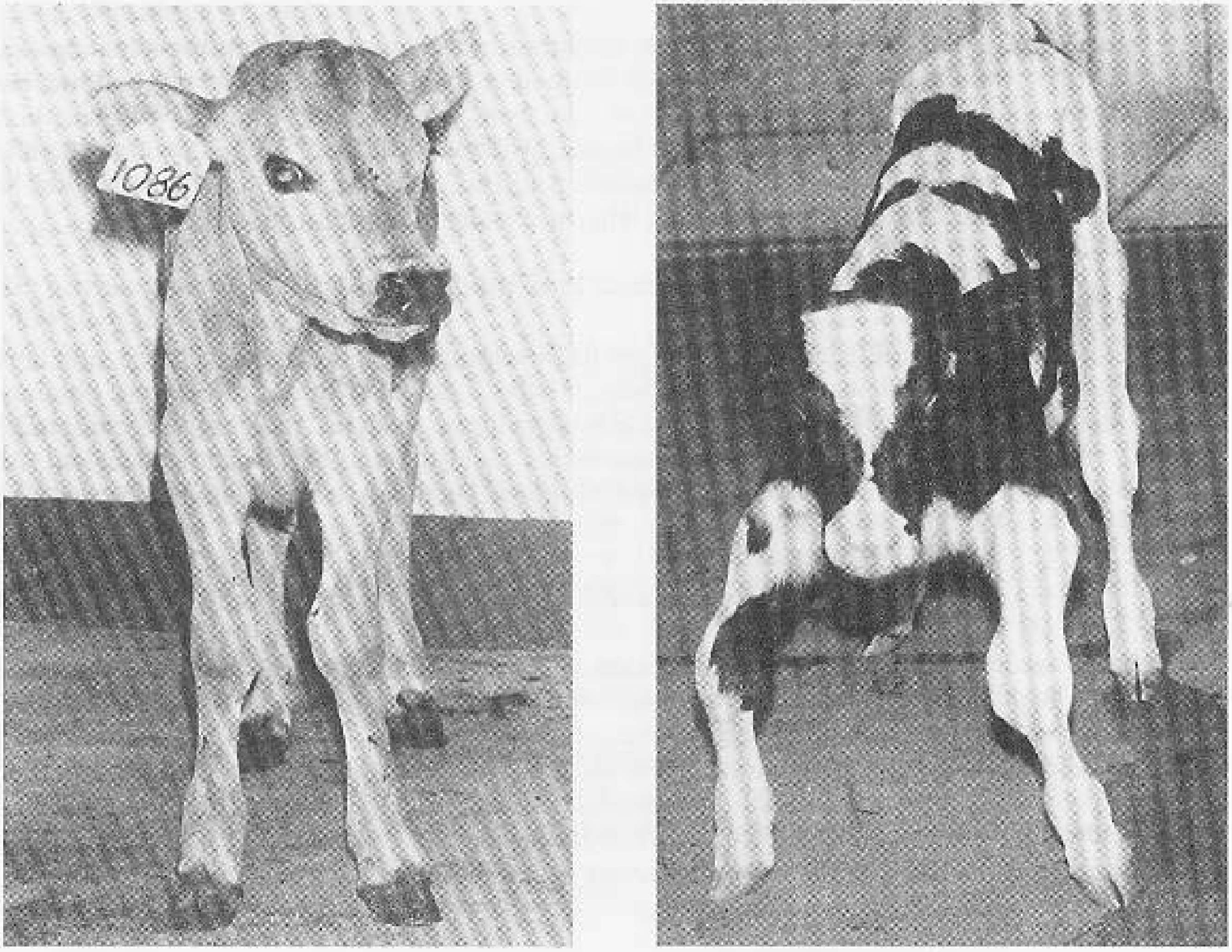


Figure 5.1. Calves Mildly (left) and Severely (right) Affected with Angular Limb Deformity.

SYNCRO-MATE B® INDUCES ESTRUS IN COWS WITHOUT OVARIES

W.J. McGuire and G.H. Kiracofe

Summary

Syncro-Mate B® was capable of inducing estrous behavior in ovariectomized cows. Lengthening the norgestomet implant period from 9 to 18 days did not prevent estrus. The ability of Syncro-Mate B to induce estrous behavior in ovariectomized cows helps explain the variable conception rates obtained after using this product in intact cows.

Introduction

Syncro-Mate B® is a commercially available estrous synchronization product. Use of this product typically results in a high degree of synchronization of estrus behavior. However, conception rates are often variable, especially when anestrous cows and prepubertal heifers are involved.

Normally, cows exhibit estrus in response to estrogen from their own ovaries. If Syncro-Mate B can induce estrus behavior in ovarectomized cows, then the product can produce estrus behavior independent of ovarian function, which could explain much of the variability in fertility associated with its use.

We conducted two trials to determine if 1) treatment of ovariectomized cows with Syncro-Mate B could induce estrous behavior and 2) if so, would lengthening the exposure to the norgestomet implant prevent the treatment-induced estrous behavior.

Experimental Procedures

Trial 1. Trial 1 was replicated three times and consisted of 9, 9, and 11 mature Hereford x Simmental cows, respectively. Cows were ovariectomized either 6 months or 3 days before the start of the experiment. All cows received the recommended Syncro-Mate B treatment: a 2 cc intramuscular injection containing 5 mg estradiol valerate and 3 mg norgestomet given simultaneously with a hydron ear implant containing 6 mg norgestomet. The implant was removed 9 days later. Cows were observed for estrus four times daily for 3 days following implant removal. Blood samples were collected from cows in estrus and again 10 day following estrus.

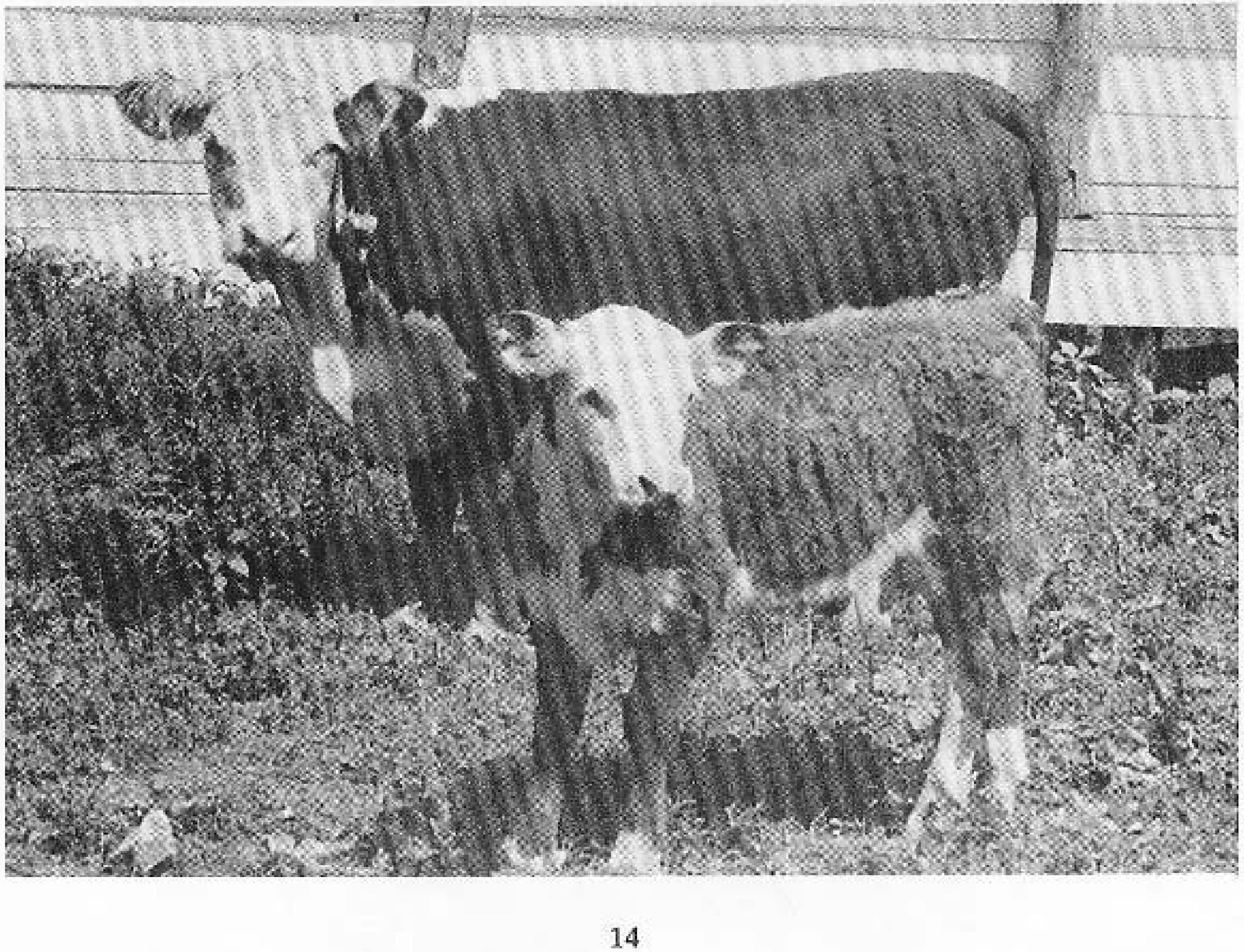
Trial 2. The same cows used in Trial 1 were randomly allotted to receive either 1) the same Syncro-Mate B treatment used in the previous trial or 2) the standard Syncro-Mate B treatment plus a second 9 day norgestomet implant given 12 hours before the removal of the first implant. Treatments were timed such that implants were removed from both groups at the same time. The trial was repeated twice, and cows were switched between treatment groups. Cows were observed for estrus, and blood was collected for progesterone assay as in the first trial.

Results and Discussion

Trial 1. The incidence of estrual behavior in the ovariectomized cows following treatment with Syncro-Mate B was 3, 7, and 6 out of 9, 9, and 11 cows, respectively. Pooled results showed that 55% of the cows exhibited estrus. Only basal levels of progesterone were found in blood serum collected 10 days after estrus, indicating that ovariectomy was complete and that no ovulation had occurred. Serum estradiol-17 beta concentrations on the day of estrus were not different (3.78 vs. 4.40 pg/ml) between the long-term and recently ovariectomized cows. However, estradiol concentrations did differ ($P<0.05$) between long-term cows that exhibited estrual behavior vs. those that did not (3.78 vs. 1.38 pg/ml).

Trial 2. The incidence of estrus in ovariectomized cows after one implant was 1/5, 2/5, and 0/5; with two implants, it was 1/6, 1/6, and 1/5. Extending the length of the norgestomet implant period had no effect on the number of cows exhibiting estrus (20% of the single-implant cows vs. 17.6% of the double-implant cows). In the single implant group, serum estradiol concentrations tended to be higher for cows exhibiting estrus. There was no difference between estrual and nonestrual cows of the double-implant group. In cows that exhibited estrus, serum estradiol concentrations were higher in the single- vs. the double-implanted cows (2.96 vs. 1.16 pg/ml).

Fertilization after insemination at the synchronized estrus depends on precise timing of ovulation with estrus. In the intact cow, the Syncro-Mate B treatment may be capable of either inducing estrus without ovulation or altering the timing between estrus and ovulation, resulting in a fertilization failure.



CONCEPTION RATES OF BEEF HEIFERS TREATED WITH GnRH ANALOG AT THE TIME OF ESTRUS OR AT THE TIME OF ARTIFICIAL INSEMINATION[1,2]

L.R. Corah, W.E. Beal,[3]
J.S. Stevenson, and M.F. Spire[4]

Summary

Injecting a GnRH-analog at the time of estrus or at insemination did not generally improve conception rates in heifers inseminated following a synchronized estrus. However, within some herds, a significant positive response was noted.

Introduction

Recent research in Kansas has shown that gonadotropin releasing hormone (GnRH) has improved conception rates in dairy females, particularly in those inseminated on the second and third estrus. The objective of our study was to determine the efficacy of GnRH in beef heifers following estrus synchronization.

Experimental Procedures

Three hundred and seventy-nine yearling beef heifers in five commercial Kansas herds were used to determine if administering gonadotropin releasing hormone analog (GnRH-a Fertinelin acetate) improved conception rates following artificial insemination. Heifers in good body condition were fed .5 mg MGA® per head daily for 14 days. Prostaglandin (Lutalyse®) was injected I.M. 17 days after the last day of MGA feeding. Heifers exhibiting a synchronized estrus received 1) no treatment (control), 2) 100 micrograms GnRH-a I.M. at the time of estrus detection (GnRH-E), 3) 50 micrograms of GnRH-a at the time of insemination (GnRH-B-50), or 4) 100 micrograms GnRH-a at the time of insemination (GnRH-B-100). All heifers were inseminated 12 hours after estrus detection. Semen and inseminators were assigned randomly among treatment groups at each location. Data were analyzed by analysis of variance procedures appropriate for categorical data, with location and treatment as main effects.

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[1] Appreciation is expressed to the Upjohn Company for the supplying the GnRH Analog and to John Chenault for his consultation.

[2] Appreciation is expressed to cooperating commercial cattlemen, Gary Johnson, Craig Johnson, Ken Stielow, Larry Wickstrum, and Rodney Oliphant.

[3] Virginia Polytech Institute.

[4] College of Veterinary Medicine.

Results

Results are shown in Table 7.1. There was no effect due to any GnRH treatments, and the treatment x location interaction was not significant. The administration of 50 micrograms GnRH-a at the time of insemination raised the mean conception rate by 9%, but the effect was not statistically significant.

Table 7.1. Effect of GnRH Treatment at Estrus or at the Time of Artificial Insemination on First Service Conception Rates of Heifers

Treatment	No. Heifers	Conception Rate (%)
3 Locations		
Control	80	71.3
GnRH-B-50	68	80.9
GnRH-B-100	71	76.1
2 Locations		
Control	54	66.7
GnRH-E	49	57.1
GnRH-B-100	57	59.6

LIMIT VERSUS FULL CREEP-FEEDING OF A HIGH PROTEIN SUPPLEMENT TO CALVES GRAZING LATE SUMMER BLUESTEM

R.C. Cochran, C.E. Binns, L.R. Corah,
T. DelCurto, and E.S. Vanzant[1]

Summary

Limit creep-feeding a 36% protein supplement (avg. salt concentration = 7.9%) was compared with unlimited consumption of the same supplement without salt (full creep-feeding) and with no supplementation. Average daily gain of steer calves was increased ($P \leq .06$) by .19 (limit creep-feeding) and .38 (full creep-feeding) lb per day compared with non-supplemented calves. Average daily gain of heifer calves was not increased by creep feeding. Efficiency with which creep was converted to extra gain was poor for both limit and full creep-feeding groups. Little difference was observed in postweaning average daily gains; however, the calves given ad libitum access to creep feed tended ($P=.12$) to have greater daily gains (1.9 lbs) than non creep-feeding calves (1.6 lbs). Limit creep-fed calves had average daily gains of 1.7 lbs. Feed conversion during the post-weaning period was slightly improved ($P=.09$) in calves that had been given ad libitum access to creep feed.

Introduction

Previous research at Kansas State University has compared limit and full creep-feeding of a 16% crude protein (CP) supplement to suckling calves grazing late-summer, Flint Hills range. Conversion efficiencies (lb creep per lb extra gain) in that study were relatively poor, with no benefit observed from limit creep-feeding. Since digestibility and intake of poor quality forage can be negatively affected by supplements containing a low (8 to 14%) concentration of crude protein, use of a high protein creep supplement might alter the response to limit vs. full creep-feeding. Therefore, the objective of our study was to compare limit and full creep-feeding of a high protein (36% CP) supplement to no supplementation for suckling calves grazing late-summer bluestem. We also determined the effect creep feeding has on subsequent postweaning gain and feed conversion.

Experimental Procedures

Eighty-four Angus x Hereford calves were randomly assigned to three treatments: 1) limit creep-feeding with salt used to limit consumption of a soybean meal + milo supplement available free choice in a creep feeder; 2) full creep-feeding the same soybean meal + milo supplement without salt, offered free choice in a creep feeder; and 3) control, no supplementation. The supplement was approximately 65% soybean meal and 35% rolled

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[1] Appreciation is expressed to Mr. Gary Ritter and Mr. Wayne Adolph for their expert assistance during the data collection.

sorghum grain. Supplement consumption by the limit creep-fed group was held at 1.8 lb/day (excluding salt). An average of 7.8% salt was required to maintain the calves at this level of consumption. Both supplemented groups were initially exposed to the basal supplement without salt for 2 to 3 days.

Treatment groups were randomly assigned to separate bluestem pastures and, subsequently, were rotated among pastures so that all treatments were exposed to each pasture during the course of the study. Stocking rates were similar among treatment groups. Calves were weighed at the beginning (Aug. 11, 1988) and end (Oct. 19, 1988) of the creep period. Before each weigh day, cow/calf pairs were held overnight without feed or water; however, calves were allowed to suckle their dams. The calves were weaned on October 19, 1988, and shipped to the KSU Beef Research Unit for a 43-day growing trial. During this period, the calves were fed an average of 2.5 lb of a 36% protein supplement, .5 lb of milo, and a full-feed of grain sorghum and forage sorghum silages. Final calf weights were taken on December 1, after an overnight stand without feed.

Results and Discussion

Influence of creep-feeding on average daily gain was dependent (P=.07) on calf sex (Figure 8.1). Average daily gain of heifer calves was not significantly increased by limit (2.14 lb/day) or full creep-fed (2.17 lb/day) compared with no supplementation (2.08 lb/day). In contrast, average daily gain for steer calves within the limit and full creep-fed groups was increased (P≤.06) compared with non-supplemented controls (2.32, 2.51, and 2.13 lb/day, respectively). Gains of steer calves in the limit creep-feeding group were less (P=.05) than those observed for the full creep-feeding group. The lack of gain response for heifers could have been due to differences in intake. However, since creep intake was not available on an individual basis, verification was not possible. An alternative explanation might be that steers, which would have a slightly greater growth potential, may have been able to use creep feed more efficiently to promote extra gain when faced with the less-than-adequate nutrient supply on late-summer pasture.

The efficiency with which creep feed was converted to extra gain (i.e., gain above the control group) was relatively poor for both groups. However, the conversion efficiency for the limit creep-feeding group (13.8 lbs creep/lb extra gain) was considerably better than that of the full creep-feeding group (23.2 lbs creep/lb extra gain). Daily intake of creep was 1.8 and 5.1 lbs for the limit- and full-creep groups, respectively. Conversion efficiency for the limit-creep group was similar to that observed in a previous trial (13 lbs creep/lb extra gain), in which calves consumed 1.5 lbs/day of a 16% CP supplement.

Postweaning performance is illustrated in Table 8.1. Calves previously on the full-creep treatment gained 0.3 lb per day more than non-creep-fed calves (P=.12) in the 43-day feeding period. Limit-creep feeding did not increase postweaning average daily gains. Average dry matter intake varied only slightly among creep treatments and, therefore, the full-creep calves tended (P=.09) to be more efficient in feed conversion than non creep-fed calves, 6.5 and 8.3 lb gain per lb feed, respectively. Feed conversion of the limit-creep calves was intermediate (7.8) compared with the other two treatments.

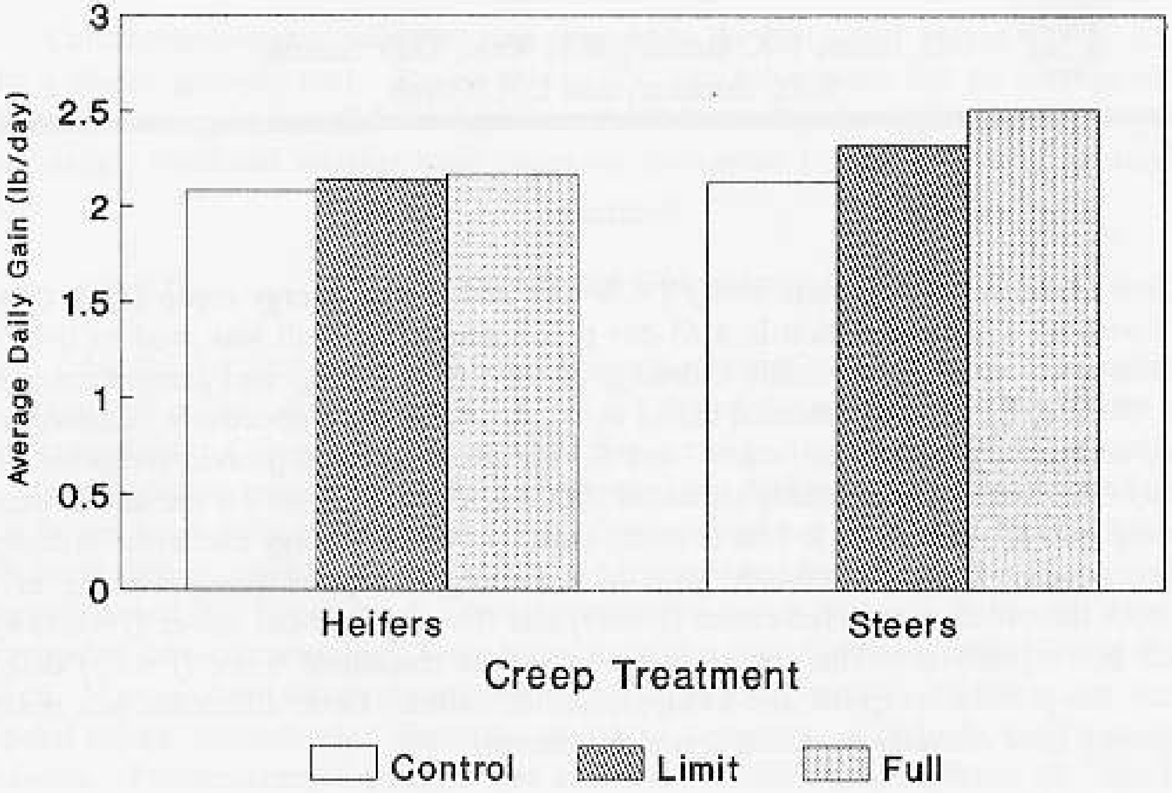

Figure 8.1. Influence of Creep-feeding Treatment on the Average Daily Gain of Steers and Heifers Grazing Late-summer Bluestem (standard error = .06).

Table 8.1. Influence of Creep Feeding on 43-day Postweaning Performance

Item	No Creep	Limit Creep	Full Creep	Standard Error
Number of Calves	29	29	29	
Final Weight, lb	622	643	632	
43-day Postwean Gain, lb	70.3[a]	73.3[ab]	83.0[b]	5.0
Average Daily Gain, lb	1.6[a]	1.7[ab]	1.9[b]	.12
Daily Dry Matter Intake, lb	13.5[a]	13.1[a]	12.5[a]	.49
Feed/Gain	8.3[a]	7.8[ab]	6.5[b]	.61

[ab] Means in a row not sharing the same superscript tend to differ (P<.12).

INFLUENCE OF LIMITED-CREEP FEEDING ON PRE- AND POSTWEANING PERFORMANCE OF SPRING-BORN CALVES

C.E. Binns, F.K. Brazle[1], G.L. Kuhl, D.D. Simms,
K.O. Zoellner, and L.R. Corah

Summary

Limit-feeding a high protein creep (36% CP) and a high energy creep (16% CP) was compared with no supplementation in a 61-day preweaning trial. Salt was used to limit daily creep intake to 1.5 to 2.0 lb per head. Calves given the limited energy and protein creep feeds outgained ($P<.01$) the unsupplemented calves by 0.2 lb and 0.3 lb, respectively. Conversion of creep feed consumed to extra gain was 6.7 and 5.3 for the energy and protein creep-fed calves, respectively (salt included). Trucking shrink of the noncreep-fed calves on the day of weaning and shipping was 4.9 lb and 7.0 lb less ($P<.05$) than that of the energy and protein creep-fed calves, respectively. Postweaning daily gains of the energy creep-fed calves was higher than those of both the protein creep-fed calves ($P=.09$) and the noncreep-fed calves ($P<.01$) by 0.3 lb and 0.5 lb, respectively. The energy creep-fed calves consumed more ($P<.05$) daily dry matter than the protein creep-fed and unsupplemented calves. Little difference was observed in postweaning feed conversion among creep treatments.

Introduction

Milk production of spring-calving cows decreases in late summer and early fall, coinciding with decreased nutritional value of native grasses. This can result in less than optimum gains in suckling calves. Creep feeding offers a way to improve weaning weights and increase carrying capacity of late summer pastures.

Research has shown that "full" creep feeding is often economically unattractive because of poor feed conversion and/or excessive calf condition at weaning, which may reduce market value. Limit-creep feeding suckling calves appears to be more cost effective because of improved feed conversion. The objective of this study was to evaluate the pre- and postweaning performance of spring-born calves receiving salt-limited creep feeds vs unsupplemented calves.

Experimental Procedures

One hundred and sixty-three Angus-Hereford crossbred, suckling calves averaging 400 lbs were allotted randomly to three treatments: (1) noncreep-fed controls, (2) energy creep-fed, or (3) protein creep-fed. On August 19, 1988, the calves were weighed, paired with dams, allotted to treatment groups, and put on native pasture located in east central Kansas. Treatment groups 2 and 3 were provided creep feed in self feeders located in cattle loafing

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[1] Extension Livestock Specialist, Southeast Kansas.

areas. Nutrient composition of the creep feeds is shown in Table 9.1. Creep intake was closely monitored, and salt content was increased as needed to limit daily intakes to 1.5 to 2.0 lb per head. The cow-calf pairs were rotated among pastures, so all treatment groups were exposed to each pasture for the same length of time.

Calves were weaned, weighed, and shipped to the KSU Beef Research Unit on October 19 for a 43-day growing trial. During this period, the calves were fed an average of 2.5 lb of a 36% protein supplement, 0.5 lb of milo, and full-feed of grain sorghum and forage sorghum silages daily. Final calf weights were taken on December 1 after an overnight stand without feed.

Results and Discussion

Table 9.2 details the pre- and postweaning performance of the calves. Calves consuming the energy and protein creeps gained 0.2 and 0.3 lb per day more ($P<.01$) than non-creep fed calves preweaning. Calves given the energy creep consumed an average of 1.9 lb per head daily with a conversion to extra gain of 6.7. Calves receiving the protein creep consumed an average of 1.9 lb per head daily and required 5.3 lb of creep feed per lb of added gain. Both types of creep feeds required up to 15% added salt late in the creep feeding period to limit daily intakes between 1.5 and 2.0 lb per head. Protein creep-fed calves were 27 lb heavier ($P<.01$) than noncreep-fed calves at weaning. Transit shrink on the day of weaning and shipping (100 miles) differed. Noncreep-fed calves shrunk 4.9 lb and 7.0 lb less ($P<.05$) than the energy and protein creep-fed calves, respectively. Similarly, shrink as a percentage of body weight varied among treatments. Protein creep-fed calves had a shrink of 4.6%, which differed ($P<.01$) from that of the noncreep-fed controls (3.6%). Energy creep-fed calves had a shrink of 4.3%, which also tended ($P=.06$) to differ from that of the noncreep-fed calves. This difference in shrink was most likely due to differences in fill prior to shipping.

Energy creep-fed calves gained 0.5 lb per day more ($P<.01$) than noncreep-fed controls and 0.3 lb per day more ($P=.09$) than protein creep-fed calves in the 43-day postweaning feeding period. The energy creep-fed calves consumed 0.8 and 1.4 lb more ($P<.02$) dry matter daily than protein creep-fed and noncreep-fed calves, respectively. Postweaning conversion varied only slightly; however, the energy creep-fed calves tended ($P=.10$) to have better feed conversion than noncreep-fed calves, 5.6 vs 6.1. For the entire trial (61 days preweaning + 43 days postweaning), the energy and protein creep-fed calves averaged 1.9 lb gain per day, which was significantly more ($P<.01$) than the noncreep-fed controls (1.5 lb/day).

Table 9.1. Nutrient Composition of Limited-Creep Feeds Used

Nutrient	Energy Creep	Protein Creep
Crude Protein, %	16.0	36.0
Crude Fiber, %	11.2	11.5
Estimated TDN, %	69.5	68.6
Calcium, %	.85	.85
Phosphorus, %	.85	.85

Table 9.2 Effect of Limited-Creep Feeding on Pre- and Postweaning Calf Performance

Item	No Creep	Limit-Fed Energy Creep	Limit-Fed Protein Creep
Preweaning Calf Performance: 61 days			
Number of calves	56	53	54
Weaning Weight., lb	499^{a}	509^{ab}	526^{b}
Total Gain, lb	73^{a}	85^{b}	92^{b}
Daily Gain, lb	1.16^{a}	1.44^{b}	1.50^{b}
Daily Creep Intake, lb	-0-	1.91	1.82
Creep/Extra Gain, lb	-0-	6.8	5.4
Trucking Shrink, lb	18.1^{a}	22.2^{b}	24.4^{b}
Shrink as a % of Body Weight	3.6^{a}	4.3^{ab}	4.6^{b}
Postweaning Calf Performance: 43 days			
Daily Gain, lb	2.1^{a}	2.6^{b}	2.3^{ab}
Total Gain, lb	90^{a}	112^{b}	99^{ab}
Daily Dry Matter Intake, lb	12.8^{a}	14.2^{b}	13.4^{a}
Full Dry Matter/Gain	6.1^{a}	5.6^{a}	5.8^{a}
Whole Trial: 104 days			
Daily Gain, lb	1.5^{a}	1.9^{b}	1.9^{b}

^{ab}Means in a row not sharing the same superscript differ (P<.05).

EFFECT OF LIMITED-CREEP FEEDING ON PERFORMANCE OF SPRING-BORN CALVES: RESULTS OF 1988 FIELD TRIALS[1]

D. Simms and G. Kuhl

Summary

Two field trials were conducted to evaluate limited-creep feeding of spring- born calves using pelleted creep rations with either 0.5, 5, or 10% salt. Average daily gain was increased ($P<.05$) over controls in trial 2 and when both trials were combined. However, intakes were higher than desired and feed conversion much poorer than expected.

Introduction

The energy and protein content of native grass in Kansas declines during late summer and fall. Correspondingly, milk production of spring calving cows declines during the grazing season, resulting in reduced calf nutrition. Although feed conversion on traditional creep feeding programs has been shown to be poor, research on salt-limited creep rations has shown considerable promise. However, prior research with starting calves on 5% salt, pelleted creep rations has yielded variable results (1988 Cattlemen's Day Report). These trials were conducted to determine the effectiveness of starting calves on a 0.5% salt creep as a means of overcoming the problems noted in earlier trials.

Experimental Procedures

In each trial, spring-calving cows and their calves were assigned randomly to pastures and treatments: (1) Control - no creep or (2) Limited-Creep. At the start of each trial, a 16% protein, 0.5% salt, pelleted creep feed containing 60 mg Bovatec/lb was placed in the limited-creep pastures. When daily intake exceeded 3 lb per head, a 5% salt, pelleted creep feed replaced the 0.5% salt creep. Subsequently, when the daily intake again exceeded 3 lb per head, a 10% salt, pelleted creep feed replaced the 5% salt creep. Trial 1 was initiated on July 22, 1988, and terminated on Oct. 10, 1988. Trial 2 was initiated on June 26, 1988, and terminated on Oct. 31, 1988. Individual, non-shrunk weights were taken at initiation and termination of the trials.

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[1] Sincere appreciation is expressed to Farmland Industries, Inc., Kansas City, MO for supplying creep feed; to Dick Poovey, Paxico, KS, and Joe Theilen, Dorrance, KS, for providing cattle, facilities, and management; and to Chuck McNall, Wabaunsee County Extension Agricultural Agent for assistance with data collection.

Results and Discussion

As in prior trials, creep intakes were low during July and August, even though the summer of 1988 was extremely dry, with less than normal precipitation and grass production. Table 10.1 shows the results of the 1988 limit-creep field trials. Limit-creep feeding increased average daily gains ($P<.05$) in trial 2 and when both trials were combined ($P<.05$). Average daily intakes throughout the trial were greater than desirable on a limit-creep program. It is clear that a 10% salt level is not high enough to maintain intakes below 3 lb per head daily late in the grazing season. Conversion of creep feed to gain was much higher than expected based on prior research in Kansas and other states, and even poorer than in the 1987 trials.

As noted in last year's report, maintaining intake of a pelleted creep ration at an acceptable level is difficult because of problems in adjusting the salt level. Even starting the calves on a 0.5% salt creep feed didn't overcome the intake variability noted in 1987. These trials indicate that successful limit-creep feeding will require considerable management to monitor intake and to adjust the salt level in the ration. Additionally, use of a meal form rather than a pelleted form seems preferable, since the salt level can be adjusted more easily.

Table 10.1 Results of 1988 Field Trials Evaluating Limit-Creep Feeding of Suckling Calves

		------Average daily gain, lb-----			
Trial	Length of Trial (Days)	Control (n)[1]	Limited-Creep (n)	Average Daily Consumption, lb	Creep to Gain Conversion
1	80	2.44 (25)	2.58 (24)	4.35	31.1
2	127	1.78^a (20)	1.98^b (35)	2.41	12.1
Combined	--	1.97^a (45)	2.15^b (57)	3.38	18.8

[1] n = number of calves.

[ab] Means in a row with different superscripts differ ($P<.05$).

VISUAL BODY CONDITION SCORE OF COWS

C.K. Clarke and R.R. Schalles

Condition scores are often used to describe the "fleshiness" of cows . These scores range from 1 (extremely emaciated) to 9 (extremely fat), and are described in detail below.

1 = Extreme emaciation. Ribs, hip bone, and tailhead projecting very prominently. No fat deposition detectable in any area. Transverse processes and neural spines easily distinguished and sharp to the touch.

2 = Very thin and devoid of fatty tissue deposition in all regions. However, the prominent muscular atrophy characteristic of condition 1 is not evident. All areas of the skeletal structure are visible and feel sharp upon palpation.

3 = Thin, but no evidence of muscular atrophy. Slight feeling of fat deposition over the ribs. Hip bone and tailhead regions are less prominent than in condition 2, but spinous processes still sharp to the touch and no fat present around tailhead.

4 = Prominent features of hip bone, tailhead, and ribs still evident, but overall less obvious and demonstrating some fat deposition, particularly in the area of the ribs. Spinous processes can be individually palpated and give slight indication of rounding. Tissue cover in the tailhead region is slight to the touch.

5 = Overall features of skeletal structure less discernible. Smooth appearance over the rib area. Spinous processes can be identified individually, but feel rounded to the touch. Some fat tissue is evident and can be felt around the tailhead.

6 = Overall skeletal features of hip bone and tailhead can be seen but give a smooth appearance. Spinous processes are only slightly evident and rounded to the touch with firm pressure. Rib area is smooth with palpable evidences of fat. Some initial appearances of fat deposition on either side of the tailhead.

7 = Generalized protrusion of the hip bone and tailhead can be seen, but increased fat deposition gives the animal a smooth appearance. Spinous processes cannot be visualized and are felt only with firm pressure. Rib area appears completely smooth with fat cover on either side of the tailhead being easily felt.

8 = Smooth appearance throughout with definite evidences of fat deposition over the hip bone and tissue covering both over and filling the area between the ribs. Fat cover around tailhead evident as slight swells and somewhat soft to the touch. Beginning of some fat deposits in the flank area can be noted, and the initial development of a fat fold in the rear immediately below the vulva can be seen.

9 = Extremely fat animal giving an overall blocky appearance. Skeletal features of tailhead and hip bone difficult to perceive because of extensive fat cover. Rib area shows bulging of fat with patches of fat evident in the flank and over the pin bones. Large roll of fat also apparent immediately below the vulva.

EFFECTS OF WINTER HERBAGE REMOVAL ON FLINT HILLS RANGELAND

L. M. Auen and C.E. Owensby[1]

Summary

Intensive-early stocking (IES) in the Kansas Flint Hills has greatly increased livestock production efficiency. The potential for grazing of regrowth on IES pastures the following winter was studied by mowing different plots on a monthly basis from October to April, 1983-1985. Winter herbage removal had no significant effect on herbage production in the following seasons or on the total nonstructural carbohydrates (TNC) of big bluestem (*Andropogon gerardii*) rhizomes. Since there was no reduction in herbage yield for any mowing date, cattle producers can apparently restock IES pastures after October 1.

Introduction

Kansas Flint Hills range is converted to saleable red meat more efficiently by intensive-early stocking (IES) than by season-long stocking. IES results in higher animal gains per acre without sacrificing individual performance. In addition, IES cattle can be sold in July, when traditionally fewer cattle are sold and prices are higher. IES consists of stocking at double the season-long rates during the first half of the growing season, then removing the animals and allowing the forage to regrow for the remainder of the season in order to replenish carbohydrate reserves. Winter grazing of regrowth on IES pastures offers additional grazing resources and gives greater flexibility in purchasing cattle. The objective of this study was to determine the effects of winter herbage removal on subsequent herbage production and on total nonstructural carbohydrates (TNC) reserves in big bluestem rhizomes, a key dominant of the Flint Hills.

Procedures

The study was conducted on the Konza Prairie Research Natural Area near Manhattan, Kansas. The plots were located on a loamy upland range site with a Benfield-Florence complex soil. The site was burned by a wildfire in early spring of 1982. The vegetation within the plots was typical of the Flint Hills rangeland. The dominant grasses were big bluestem (*Andropogon gerardii*), indiangrass (*Sorghastrum nutans),* and little bluestem (*Andropogon scoparius*).

Treatments were mowing and removing herbage or mowing and leaving herbage on different plots on the first of each month from October 1983 to April 1984 and October 1984 to April 1985. These two treatments were replicated three times and applied on seven dates for 2 years. Snow cover eliminated December and February treatments. The 10 x 10-ft plots were mowed to a 2 inch stubble height with a sicklebar mower, and the cut herbage was either raked off or returned evenly over the plots. For comparison plots, herbage was removed on

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[1] Department of Agronomy.

May 1 by burning in 1984 and by mowing and raking in 1985. Herbage production for all treatments was determined from fixed subplots by hand clipping to 2 inches on May 15, June 1, June 15, July 1, and July 15, 1984 and 1985. Samples were dried to a moisture-free basis and weighed to estimate dry-matter production. Rhizomes from six big bluestem plants were collected from each plot every 2 weeks from October 1, 1983 to May 1, 1984 and October 1, 1984 to May 1, 1985 and monthly from June 1 to September 1 of both years. No plants were removed from the herbage subplots. The rhizomes were dried and stored until the completion of the field study. Then the rhizomes were cleaned, and roots were removed, ground using a 1-mm mesh, and analyzed for TNC.

Results and Discussion

None of the winter mowing treatments reduced herbage yields in the following season when compared to the control plots, with the herbage yield averaging 2,805 lb dry matter per acre on July 15, 1984 compared to 2,128 lb per acre on July 15, 1985. Precipitation during May and June was higher in 1984 than 1985 (Figure 12.1) and likely accounted for the difference. A previous study showed that intensive herbage removal by clipping through the growing season did not lower TNC reserves in big bluestem rhizomes until the second year following the clipping. In this study, two consecutive years of winter mowing did not significantly reduce TNC at any date for any treatment in the second year. In addition, the translocation of carbohydrates occur primarily during September, with little movement thereafter throughout the winter season. Therefore, restocking before October 1 would result in lower carbohydrate storage and lower herbage production in the following season. Removing all herbage by mowing to 2 inches on a given date during the winter should be more detrimental to subsequent herbage yields than selective herbage removal through the winter by grazing. Since winter mowing to 2 inches on Flint Hills range did not reduce herbage yields or TNC concentration in big bluestem rhizomes in the following season, cattle producers apparently can use IES pastures during the winter after sufficient regrowth has occurred.

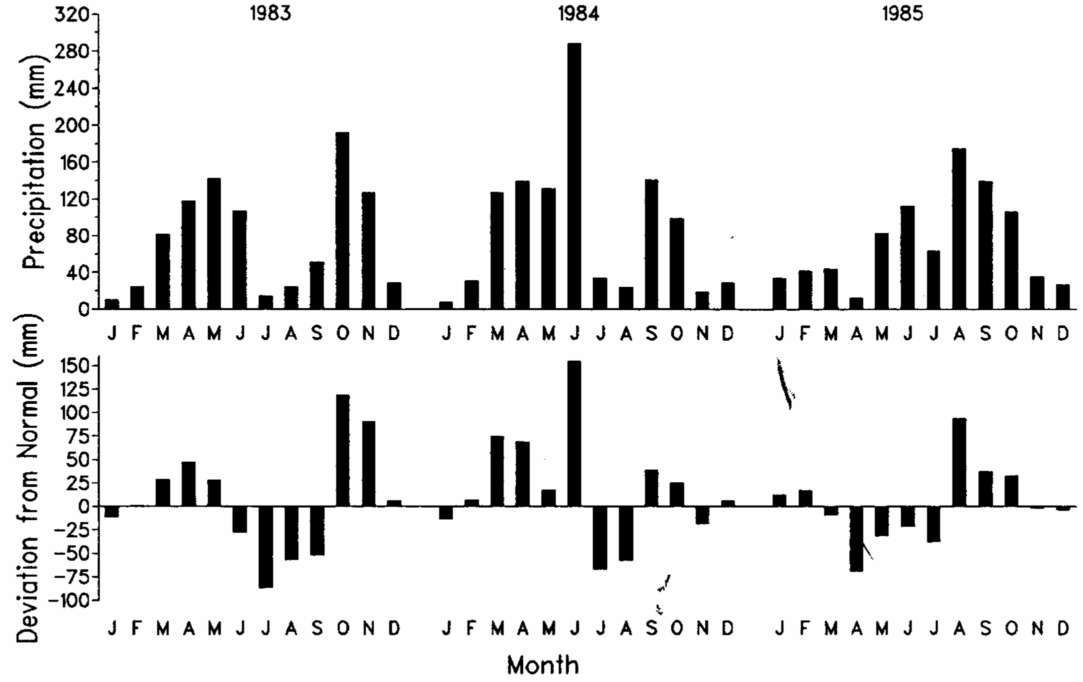

Figure 12.1. Precipitation for Manhattan, KS during the study period.

INFLUENCE OF LEVEL OF GRAIN SUPPLEMENTATION ON THE PERFORMANCE OF INTENSIVE-EARLY STOCKED STEERS

R.C. Cochran, C.E. Owensby, and E.S. Vanzant

Summary

Two levels of sorghum grain supplementation (2 or 4 lb/day) for steers in an intensive-early stocking program tended to increase average daily gain in direct proportion to increasing supplement level (2.7 and 2.9 lb/day, respectively, compared to 2.5 lb with no supplement). Similarly, grass remaining in the pastures after the cattle were removed on July 15, and at the end of the growing season on October 1, was greater when cattle were supplemented.

Introduction

Intensive-early stocking is an effective management option for stocker operations in the Flint Hills. During the intensive-early stocking period, typically May 1 to July 15, forage quality is relatively high. Previous research from K-State indicates that steers consuming harvested (green-chopped) bluestem-range forage during this period can be supplemented with up to 4 pounds of grain per day without harming forage intake or digestibility. However, information regarding how grain supplementation affects animal performance and pasture characteristics when used in conjunction with intensive-early stocking is unavailable. Therefore, the objective of this study was to monitor average daily gain and changes in forage production when intensive-early stocked steers were supplemented with increasing levels of sorghum grain.

Experimental Procedures

Two hundred and forty crossbred steers were randomly assigned to six, 60-acre pastures. Stocking rate (1.5 acres/steer = 40 steers/pasture) was equal among pastures. Pastures were randomly assigned to three treatments (two pastures per treatment): 1) no supplementation; 2) 2 lb rolled sorghum grain per head; or 3) 4 lb rolled sorghum grain per head daily. Supplemented groups were bunk-fed daily at 1:00 to 2:00 pm. All pastures were burned in late April, and steers grazed the pastures from May 5, 1988 through July 14, 1988. Weights were taken at trial initiation (May 5), June 9, and at trial termination (July 15) following overnight stands without feed or water.

Conversion efficiency (lb feed/lb extra gain) was calculated by dividing the quantity of supplement fed to a treatment group by the amount of gain above the unsupplemented steers during the same period. Steers were implanted with Compudose® during initial processing and had unlimited access to a Bovatec® mineral mixture during the entire trial.

Consumption of the mineral mixture was not different (P>.10) among treatments and averaged .15 lb/day (approximately 110 mg Bovatec/head/day). Forage remaining in the pastures at the end of the grazing period on July 15, and at the end of the growing season on October 1, was determined by clipping 10, 0.5 m^2 frames at random locations within both the loamy upland and breaks range sites for each pasture.

Results and Discussion

Average daily gain over the entire grazing period tended to increase (P=.12) in direct proportion to the increase in supplementation level (Figure 13.1). In contrast to our expectation, steers showed little response to supplementation during the early period (May 5 to June 9). However, considerable increase (P=.09) in gain was observed during the latter grazing period (June 10 to July 15), which resulted in the trend toward increased gain over the entire grazing period. Because the level of supplement offered was fixed, the conversion efficiencies followed the same pattern as average daily gain.

Conversion efficiency during the early grazing period was poor but improved considerably during the latter part of the intensive-early stocking period (2 lb = 5:1 and 4 lb = 6.4:1). Conversion efficiency for the entire grazing period was 11.8:1 and 9.5:1 for the 2 lb and 4 lb groups, respectively. Using a rolled milo cost of $66.00/ton, the cost of feed to put on an additional pound of gain would be $.39 and $.31 for the 2 lb and 4 lb treatment groups, respectively.

Quantity of grass remaining on loamy upland sites in the pastures after the steers were removed increased (P<.05) in direct proportion to the level of supplement fed (Figure 13.2). Similarly, grass remaining on the breaks sites were greater when cattle were supplemented. However, little difference was evident between the two levels of supplementation regarding the quantity of grass remaining in mid-July. When measured at the end of the growing season, the same patterns were evident, except that grass production on the breaks was similar for all treatments.

In contrast to observations from confinement trials,which indicated that forage intake was not affected by supplementation level, the increased quantity of grass remaining in the pastures when steers were supplemented suggests that the supplement substituted for forage to some degree and, thus, reduced grazing pressure.

The summer of 1988 was quite dry, and forage production was down approximately 40 to 50% compared to 1982-87. Reduced forage availability may have modified the supplement's influence on digestive physiology and forage intake. Research will continue in this area in order to monitor responses under various environmental conditions.

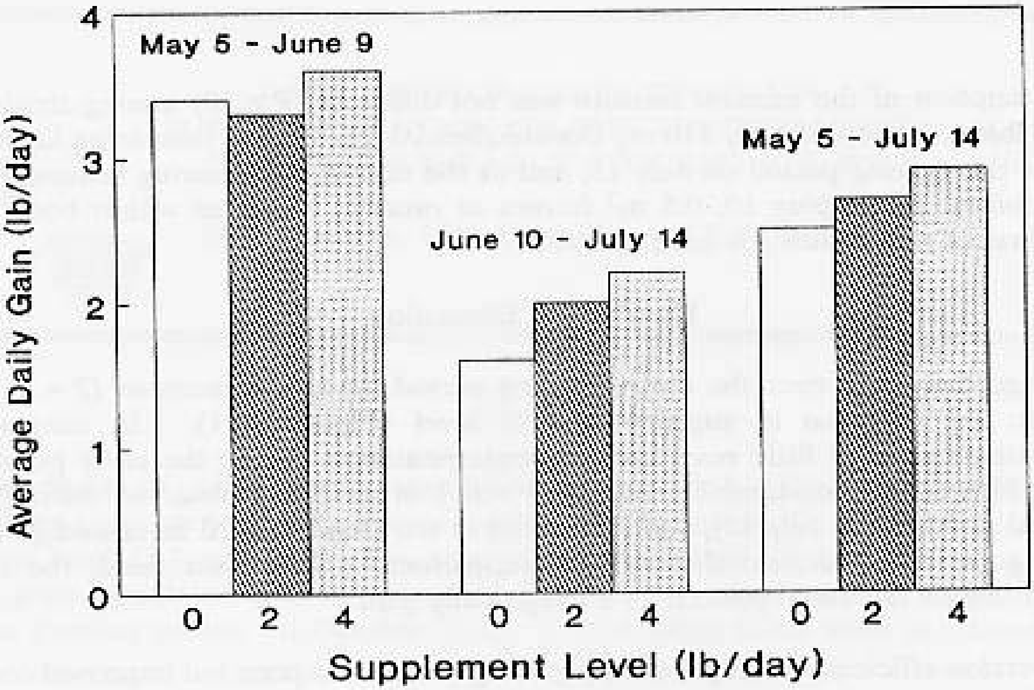

Figure 13.1. Influence of Level of Grain Supplementation on the Average Daily Gain of Intensive-early Stocked Steers (a linear increase in gain was observed with increasing supplement level; P=.09 for 6/10 - 7/14 and P=.12 for 5/05 - 7/14).

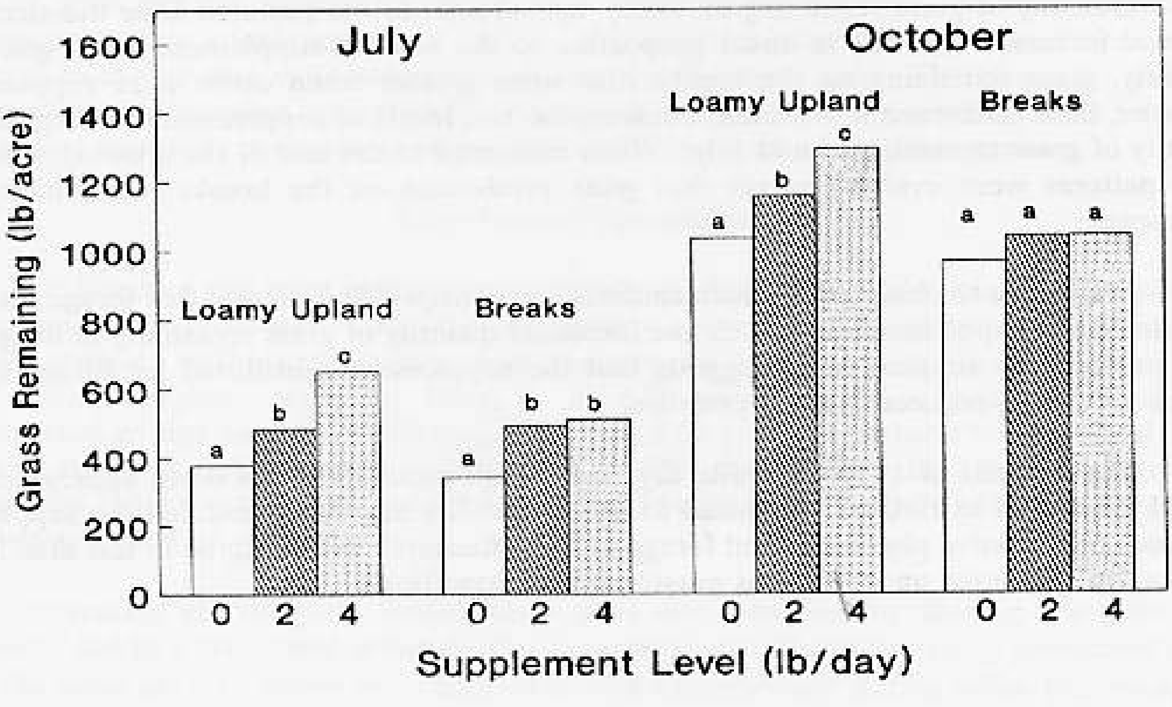

Figure 13.2. Influence of Level of Grain Supplementation on the Grass Remaining in Intensive-early Stocked Pastures at Mid-July and Early October (columns within range sites accompanied by different letters differ, P<.05).

PERFORMANCE OF STOCKER STEERS GRAZING SMOOTH BROMEGRASS AT TWO STOCKING RATES AND DEWORMED WITH MORANTEL TARTRATE[1]

K.P. Coffey, J.L. Moyer, and L.W. Lomas[2]

Summary

Early-intensive grazing of smooth bromegrass reduced animal gains but improved gain/acre. Morantel tartrate reduced fecal nematode egg counts but had no effect on animal performance at either stocking rate.

Introduction

Smooth bromegrass is a highly productive, sod-forming, perennial, cool-season grass that is adapted to most temperate climates. As much as 75% of the total seasonal yield of bromegrass generally occurs during the spring. Therefore, use of high early-season stocking rates, like those used in the Flint Hills, should improve pasture productivity. In areas of abundant rainfall, internal parasite propagation is a problem, particularly when cattle are stocked more intensively. The objectives of this experiment were to evaluate the effects on performance of early intensive grazing of smooth bromegrass, in combination with a continuous deworming program.

Experimental Procedures

One hundred twenty crossbred steers were randomly allotted by weight into six lots of 10 head or four lots of 15 head each. Each lot was assigned to one of 10, 10-acre smooth bromegrass pastures beginning on April 8. Three lots of 10 head and two lots of 15 head received morantel tartrate (MT), an antiparasite drug, in a free choice mineral mixture (Table 14.1), whereas the remaining lots received no internal parasite treatment (C). Pastures were stocked with either 1.5 steers/acre from April 8 to June 24 for the early-intensive (EI) treatment or at 1.0 steer/acre from April 8 to September 1 for the season-long (SL) treatment. Initial and final weights were determined as the mean of full weights on two consecutive days at the beginning and end of the study for each group of steers. All steers were implanted with Synovex-S at the initiation of the experiment.

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[1] Morantel tartrate and partial financial support were provided by Pfizer, Inc., Lee's Summit, MO.

[2] Southeast Kansas Branch Experiment Station.

Fecal samples were collected from half of the steers on April 8, May 20, June 24, and September 1, 1988, and fecal nematode egg counts were determined. Available forage was determined using a rising disk-meter on May 10, June 3, June 24, and July 21.

Results and Discussion

At the time EI steers were removed from pasture (June 24), SL steers were 16 lb heavier ($P<.05$) (Figure 14.1). Steers grazed season-long gained an additional 33 lb during the grazing period between June 24 and September 1, so that they were 49 lb heavier ($P<.05$) on September 1 than EI steers had been on June 24.

Steers on EI pastures produced 95 lb more ($P<.05$) beef per acre by June 24 than steers on SL pastures (Figure 14.2). Even though SL pastures were grazed 70 days longer, gain/acre on September 1 was still 62 lb greater ($P<.05$) from EI pastures.

Parasite treatment had no effect ($P>.10$) on gain per animal or per acre, possibly because of the relatively low nematode infestations observed throughout this study (Figure 14.3). Statistical differences in nematode egg counts were detected ($P<.10$) between MT and C on June 24, but the infestation in the C steers was still quite low. Other studies indicate that a parasite burden of 300 eggs/gram of feces is necessary to alter animal performance.

Forage availability at different dates is shown in Figure 14.4. These data indicate that forage availability was lower for EI steers but that adequate forage was available to the steers until they were removed on June 24.

Data from this experiment indicate that early-intensive stocking of smooth bromegrass may improve beef production per acre with minimal reductions in animal gain. The spring of 1988 was very dry in Southeast Kansas. Dry weather inhibited forage yield in the early season, which possibly hindered performance of the early intensive stocked steers. During years of higher rainfall, the early-intensively stocked steers could probably graze longer and produce more beef per acre than demonstrated here. Nematode propagation would likely be more severe during a spring with more typical rainfall, resulting in possible benefits from internal parasite control.

Table 14.1. Composition of Mineral Mixture Offered to Steers Grazing Smooth Bromegrass Pastures

Ingredient	C	MT
	------------- %	-------------
Trace mineralized salt	75.00	72.48
Dicalcium phosphate	25.00	24.28
Rumatel 88 premix (88g morantel tartrate/lb)	-	2.88

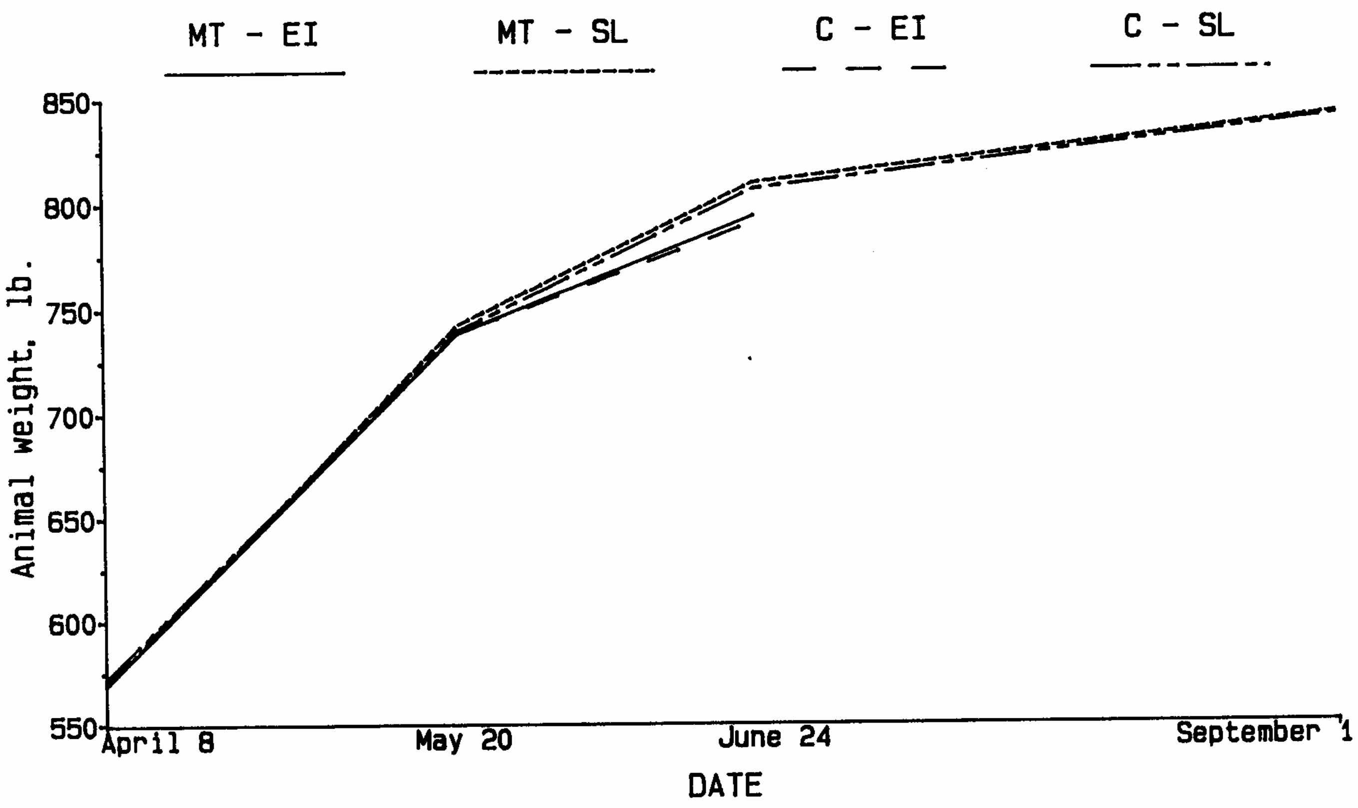

Figure 14.1. Weights of steers offered a control (C) mineral mixture or a mineral mixture containing morantel tartrate (MT) while grazing smooth bromegrass pastures that were early-intensive (EI) or season-long (SL) grazed.

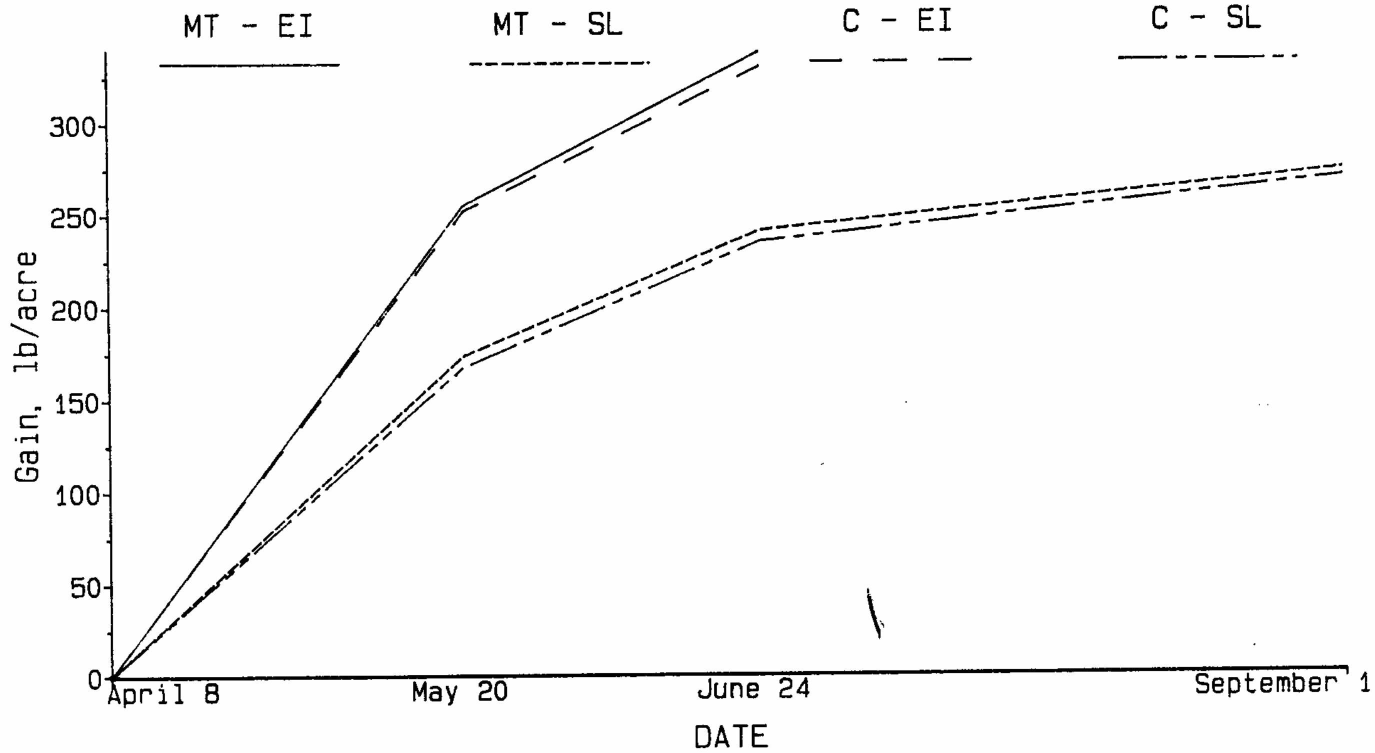

Figure 14.2. Gain per acre from smooth bromegrass pastures that were early-intensive (EI) or season-long (SL) grazed with steers offered a control (C) mineral mixture or a mineral mixture containing morantel tartrate (MT).

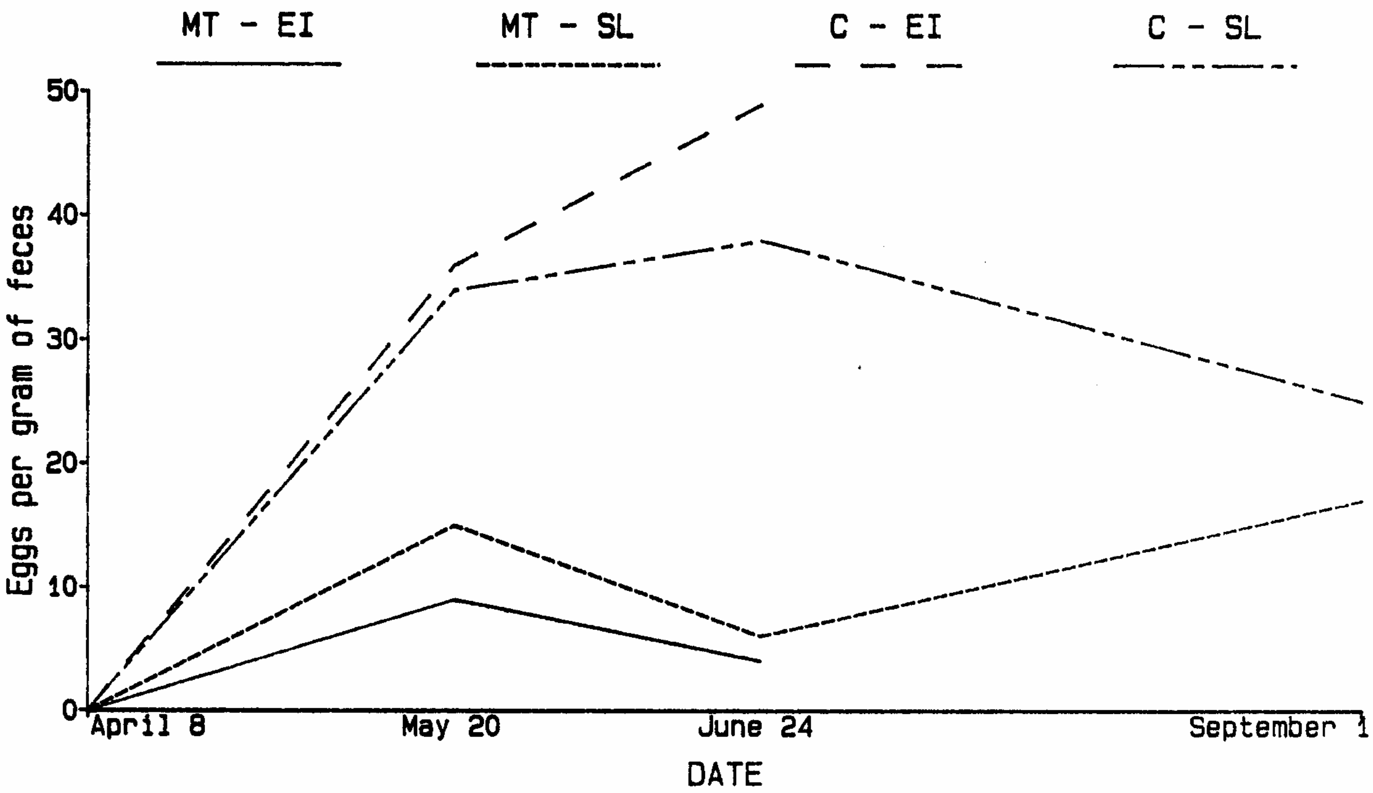

Figure 14.3. Nematode egg counts of steers offered a control (C) mineral mixture or a mineral mixture containing morantel tartrate (MT) while grazing smooth bromegrass pastures that were early-intensive (EI) or season-long (SL) grazed.

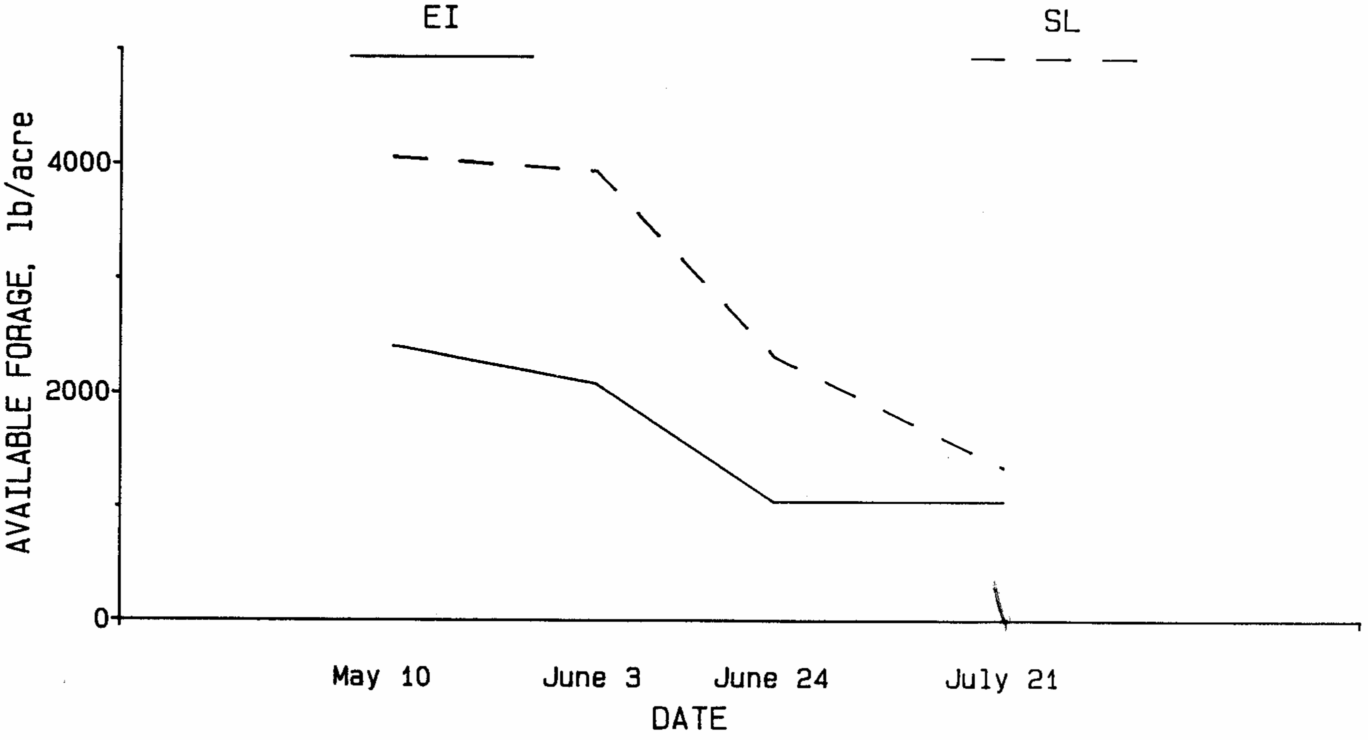

Figure 14.4. Forage availability from smooth bromegrass pastures that were either early-intensive (EI) or season-long (SL) grazed.

EVALUATION OF WHEAT MIDDLINGS AS A SUPPLEMENT FOR CATTLE CONSUMING WINTER RANGE FORAGE[1]

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R.B. Hightshoe, and T. DelCurto

Summary

Intake of dormant, bluestem-range forage was increased by feeding steers supplements based on wheat middlings or soybean meal + sorghum grain, although the degree of influence on forage intake depended on type and level of supplementation. All supplements increased ($P<.10$) total diet digestibility. However, fiber digestibility tended to be slightly lower for steers receiving the high level of wheat middlings and the soybean meal + sorghum grain supplement.

Introduction

Kansas leads the nation in quantity of wheat production (17.4% of U.S. total in 1987) and wheat flour milling (14.2% of U.S. total in 1987). Approximately 25% of the total wheat milled is left as a byproduct, frequently referred to as wheat middlings or mill feed. In 1987, 793,160 tons of wheat middlings were produced in Kansas. Wheat middlings are frequently available at very reasonable prices and are often included in range cattle supplements. However, little research has specifically documented the utility of this feedstuff as a supplement for cattle on dormant winter range. Therefore, a trial was initiated to measure forage intake and digestibility responses when cattle consuming dormant, bluestem-range forage were supplemented with either wheat middlings or soybean meal (SBM) + sorghum grain supplements.

Experimental Procedures

Sixteen ruminally cannulated, Hereford x Angus steers averaging 830 lbs were randomly assigned within weight groups to one of four treatments: 1) control (no supplement); 2) SBM + sorghum grain - 2.9 lb/head/day; 3) low level wheat middlings - 3.5 lb/head/day; 4) high level wheat middlings - 7 lb/head/day, all expressed on an as-fed basis. Preliminary analysis of crude protein concentrations in feedstuffs yielded the following: wheat middlings - 18.4%; soybean meal + sorghum grain - 18.7%; and dormant, winter-harvested, bluestem-range forage - 2.5%. The SBM + sorghum grain and the low level wheat middlings supplement were fed at equal supplemented metabolizable energy levels (3.5 Mcal/head/day). Steers were housed in individual drylot pens. Dormant bluestem was fed at 130% of each animal's previous 5 day intake. The

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[1] The authors express sincere appreciation to Mr. Gary Ritter, Mr. Wayne Adolph, and the student employees at the Range/Cow-calf Unit for their invaluable assistance in conducting this trial.

trial consisted of a 14-day adaptation period, a 7-day intake measurement period, and a 7-day total fecal collection period. Forage and grain offered, forage refusals, and fecal output were weighed and sampled daily, analyzed for dry matter, and stored for future analyses.

Results and Discussion

Intake of dormant, bluestem-range forage was increased ($P<.10$) 23% by the SBM + sorghum grain supplement and 32% by the high-level wheat middlings supplement compared with unsupplemented controls (Table 15.1). The low level of wheat middlings also tended ($P=.16$) to increase forage intake (14% increase). Because of additional supplement fed, all supplemented groups had greater ($P<.10$) total intakes than unsupplemented steers. In addition, total intake was greater ($P<.10$) for the high wheat middlings treatment than the other supplemented groups. All supplements enhanced ($P<.10$) total diet digestibility by approximately 14%. In contrast, fiber (neutral detergent fiber) digestibility, compared with that of unsupplemented steers, was slightly depressed ($P<.05$) when wheat middlings were fed at the high level. Similarly, fiber digestibility tended ($P=.14$) to be depressed in those steers supplemented with the SBM + sorghum grain supplement. The trend toward depressed fiber digestibility in the high wheat middlings group may be a result of the large increase in total intake, which would tend to reduce the length of time the digesta remained in the rumen. The improvement in forage utilization with protein supplementation in this study is consistent with previous research conducted at Kansas State. However, the degree of response was slightly less than that observed with supplements containing 25% protein or more. Additional research quantifying the optimal level for using wheat middlings in winter supplements would be useful.

Table 15.1. Influence of Supplemental Protein Sources on Intake, Diet Digestibility, and Fiber Digestibility of Dormant, Bluestem-Range Forage

	Supplement				
Item	None	SBM + Sorghum Grain	Low Wheat Middlings	High Wheat Middlings	SE[1]
Forage DM intake, lb/d	0.87^{a}	1.07^{bc}	0.99^{ac}	1.15^{b}	.10
Supplement DM intake, % BW[2]	---	0.31	0.39	0.77	
Total DM intake, % BW[2]	0.86^{a}	1.38^{c}	1.39^{c}	1.92^{b}	.06
Total DM digestibility, %	43.93^{a}	49.43^{b}	50.55^{b}	50.44^{b}	1.5
Neutral Detergent Fiber Digestibility, %	56.9^{a}	53.8^{ab}	56.1^{ab}	51.7^{b}	1.8

[1] SE = standard error (n=4).
[2] BW = body weight.
[abc] Row means without a common superscript differ ($P<.10$).

INFLUENCE OF SUPPLEMENTAL PROTEIN CONCENTRATION ON INTAKE, UTILIZATION, AND QUALITY OF DIET SELECTED BY STEERS GRAZING DORMANT TALLGRASS-PRAIRIE

T. DelCurto, R. C. Cochran, L. R. Corah,
A. A. Beharka, and E. S. Vanzant

Summary

Fifteen ruminally and 12 esophageally cannulated steers were randomly assigned to receive low (LP), moderate (MP), and high (HP) crude protein (CP) supplements in a 23-day winter grazing trial designed to evaluate dormant tallgrass forage intake and utilization. Supplemental CP levels were 13, 26, or 39%, respectively. Forage organic matter (OM) intake was greatest ($P<.05$) for the MP steers. Likewise, fiber (NDF) digestibility and ruminal fill were largest ($P<.10$) for the MP treatment. Furthermore, the quality of diet selected tended to improve with increasing supplemental protein concentration. Increasing CP concentration in supplements dramatically improves the intake and utilization of dormant forage. In this study, intake and digestibility were optimized with the MP supplement.

Introduction

Previous research at Kansas State University indicates that moderate to high levels of supplemental crude protein (CP) stimulates forage intake and utilization. Those studies were conducted in confinement with harvested dormant forage. With controlled studies simulating winter grazing conditions, however, protein supplementation often yields variable responses. Responses to supplemental protein are most likely to be observed when the CP content of forages are less than 6 to 8%. As the digestibility of forage declines, however, the availability of the CP to the microbial population and host animal also declines. Therefore, forage digestibility as well as CP content must be considered when predicting intake responses to supplemental protein.

The objective of this study was to evaluate the effect of increasing CP concentrations in supplements fed to beef steers grazing dormant, tallgrass-prairie forage.

Experimental Procedures

Fifteen ruminally and 12 esophageally cannulated Angus x Hereford steers averaging 703 and 783 lbs, respectively, were used in a randomized complete block design. Steers were blocked by weight and assigned to: 1) low protein, 13% CP supplement; 2) moderate protein, 26% CP supplement; or 3) high protein, 39% CP supplement. Low, moderate and high protein supplements were individually fed at .5% body weight and corresponded to 39.7%, 79.3%, or 119.8%, respectively, of the CP required by 700 lb yearling steers gaining .5 lb per head daily.

The forage utilization study simulated normal winter grazing conditions typical of the tallgrass prairie region. Two adjacent 10-acre pastures were used during the 23-day study.

The vegetation consisted of big bluestem (*Andropogon gerardii*), little bluestem (*Andropogon scoparius*), indiangrass (*Sorghastrum nutans*), Kentucky bluegrass (*Poa pratensis*), sedges (*Carex spp.*), and numerous other grasses and forbs. The ruminally and esophageally cannulated steers were maintained separately, but groups were rotated between pastures daily to decrease the potential for variation from differences between pastures. The 23-day trial began in mid-December and consisted of a 16-day adaptation period, 6-day fecal collection period, and complete ruminal evacuations on day 23. Esophageal collections were taken on days 17 through days 20 at 7 A.M., 10 A.M., 1 P.M., and 4 P.M.

Results and Discussion

The percentage of organic matter (OM) in forage was unaffected (P>.10) by supplement treatment (Table 16.1). Low percentage OM (83.5%) in esophageal samples reflect salivary contamination and reinforces the need to express other nutrients on an OM basis. The CP content in the forage OM selected tended to increase in direct proportion (P=.14) to increasing supplemental protein concentration. The selected diet was 8.7% CP when averaged across treatments. Similar forage harvested during winter months and fed to confined steers was less than 3% CP. Under normal grazing conditions, therefore, steers appear to select a diet substantially higher in CP than the average quality of forage available. Steers in this study may have preferentially selected Kentucky bluegrass and sedges, which are cool-season species and would have higher CP contents than the warm-season forage component. If ash contribution and acid detergent insoluble nitrogen (ADIN) are factored in, however, the CP in the forage DM falls to 5 to 6%. In addition, contamination from salivary nitrogen would be expected to elevate CP levels. Acid detergent insoluble nitrogen tended (P=.10) to decrease linearly with increasing supplemental protein and represented over 30% of the total forage nitrogen for all supplement treatments. Acid detergent lignin concentrations in forage OM were relatively unaffected (P>.10) by supplemental protein treatments. In contrast, the fiber (NDF) content in the forage OM decreased (P<.10) in direct proportion to increasing supplemental protein. Acid detergent fiber (ADF) in the grazed forage was lowest (P<.10) for the MP steers.

Forage and total OM intake increased (P<.05) with protein supplementation, with the MP steers having the highest intakes (Table 16.2). On a percent body weight basis, MP steers consumed 50% and 32% more forage than LP and HP steers, respectively. The depression in forage intake associated with the HP supplement was unexpected. In a similar study in which dormant tallgrass forage was harvested and fed to confined steers, MP steers also consumed slightly more forage than HP steers. However, both supplements supported higher intakes than the LP supplement.

Total OM digestibility tended (P=.15) to exhibit the same pattern as intake, with MP steers having the highest digestibilities. Fiber (NDF) digestibility was affected similarly (P<.10); MP steers had 37% and 29% higher NDF digestibilities than LP and HP steers, respectively. Once again, the trend toward lower digestibility in HP vs. MP supplementation was unexpected and may have been due to the trend toward higher diet quality selected by MP steers.

Total OM fill (from ruminal evacuations) followed the same trend (P<.10) as that observed for forage intake (Table 16.3). Steers fed MP supplements had 19% and 26% more fill than LP and HP steers, respectively. In contrast, indigestible fiber (APL) fill and passage were unaffected (P>.10) by supplemental protein concentration. Ruminal liquid volume tended (P=.11) to increase in direct proportion to increasing supplemental protein concentration, but rate of liquid passage was not influenced (P>.10).

In conclusion, increasing supplemental protein concentration dramatically improved the intake and utilization of dormant, tallgrass prairie forage. In this study, the steers supplemented with moderate levels of CP (26%) displayed the highest forage intake levels and fiber digestibilities.

Table 16.1. Effect of Supplemental Protein Concentration on Quality of Diet Selected by Esophageally Cannulated Steers

Item	Low Protein	Moderate Protein	High Protein	SE[a]	Contrasts[b] Linear	Contrasts[b] Quadratic
Organic Matter, %	83.1	83.6	84.0	.6	.344	.915
ADIN[c]	34.5	31.0	29.6	1.8	.102	.643
	- - % of Forage Organic Matter - -					
Crude Protein	8.26	8.76	8.94	.28	.139	.658
NDF[d]	80.7	78.5	78.9	.6	.087	.149
ADF[e]	63.6	61.3	62.3	.6	.197	.064
ADL[f]	10.5	10.2	9.6	.4	.185	.829

[a] Standard error of the means (n=4).
[b] Probability of observing a greater F-value.
[c] ADIN = acid detergent insoluble nitrogen expressed as percent of total N.
[d] NDF = neutral detergent fiber.
[e] ADF = acid detergent fiber.
[f] ADL = acid detergent lignin.

Table 16.2. Effect of Supplemental Protein Concentration on OM Intake and Digestibility in Ruminally Cannulated Steers

Item	Supplemental Protein				Contrasts[b]	
	Low Protein	Moderate Protein	High Protein	SE[a]	Linear	Quadratic
OM Intake, lb						
Forage	6.19	9.28	7.14	.84	.430	.016
Supplement	3.26	3.22	3.17			
Total	9.46	12.50	10.32	.84	.467	.016
OM Intake, % body wt:						
Forage	.87	1.31	.99	.10	.449	.033
Supplement	.47	.46	.46			
Total	1.34	1.77	1.45	.10	.487	.033
Total OMD, %[c]	43.3	48.9	44.5	2.6	.725	.152
Fiber Digestibility,%[d]	32.2	44.0	34.2	4.6	.771	.094

[a]Standard error of the means (n=5).
[b]Probability of observing a greater F-value.
[c]OMD = organic matter digestibility.
[d]Neutral detergent fiber digestibility.

Table 16.3. Effect of Supplemental Protein Concentration on Fill, Flow and Passage Rates in Ruminally Cannulated Steers

Item	Low Protein	Moderate Protein	High Protein	SE[a]	Contrasts[b] Linear	Quadratic
Total OM Fill, lb	8.2	9.7	7.7	.7	.738	.096
Indigestible Fiber (APL) Fill, lbs[c]	.44	.53	.44	.07	.847	.291
Indigestible Fiber (APL) passage, %/h[c]	3.1	3.4	3.4	.4	.557	.785
Indigestible Fiber (APL) Flow, g/h[c]	4.7	6.1	5.4	.8	.564	.308
Liquid Volume, liter	29.1	46.8	47.0	7.1	.112	.343
Dilution Rate, %/h	10.7	11.3	11.3	.6	.529	.668
Liquid Flow, liter/h	3.2	5.5	4.7	1.0	.305	.227

[a]Standard error of the means (n = 5).
[b]Probability of observing a greater F-value.
[c]Alkaline peroxide lignin (APL) was used to describe an indigestible fiber component of the diet.

SOYBEAN MEAL+MILO, ALFALFA HAY, AND DEHYDRATED ALFALFA PELLETS AS PROTEIN SOURCES FOR STEERS FED DORMANT, NATIVE TALLGRASS FORAGE IN DRYLOT

T. DelCurto, R. C. Cochran, T. G. Nagaraja,
A. A. Beharka, and E. S. Vanzant

Summary

Sixteen ruminally-cannulated steers consuming dormant tallgrass-prairie forage were randomly assigned to one of four treatments: 1) control, no supplement; 2) soybean meal (SBM)+sorghum grain; 3) alfalfa hay; or 4) dehydrated alfalfa pellets. Forage dry matter (DM) intake was at least doubled by all three supplemental protein treatments ($P<.01$). In addition, steers supplemented with dehydrated alfalfa pellets displayed 15% higher forage DM intakes than steers supplemented with SBM+sorghum grain or alfalfa hay. Total DM digestibility did not differ ($P>.10$) among treatments; however, fiber (NDF) digestibility was depressed in steers supplemented with SBM+sorghum grain or dehydrated alfalfa pellets, compared with controls. Results from this study reinforce the concept that supplemental protein improves forage intake and utilization. Additionally, alfalfa hay and dehydrated alfalfa pellets appear to be at least as effective as SBM+sorghum grain when fed on an equal protein and energy basis.

Introduction

Previous research at Kansas State University has indicated that moderate (26% CP) and high (39% CP) crude protein levels in winter supplements increase dormant, tallgrass-prairie forage intake and utilization. In addition, mature cows on such supplements during the winter grazing period lost less weight and body condition than cows supplemented with a low CP (13%) supplement. Although there is little doubt about the benefit of supplemental protein during the winter grazing period, there is a lack of information regarding specific supplemental proteins. The objective of this study was to evaluate SBM+sorghum grain, alfalfa hay, and dehydrated alfalfa pellets as supplemental protein sources for beef cattle consuming dormant, tallgrass-prairie forage.

Experimental Procedures

Sixteen ruminally-cannulated steers were blocked by weight (avg wt = 570 lbs) and randomly assigned to four treatments: 1) control, no supplement; 2) 2.5 lbs soybean meal (SBM)+sorghum grain; 3) 3.6 lbs alfalfa hay; 4) 3.5 lbs dehydrated alfalfa pellets per head per day. The supplemental protein and energy were equal in all treatments. Supplemented steers received 57% of the protein required by a 600 lb steer gaining .5 lb per head per day. Alfalfa hay and dehydrated alfalfa pellets came from third cutting, mid-bloom hay harvested on an alternate windrow basis to ensure equal forage quality in the original material before processing. Dehydration of alfalfa slightly increased the concentration of crude protein (CP) and decreased the fiber component (Table 17.1).

Steers were housed in 6' by 18' pens and had free access to water and trace-mineralized salt. At 8 A.M. daily, refused feed was removed from feed bunks, weighed, and subsampled just prior to feeding supplements. Immediately following consumption of the supplements, dormant, tallgrass-prairie forage was offered at 150% of the previous 5-day average intake. The dormant, tallgrass-prairie forage was harvested in early March and consisted of big bluestem (*Andropogon gerardii*), little bluestem (*Andropogon scoparius*), indiangrass (*Sorghastrum nutans*), and numerous other grasses and forbs. Its composition is shown in Table 17.1.

The 30-day digestion study consisted of 16-day adaptation, 7-day intake, and 7-day fecal collection periods. Ruminal contents were evacuated on day 31 at 0 and 5 hours post-supplementation.

Results and Discussion

Steers supplemented with protein at least doubled ($P<.01$) their forage dry matter (DM) intake (Table 17.2). In addition, steers supplemented with dehydrated alfalfa pellets consumed 15% more forage ($P<.10$) than steers supplemented with SBM+milo or alfalfa hay. Likewise, total DM intake was highest for supplemented steers ($P<.01$), and within supplementation treatments, total DM intake was highest ($P<.01$) for the dehydrated alfalfa group followed by alfalfa hay and SBM+milo. Total DM digestibility did not differ ($P>.10$) among treatment groups. Fiber (NDF) digestibility, however, was highest ($P<.10$) for control steers and alfalfa hay supplemented steers.

Differences in forage intake and NDF digestibility may have been related to changes in the fill and passage of digesta (Table 17.3). Dry matter fill just prior to supplementation (0 h) was higher for steers receiving dehydrated alfalfa pellets ($P<.10$) than for steers on all other treatments. By five hours post-supplementation, however, rumen DM fill was at least 75% larger in all supplemented groups compared with the unsupplemented steers ($P<.05$). Indigestible fiber (IADF) fill was similar for the 0 and 5 hour evacuations. Both alfalfa hay and dehydrated alfalfa-supplemented steers had higher ($P<.10$) IADF fills than unsupplemented steers. In contrast, IADF passage did not differ ($P>.10$) among treatment groups. The total quantity of indigestible fiber leaving the rumen per day was doubled ($P<.01$) in steers receiving supplemental protein. In addition, steers supplemented with dehydrated alfalfa displayed a 20% increase in the outflow of indigestible fiber ($P<.10$) compared to steers supplemented with SBM+sorghum grain.

Results from this experiment reinforce the concept that supplemental protein improves the intake and utilization of dormant tallgrass-prairie forage. Additionally, alfalfa hay and dehydrated alfalfa pellets appear to offer at least the same potential as SBM+sorghum grain supplements in eliciting a supplemental protein response. However, approximately 40% more of the alfalfa hay products had to be fed to offer the same level of protein as that in the SBM+sorghum grain supplement used in this study.

Table 17.1. Chemical Composition[1] of Dormant, Tallgrass-Prairie Forage and Protein Supplements

Item	Component (%)[2]				
	OM	CP	NDF	ADF	IADF
Dormant forage	93.6	2.67	80.82	52.14	33.75
Treatment supplements:					
SBM+milo	96.3	25.0	14.03	5.94	1.06
Alfalfa hay	90.3	17.0	49.45	36.77	25.41
Dehydrated alfalfa	89.8	17.4	46.16	33.44	21.32

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[1] Dry matter basis.

[2] OM = organic matter, CP = crude protein, NDF = neutral detergent fiber, ADF = acid detergent fiber and IADF = indigestible acid detergent fiber.

Table 17.2. Effect of Supplemental Protein Source on Forage Intake and Digestibility in Ruminally-Cannulated Steers

Item	Control	SBM+milo	Alfalfa hay	Dehy. alfalfa	SE[1]
DM intake, lb/d:					
Forage	2.62^{a}	5.94^{b}	5.94^{b}	6.94^{c}	.33
Supplement		2.49	3.63	3.54	
Total	2.62^{a}	8.43^{b}	9.57^{c}	10.49^{d}	.33
DM intake, % body wt:					
Forage	$.49^{a}$	1.07^{b}	1.05^{b}	1.21^{c}	.05
Supplement	---	.45	.64	.62	
Total	$.49^{a}$	1.52^{b}	1.69^{c}	1.83^{d}	.05
DM digestibility, %	42.7	46.3	49.6	44.2	2.8
Fiber digestibility, %[2]	57.3^{a}	48.5^{bc}	52.7^{ac}	45.8^{b}	2.3

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[1] Standard error of the means (n=4).

[2] Neutral detergent fiber digestibility.

[abcd] Row means without common superscript differ (P<.10).

Table 17.3. Effect of Supplemental Protein Source on Ruminal Fill, Passage and Flow Rates in Ruminally-Cannulated Steers

Item	Control	SBM+milo	Alfalfa hay	Dehy. alfalfa	SE[1]
Rumen DM fill, lb					
0 h PS[2]	5.97[a]	8.82[a]	8.87[a]	11.71[b]	1.11
5 h PS	6.71[a]	11.91[b]	12.45[b]	14.90[b]	1.23
Indigestible fiber fill, lb[3]					
0 h PS	2.44[a]	3.44[ac]	3.87[bc]	4.80[b]	.47
5 h PS	2.68[a]	3.81[ac]	4.82[bc]	5.66[b]	.48
Indigestible fiber passage, %/h[3]					
0 h PS	2.66	3.51	3.36	3.05	.30
5 h PS	2.55	3.16	2.71	2.57	.28
Indigestible fiber[3]					
Flow, g/h	26.2[a]	53.8[b]	58.8[bc]	64.9[c]	3.8

[1] Standard error of the means (n=4).

[2] Post supplementation.

[3] Indigestible acid detergent fiber (IADF) was used to describe an indigestible fiber component of the diet. Rumen DM fill, IADF fill, IADF passage and IADF flow were obtained from ruminal content evacuations 0 and 5 h post-supplementation (PS).

[abcd] Row means without common superscripts differ (P<.10).

SOYBEAN MEAL+SORGHUM GRAIN, ALFALFA HAY, AND DEHYDRATED ALFALFA PELLETS AS PROTEIN SUPPLEMENTS FOR BEEF COWS GRAZING DORMANT, TALLGRASS-PRAIRIE[1]

T. DelCurto, R. C. Cochran,
L. R. Corah, and E. S. Vanzant

Summary

Eighty-six pregnant, Hereford x Angus cows were randomly assigned to one of three winter supplement treatments: 1) soybean meal+sorghum grain, 2) alfalfa hay, or 3) dehydrated alfalfa pellets. Cows supplemented with dehydrated alfalfa pellets gained more ($P<.05$) weight during gestation and lost the least ($P<.05$) weight at calving. However, no differences ($P>.10$) were detected in cow body condition change, reproductive efficiency, or calf growth.

Introduction

Previous research at Kansas State University has indicated that moderate (26%) and high (39%) crude protein (CP) levels in winter supplements increase dormant, tallgrass-prairie forage intake and utilization. In addition, mature cows supplemented with moderate to high CP levels during the winter grazing period lost less weight and body condition than cows supplemented with a low (13%) CP supplement. High levels of supplemental protein appear to be particularly beneficial during the last trimester of gestation and early lactation. Although there is little doubt about the benefit of supplemental protein during the winter grazing period, there is little information regarding various forms of available supplemental protein. The objective of our study, therefore, was to compare SBM+sorghum grain, alfalfa hay, and dehydrated alfalfa pellets as supplemental protein sources for beef cattle grazing dormant, tallgrass-prairie forage.

Experimental Procedures

Eighty-six pregnant, Hereford x Angus cows averaging 1078 lbs were randomly assigned to one of three supplement treatments: 1) 4.7 lbs SBM+sorghum grain, 2) 6.8 lbs alfalfa hay, or 3) 6.7 lbs dehydrated alfalfa pellets per head per day (dry matter basis). The quantity of supplements fed and formulation of the SBM+sorghum grain mixture were designed to equalize daily supplemental protein and metabolizable energy. Supplements provided 69% of the CP requirement for 1100 lb nonlactating pregnant mature cows in the last third of gestation. The tallgrass vegetation consisted of big bluestem (*Andropogon gerardii*), little bluestem (*Andropogon scoparius*), indiangrass (*Sorghastrum nutans*), and numerous other grasses and forbs. Cattle were gathered each morning, separated into treatment groups, and bunk fed their respective supplements. Supplementation began in mid-November and continued until calving. The average calving date across all treatment groups was March 21, 127 days after the beginning of the trial. After calving, all cows were placed in one pasture and fed 10 lbs of alfalfa hay per head per day until the beginning of the breeding period in mid-May.

Cows were weighed following an overnight shrink on days 0, 28, 56, 84, 127 (within 48 hours postpartum), 183, and 265. All cows were scored for body condition using a 9-point scale

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[1] Appreciation is expressed to Gary Ritter, Wayne Adolph, and Tammi DelCurto for their expert assistance in data collection during this study.

(1 = extremely thin, 9 = extremely fat). Pregnancy status was determined by rectal palpation prior to the initiation of the experiment. Cows that lost calves at birth were removed from the trial. Calf average daily gain (ADG) was calculated as weight minus the birth weight, divided by the number of days since birth. Calf weights were taken within 48 hours postpartum, and on days 55 and 140 postpartum.

Results and Discussion

Cows supplemented with dehydrated alfalfa pellets gained more weight ($P<.05$) during the first 84 days than cows supplemented with SBM+sorghum grain or alfalfa hay (Figure 18.1). By day 84, cows supplemented with dehydrated alfalfa pellets had gained 41 lbs, whereas SBM+sorghum grain and alfalfa hay supplemented cows had lost 7 lbs and gained 5 lbs, respectively. In addition, dehydrated alfalfa-supplemented cows lost the least weight ($P<.05$) at calving (day 127) and just prior to breeding (day 183). By mid-August (day 265), however, all treatment groups had regained the body weight lost during the winter grazing period. In contrast, cow body condition was unaffected ($P>.10$) by supplemental treatments (Figure 18.2). Numerical trends, however, parallelled the differences in weight change. Calf birth weights and gains were unaffected ($P>.10$) by their dam's previous supplemental treatment (Table 18.1). Pregnancy rate did not differ ($P>.10$), averaging 94% across all treatment groups. Likewise, calving interval was similar ($P>.10$), averaging 361 days.

All three supplements appeared adequate, because the relative magnitude of body weight and condition loss, given the initial status of the cows in this experiment, were acceptable for cows grazing winter forage. The dehydrated alfalfa pellet supplement appeared to perform best in terms of cow weight changes, but further research is required to determine if the observed response is reproducible. Also, approximately 40% more alfalfa product was needed in order to feed an equal amount of protein and energy compared to the SBM+sorghum grain supplement.

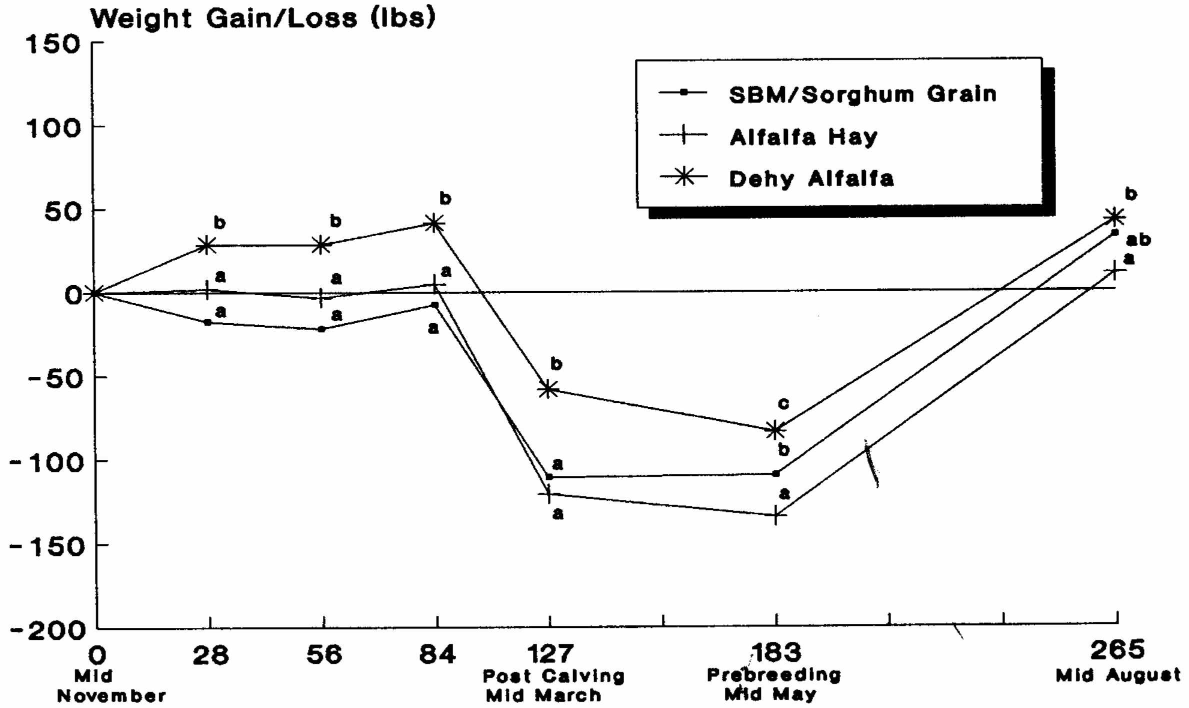

Figure 18.1. Influence of Winter Supplementation of SBM + Sorghum Grain, Alfalfa Hay, or Dehy. Alfalfa Pellets on Cow Weight Change. Differences ($P<.10$) among treatments within time periods are denoted by superscripts (a, b, c).

Table 18.1. Influence of Winter Supplementation with SBM+Sorghum Grain, Alfalfa Hay or Dehydrated Alfalfa Pellets on Subsequent Cow Reproduction and Calf Growth

Item	Soybean meal + Sorghum Grain	Alfalfa Hay	Dehydrated Alfalfa	SE[1]
No. cows	29	29	28	--
Calf birth wt, lbs	88.7	88.0	83.5	2.3
0 to 55-day calf ADG[2], lb	2.20	2.07	2.23	.05
0 to 140-day calf ADG[2], lb	2.29	2.24	2.27	.03
Pregnancy rate, %[3]	89.4	96.2	95.7	5.5
Calving interval[4]	361.5	360.9	362.0	2.3

[1] Pooled standard error of the means.

[2] ADG = average daily gain.

[3] No. of cows diagnosed pregnant by rectal palpation divided by the number of cows exposed.

[4] Length of time (days) from calving to calving the following year (based on estimated fetal age).

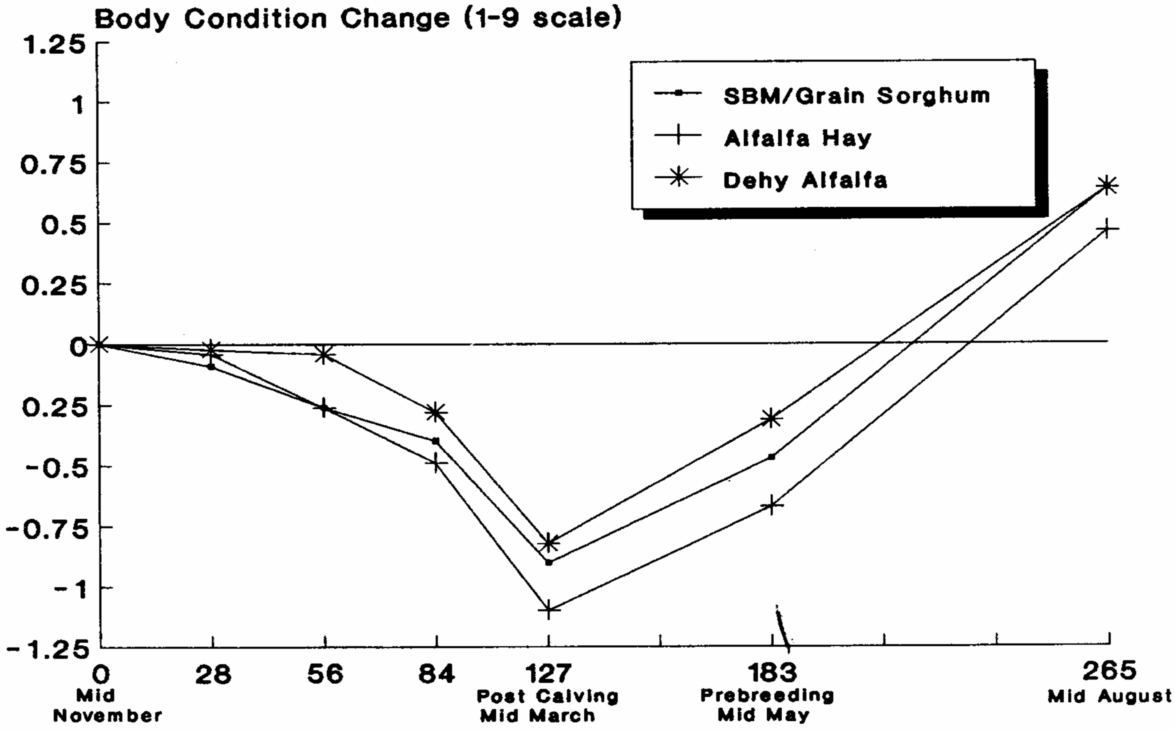

Figure 18.2. Influence of Winter Supplementation of SBM + Sorghum Grain, Alfalfa Hay, or Dehydrated Alfalfa Pellets on Cow Body Condition Change.

INFLUENCE OF RUMEN BYPASS FAT IN CATTLE SUPPLEMENTS ON FORAGE UTILIZATION[1]

R.B. Hightshoe, R.C. Cochran,
L.R. Corah, D. L. Harmon, and E.S. Vanzant

Summary

Incorporation of rumen bypass fat into a supplement to be fed with low quality forage did not affect total dry matter digestibility or ruminal dry matter fill. Similarly, no difference in digestibility was observed among types (animal vs. plant) or levels (low vs. high) of lipids used in this study. Rumen bypass fat apparently avoids the negative impact on forage utilization seen with conventional fats.

Introduction

Historically, incorporation of energy-dense fat products into cattle rations has been limited to finishing rations and diets of high-producing dairy cows. Previously, beef producers with cattle on forage-based diets have been reluctant to utilize conventional fats in supplements because of negative influences on forage utilization. The recent development of commercial rumen escape (bypass) fat offers Kansas beef cattle producers a method of increasing energy density in supplements. Two trials were conducted to evaluate how incorporation of different levels and types of bypass fat in supplements would affect forage intake and digestibility.

Experimental Procedures

<u>Forage intake trial</u>: Twenty-four Angus x Hereford heifers averaging 764 lbs were blocked by weight and randomly assigned to one of six treatments: 1) Negative Control (no supplement), 2) Positive Control (soybean meal(SBM) + sorghum grain supplement), 3) Low Megalac® (SBM + sorghum grain + 17% Megalac supplement) 4) High Megalac (SBM + sorghum grain + 34% Megalac supplement), 5) Low Alifet (SBM + sorghum grain + 15% Alifet supplement), or 6) High Alifet (SBM + sorghum grain + 30% Alifet supplement). Alifet is a crystallized natural animal fat that contains 92% crude fat and is incorporated with a neutral, starch-based carrier. Alifet has a digestible energy value of 3.34 Mcal/lb. Megalac is comprised of the calcium salts of fatty acids of plant origin and has a crude fat content of 82.5%. Megalacs' digestible energy value is 3.1 Mcal/lb, and it contains 8 to 10% calcium. All supplements were fed at 0.30% of body weight on a dry matter basis. The level of SBM was adjusted to equalize the crude protein (CP) content of the fat supplements with that of the 26% CP positive control. Because of the different digestible energy values for each of the bypass fat

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[1] The authors express sincere appreciation to Mr. Gary Ritter, Mr. Wayne Adolph, and the student employees at the Range/Cow-calf Unit for their invaluable assistance in conducting this trial.

products, supplements were balanced to equalize the energy within the two fat levels (High vs. Low). Heifers were housed in individual 6' x 8' pens. Poor quality prairie hay (4.3% CP) was ground to a length of 4 inches and fed at 130% of each animal's previous 7-day average intake. Forage and supplement offered and forage refusals were weighed and sampled daily, analyzed for dry matter, and stored for future analyses. The trial consisted of a 14-day adaptation period and a 7-day intake measurement period.

<u>Digestion trial</u>: Six Angus x Hereford steers averaging 1214 lbs were used in a 6x6 Latin square digestibility trial. Steers were randomly rotated through each of the six treatments outlined in the forage intake trial. All steers received mature brome hay (7.4% CP), which was limit fed at 1.5% of body weight. All supplements were fed at 0.30% of body weight on a dry matter basis. Diet digestibility was determined by total fecal collection. Ruminal dry matter fill was determined by ruminal evacuation.

Results and Discussion

All of the bypass fat supplements, as well as the SBM + sorghum grain supplement, stimulated increased forage dry matter intake compared with the unsupplemented heifers (Table 19.1). Animals fed the High Alifet supplement had higher (P<.02) forage dry matter intakes than those fed the High Megalac supplement. However, the forage intake of the High Alifet group was not different (P>.10) from that of the other supplemented groups. Total dry matter intake reflected a similar pattern with overall higher values being explained by supplement consumption. Total diet digestibility and ruminal dry matter fill were not different (P>.10) among treatments. Although further analysis detailing actual fiber digestibility values is necessary, it appears from the available data that the bypass fat products evaluated in this study do not decrease forage utilization. Further research is needed to determine under what conditions the Kansas beef producer can benefit from incorporating these energy-dense products into range supplementation regimens.

Table 19.1. Influence of Rumen Bypass Fat in Supplements on Forage Dry Matter Intake and Digestibility

Item	No Supplement	SBM + Sorghum Grain	Megalac		Alifet		SE[a]
			Low	High	Low	High	
Forage Intake, % body wt	1.56^{d}	2.16^{bc}	2.09^{bc}	2.03^{c}	2.14^{bc}	2.29^{b}	.07
Total Diet Intake, % body wt	1.56^{d}	2.44^{bc}	2.36^{bc}	2.30^{c}	2.41^{bc}	2.56^{b}	.07
Total Diet digestibility, %	55.3	55.9	56.4	57.5	56.4	56.7	1.2
Ruminal Dry Matter Fill, % body wt	1.21	1.27	1.16	1.28	1.34	1.23	.09

[a] SE = standard error.

[bcd] Means within a row without a common superscript differ (P<.02).

EFFECT OF INOCULANTS AND NPN ADDITIVES ON DRY MATTER RECOVERY AND CATTLE PERFORMANCE: A SUMMARY OF 22 TRIALS

K.K. Bolsen, A. Laytimi,
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Summary

Results from 22 trials comparing dry matter (DM) recovery and cattle performance of inoculated or non-protein nitrogen (NPN)-treated silages to controls were summarized using paired t-test analysis. Inoculants consistently improved DM recoveries and gains per ton of crop ensiled in both corn and forage sorghums. The use of NPN adversely affected nutrient preservation and gain per ton of crop ensiled, particularly for the wetter forage sorghums.

Introduction

Silage additives have received fairly wide acceptance in the U.S. A recently published guide[1] to over 150 commercial additives indicated that microbial inoculants were the most numerous active ingredients in the products marketed today. Inoculants should promote a faster and more efficient fermentation of the ensiled material, which would increase both the quantity and quality of the silage as fed. Urea and other non-protein nitrogen (NPN) sources have been added to low-protein crops (i.e., corn and sorghum) to increase their protein equivalent and decrease supplemental protein costs.

Research with inoculant and NPN additives using the farm-scale silos in Manhattan and at the Fort Hays and Southeast Branch Experiment Stations began about 15 years ago. Summarized here are results of 22 trials in which dry matter recovery and cattle performance from inoculant and NPN silages were compared to untreated (control) silages.

Experimental Procedures and Results

Results of corn silage trials are in Table 20.1, while results of forage sorghum silage trials are in Table 20.2. In 19 of the 22 trials, silages were made by the alternate load method. In sorghum Trials 2, 3, and 10, control and treated silages were made on consecutive days. Upright, concrete stave silos were used in all but one trial; in sorghum Trial 10 both silages were made in AgBags®. Further details of all other procedures are given in the Report of Progress listed for each trial. Products from 10 companies were used in the corn silage trials and products from eight companies in the sorghum trials.

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[1] K.K. Bolsen and J. I. Heidker, 1985. Silage Additives USA, Chalcombe Publications, 13 Highwoods Drive, Marlow Bottoms, Marlow, Berks, United Kingdom SL73PU.

Statistical analysis of the data from the 12 corn silage trials and 10 forage sorghum trials was conducted using paired t-test. Only overall mean comparisons were made between paired observations for the five criteria measured.

A summary of treatment means for control and treated silages and significance levels is shown in Table 20.3.

The 16 inoculated corn silages had a 1.45 percentage unit higher (P<.001) DM recovery compared to untreated silages and the inoculated silages supported a .07 lb faster (P<.01) daily gain and a 3.5 lb increase (P<.001) gain per ton of crop ensiled.

The addition of Cold-flo ammonia did not influence any of the five criteria in the corn silage trials (P<.05); however, there was a strong trend for both DM recovery and gain per ton of crop ensiled to be lower; 2.2 percentage units and 6.3 lb (P<.07), respectively.

When untreated and inoculated forage sorghums were compared, inoculants increased (P<.01) DM recovery, improved (P<.03) feed conversion, and produced 4.9 lb more (P<.001) gain per ton of crop ensiled. The NPN-treated forage sorghum silages had a 4.8 percentage unit lower (P<.001) DM recovery, although cattle performance was not significantly affected.

Table 20.1. Effect of Inoculants and Non-protein Nitrogen Additions on Dry Matter Recovery and Cattle Performance in 12 Trials with Corn Silages

Trial No., Year, and Rpt. of Progress No.[1]		Treatment[2]	DM Recovery[3]	Avg. Daily Gain, lb	Daily DM Intake, lb	Feed/lb of Gain, lb	Gain/Ton of Crop Ensiled, lb
1.	1978:377	Control (44,15,112)	88.7	2.15	15.6	7.28	97.3
		Sila-bac	91.7	2.15	15.9	7.41	98.2
		Silo-Best	91.3	2.15	16.4	7.68*	95.0
		Cold-flo	91.5	2.04	16.2	7.93*	91.6
2.	1979:394	Control (37,20,78)	93.3	2.46	18.9	7.72	93.7
		EnsilaPlus	94.1	2.50	19.2	7.95	91.6
		Cold-flo	88.5	2.38	19.7	8.10	84.2
3.	1980:413	Control (33,16,77)	87.3	2.94	21.1	7.17	87.9
		Silo-Best	88.7	3.00	20.3	6.77*	95.1
		Sila-ferm	87.4	3.06	20.9	6.80*	92.3
4.	1981:448	Control (36,24,110)	89.0	2.18	14.6	6.56	90.5
		1177	91.4	2.22	14.8	6.73	95.8
5.	1983:470	Control (40,24,84)	92.2	2.28	15.2	6.66	109.7
		H/M Inoculant	93.0	2.43*	15.9	6.56	112.0
6.	1984:494	Control (33,16,84)	85.5	2.29	14.7	6.43	106.5
		Silo-Best Sol.	88.6	2.30	15.1	6.53	107.2
7.	1985:514	Control (36,15,84)	91.9	2.76	18.9	6.88	106.8
		USO$_3$M	93.0	2.97	19.4	6.53	114.1
		Silo-Best Sol.	92.2	2.70	18.4	6.81	107.8
8.	1985:514[A]	Control (40,18,120)	86.6	2.00	15.8	7.88	85.3
		Garst M-74	88.1	1.99	16.5	8.29	82.7
9.	1986:539	Control (36,16,80)	90.5	2.54	16.3	6.46	113.0
		Ecosyl	92.8	2.76	17.2	6.26	119.3
10.	1986:539	Control (39,16,80)	93.0	2.53	17.0	6.77	110.6
		Biomate	93.8	2.62	17.3	6.62	113.2
		Silagest	93.9	2.71	17.0	6.30	119.8
11.	1987:567	Control (38,15,84)	94.3	1.95	15.5	7.95	94.6
		Ecosyl	95.8	2.06	15.5	7.52	101.8
12.	1987:567	Control (38,15,84)	92.5	2.26	17.1	7.55	97.7
		Biomate	93.2	2.24	15.8*	7.05	105.7
		Biomate + Cold-flo	88.2	2.25	16.8	7.48	94.2

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[1] Identifies the KAES Report of Progress which contains detailed procedures and results for each trial.

[2] In parenthesis are the percent dry matter of the pre-ensiled crop, the number of cattle per silage, and the number of days in the feeding period.

[3] As a percent of the crop dry matter ensiled.

[A] Trial conducted at the Southeast Kansas Branch Station.

*Treated silage differs from the control silage ($P<.05$).

Table 20.2. Effect of Inoculants and Non-protein Nitrogen Additions on Dry Matter Recovery and Cattle Performance in 10 Trials with Forage Sorghum Silage

Trial No., Year, and Rpt. of Progress No.[1]		Treatment[2]	DM Recovery[3]	Avg. Daily Gain, lb	Daily DM Intake, lb	Feed/lb of Gain, lb	Gain/Ton of Crop Ensiled, lb
1.	1979:394	Control (33,18,84)	91.0	1.17	12.5	10.70	64.0
		Sila-bac	90.7	1.31	12.1	9.23*	74.0
		Cold-flo	84.9	1.08	11.2*	10.34	62.2
2.	1980:413[A]	Control (30,15,81)	78.1	2.56	14.5	5.67	82.6
		Sila-bac	81.1	2.52	13.8	5.48	88.8
		LSA-100	77.2	2.75	15.1	5.49	84.5
3.	1981:427[A]	Control (29,15,70)	80.0	1.87	14.7	8.11	59.2
		LSA-100	76.0	1.96	14.0	7.22	63.1
4.	1981:427	Control (43,12,56)	84.4	1.74	12.5	7.23	70.0
		1177	87.0	1.65	11.9	7.18	72.7
		LSA-100	76.2	1.98	13.5	7.21	63.4
5.	1982:448	Control (30,15,56)	85.6	1.77	11.9	6.82	90.2
		Fermentrol	87.8	1.94*	13.0*	6.78	90.8
		Urea	83.6	1.09*	10.8*	10.08*	60.5
6.	1982:448	Control (25,18,94)	77.2	1.18	10.9	9.33	59.8
		Silo-Best	82.3	1.10	10.0*	9.13	66.2
		1177	79.1	1.20	10.8	9.02	65.1
7.	1983:470	Control (28,12,84)	86.5	1.10	11.4	11.04	69.5
		Urea	79.3	1.08	11.9	11.31	59.5
8.	1984:494	Control (33,16,56)	81.4	1.94	14.1	7.33	76.8
		USO$_3$M	81.6	1.96	13.6	6.90	81.2
9.	1987:567	Control (30,15,75)	90.8	2.07	18.4	8.94	69.8
		TriLac	91.9	2.08	18.0	8.70	72.7
10.	1987:567	Control (32,15,75)	84.3	1.71	15.0	8.82	65.7
		Silagest	85.3	1.84*	15.1	8.23*	71.1

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[1] Identifies the KAES Report of Progress which contains detailed procedures and results for each trial.

[2] In parenthesis are the percent dry matter of the pre-ensiled crop, the number of cattle per silage, and the number of days in the feeding period.

[3] As a percent of the crop dry matter ensiled.

[A] Trial conducted at the Fort Hays Branch Station.

*Treated silage differs from the control silage ($P<.05$).

Table 20.3. Summary of Treatment Means for Dry Matter Recovery and Cattle Performance from Inoculant and NPN Additions to Corn and Forage Sorghum Silages

Crop and Silage Treatment	Number of Silages	DM Recovery[1]	Avg. Daily Gain, lb	Daily DM Intake, lb	Feed/lb of Gain, lb	Gain/Ton of Crop Ensiled, lb
Corn:						
Control	12	90.35	2.42	17.10	7.09	99.8
Inoculant	16	91.8	2.49	17.25	6.99	103.3
Probability Level	--	.001	.01	NS	NS	.001
Control	3	91.5	2.29	17.20	7.52	96.3
NPN	3	89.4	2.22	17.55	7.84	90.0
Probability Level	--	NS	NS	NS	NS	.07
Forage Sorghum:						
Control	8	83.3	1.70	13.40	8.24	71.0
Inoculant	9	85.2	1.73	13.15	7.84	75.9
Probability Level	--	.01	NS	NS	.03	.001
Control	6	84.3	1.70	12.92	8.24	72.5
NPN	6	79.5	1.66	12.75	8.60	65.5
Probability Level	--	.001	NS	NS	NS	NS

[1] As a percent of the crop dry matter ensiled.

ADDITIVE-TREATED CORN AND FORAGE SORGHUM SILAGES FOR GROWING CATTLE [1,2,3,4,5,6,7]

K. K. Bolsen, A. Laytimi, R.A. Hart

F. Niroomand, and J. Hoover

Summary

Whole-plant corn silages were treated with Ecosyl® or Foraform® in one trial and Biomate® or Biomate + Cold-flo® in the second trial. In both trials, the silages were well preserved, but all were highly unstable in air during the first 3 to 4 weeks of the feed-out period. Foraform-treated silage was 2 to 6 degrees F cooler than its control, but Cold-flo-treated silage was 2 to 8 degrees F warmer during the first 10 days post-filling. Laboratory silo results showed that both control silages fermented extremely fast; however, inoculated silages had slightly lower pH and higher lactic acid values through the first 4 to 7 days post-filling. Foraform lowered the initial pH of the ensiled material, restricted subsequent fermentation, and produced a silage with about one-half the acid content compared to its control. Cold-flo raised the initial pH and delayed the start of fermentation, but resulted in a silage with greater acid content and an increased dry matter loss. Though not significant, calves fed Ecosyl, Foraform, and Biomate silages had about 6 percent better feed conversion than those fed control silages and gain per ton of crop ensiled was also higher for the three treated silages. Cold-flo-treated silage produced 3.5 lb less gain per ton of crop ensiled than its control.

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[1] Ecosyl® contains *Lactobacillus plantarum* and is a product of C-I-L, Inc., London, Ontario, Canada.

[2] Biomate® contains *Lactobacillus plantarum* and *Pediococcus cerevisiae* and is a product of Chr. Hansen's Laboratory, Inc., Milwaukee, Wisconsin.

[3] Foraform® contains ammonium tetraformate, a salt of formic acid, and is a product of BP Chemicals, LTD, London, England.

[4] TriLac® contains *Lactobacillus plantarum* and *Pediococcus cerevisiae* and is a product of Quali Tech, Inc., Chaska, Minnesota.

[5] Silagest® contains multiple strains of lactic acid bacteria and is a product of Interbio, Inc., Naperville, Illinois.

[6] Cold-flo® is a non-protein nitrogen product of USS Agri-Chemicals Division of United States Steel, Atlanta, Georgia.

[7] C-I-L, Inc.; Chr. Hansen's Laboratory, Inc.; BP Chemicals, Ltd; Quali Tech, Inc.; and Interbio, Inc. all provided partial financial assistance.

Whole-plant forage sorghums were treated with TriLac® in one trial and Silagest® in the second trial. Inoculated silages had slightly lower ensiling temperatures than controls. All silages fermented rapidly, but both inoculants increased ensiling efficiency as indicated by higher lactic to acetic acid ratios (in laboratory silos) and decreased dry matter losses (in farm-scale silos). Calves fed Silagest silage outperformed those fed control silages, and both inoculants increased gain per ton of crop ensiled over control silages.

Introduction

Corn is the nearly ideal silage crop in the US and around the world. It has a high tonnage yield, a suitable dry matter content, a high level of fermentable sugars, a low buffer capacity, and, under normal conditions, can be harvested over a 2 to 3 week period without significant loss of yield or quality. Several management practices can improve corn and sorghum silages, including harvesting at the optimum maturity and moisture, fine chopping, rapid silo filling and packing, tight sealing, and a fast feed-out rate.

Numerous silage additives are marketed for corn and other crops, and many of these have been evaluated here during the past 10 years (KAES Reports of Progress 448, 514, and 539). Our objective was to continue documenting how commercial additives affect both conservation efficiency and nutritive value of corn and forage sorghum silages. Four biological inoculants (Ecosyl, Biomate, TriLac, and Silagest) and two chemical products (Foraform and Cold-flo) were evaluated using laboratory and farm-scale silos.

Experimental Procedures

Trial 1. Three whole-plant corn silages were compared: (1) control (no additive), (2) Ecosyl®, and (3) Foraform®. All three silages were made by the alternate load method in 10 x 50 ft concrete stave silos on August 11 and 12, 1987, from Ohlde 0-230 corn harvested in the mid to full-dent stage at 38 to 39% dry matter (DM). Ecosyl was applied at the blower as a liquid and supplied an average of 1.25 x 10^5 colony-forming units (CFU) of lactic acid bacteria (LAB) per gram of crop. The corn, as harvested, contained an average of 9.5 x 10^6 CFU of indigenous LAB per gram. Foraform was applied as a liquid at the blower and at a rate of 5.0 liters per ton of crop.

Each silo was partitioned vertically into thirds as it was filled, approximately 16 tons per third. The partitions were separated by plastic mesh fencing. Five thermocouple wires were placed in the vertical center of each third, and ensiling temperatures were monitored for the first 4 weeks of storage. Twice during the filling of the stave silos, fresh forage was removed from randomly selected loads and control and treated material was ensiled in PVC laboratory silos, 18 silos each. Triplicate silos were opened at 6, 12, 24, and 48 hours and 4 and 90 days post-filling.

The farm-scale silos were opened on December 23, 1987 and emptied at a uniform rate during the following 14 weeks. Samples were taken three times weekly for DM recovery calculations and chemical analyses. Each silage was fed to 15 steer and heifer calves (three pens of five calves per silage) in an 84-day growing trial, which began on December 24, 1987. Rations were full-fed and contained 87.6% silage and 12.4% supplement on a DM basis.

Rations were formulated to provide 12.0% crude protein (DM basis); 200 mg of Rumensin® per animal daily; required amounts of calcium and phosphorus; and vitamins A, D, and E. Supplements were top-dressed and partially mixed with the silages in the bunk. Feed offered was recorded daily for each pen, and the quantity of silage fed was adjusted daily to assure that fresh feed was always available. Feed not consumed was removed, weighed, and discarded every 7 days or as necessary.

For 3 days before the start of the feeding trail, all cattle were limit-fed a forage sorghum silage ration to provide a DM intake of 1.8% of body weight. Cattle were then weighed individually on 2 consecutive days after 16 hr without feed or water. For 2 days before the final weighing, the cattle were fed their respective silage rations at a restricted DM intake of 1.8% of body weight.

Trial 2. Three whole-plant corn silages were compared: (1) control (no additive), (2) Biomate®, and (3) Biomate + Cold-flo®. Both additives were applied at the blower. Biomate supplied an average of 1.5×10^5 CFU of indigenous LAB per gram of crop and Cold-flo ammonia was added at 8.0 lb per ton of crop. The corn, as harvested, contained an average of 1.4×10^6 CFU of indigenous LAB per gram. The silages were made by the alternate load method in 10 x 50 ft concrete stave silos on August 19 and 20, 1987 from Pioneer 3183 corn harvested in the full-dent stage at 38 to 40% dry matter. Each silo was partitioned vertically into thirds as it was filled, approximately 20 to 22 tons per third. All other procedures for filling and emptying the silos and the cattle feeding period were identical to those described in Trial 1. The laboratory silos were opened at 5, 10, 20, and 40 hours and 7 and 90 days post-filling.

The cattle feeding periods for Trials 1 and 2 were conducted concurrently.

Trial 3. Two whole-plant forage sorghum silages were compared: (1) control (no additive) and (2) TriLac®. Both silages were made by the alternate load method in 10 x 50 ft concrete stave silos on September 23, 1987. The sorghum hybrid was Funk's 102F, harvested in the late-dough stage of kernel development at 30 to 32% dry matter. TriLac was applied as a liquid at the blower at 2.0 liters per ton and supplied an average of 4.6×10^5 CFU of LAB per gram of crop. The sorghum, as harvested, contained an average of 4.3×10^6 CFU of indigenous LAB per gram and 3.5×10^5 yeast and mold per gram.

Each silo was partitioned vertically into thirds as it was filled, approximately 14 to 17 tons per third. The partitions were separated by plastic mesh fencing. Five thermocouple wires were placed in the vertical center of each third. Ensiling temperatures were monitored for the first 5 weeks of storage. During the filling of the middle third of the silos, fresh forage was removed from a randomly selected load, and control and inoculated material were ensiled in PVC laboratory silos, 42 silos each. One-half of the silos from each treatment were stored at 60 F, one-half at 90 F. Triplicate silos were opened at 6, 12, 24, and 48 hours and 4, 7, and 90 days post-tilling.

Each silage was fed to 15 crossbred yearling heifers (three pens of five cattle per silage) in a 75-day growing trial, which began on March 30, 1988. Rations were full-fed and contained 87.6% silage and 12.4% supplement on a DM basis. All other procedures for the rations and feeding management were as described in Trial 1. For 3 days before the start of the feeding trial, all cattle were limit-fed a prairie hay and grain sorghum ration to provide a DM intake of 1.8% of body weight. Other weighing procedures were as described in Trial 1.

Trial 4. Two whole-plant forage sorghum silages were compared: (1) control (no additive) and (2) Silagest®. The silages were made on consecutive days (October 10 and 11, 1987) in 8 ft diameter AgBags® using a Kelly Ryan Bagger®. The sorghum hybrid was DeKalb 25E harvested in the late-dough stage at 32 to 33% dry matter. Silagest was applied as granules at the bagger at a rate of 500 grams per ton. Silagest supplied an average of 2.0×10^6 CFU of LAB per gram of crop. The forage, as harvested, contained an average of 1.4×10^5 CFU of indigenous LAB per gram and 2.9×10^5 yeast and mold per gram.

Five thermocouple wires were placed in each Ag Bag during filling and ensiling temperatures were monitored for the first 5 weeks of storage. On the first filling day, fresh forage was removed from a randomly selected load and control and inoculated material were ensiled in PVC laboratory silos, 21 silos each. Triplicate silos were opened at 6, 12, 24, and 48 hours and 4, 7, and 90 days post-filling.

All procedures for rations and cattle feeding were identical to those described in Trial 3. The cattle feeding periods for Trials 3 and 4 were conducted concurrently.

Results and Discussion

Trials 1 and 2. Ensiling temperatures are shown in Table 21.1. The initial forage temperatures ranged from 90.0 to 92.9 F in Trial 1; 84.3 to 87.8 F in Trial 2. Change from initial temperature was 1.6 to 5.7 F lower for Foraform-treated silage compared to its control, but Cold-flo addition dramatically increased ensiling temperature over its control during the first 10 days post-filling. Neither inoculant affected ensiling temperatures.

Silage fermentation dynamics for the six silages in the two trials are shown in Tables 21.2 and 21.3. Control and inoculated silages underwent very rapid fermentations, reaching a pH of 4.05 or below within the first 40 to 48 hours post-filling. Ecosyl and Biomate silages still had lower pH and higher lactic acid values at some opening times, even though the control silages fermented quickly. Inoculated and control 90-day silages had very similar chemical compositions. In Trial 1, Foraform, which breaks down in the silo to formic acid, lowered the initial pH of the ensiled material from approximately 5.8 to 4.5. The subsequent fermentation was both delayed and restricted, and the Foraform-treated silage had lower lactic and acetic acids. In Trial 2, Cold-flo raised the initial pH from approximately 6.0 to 8.7 and delayed the start of fermentation, However, by days 7 and 90 post-filling, the Biomate + Cold-flo-treated silages had 1 ½ to 2 times the level of lactic acid and much less ethanol than Biomate or control silages.

Shown in Tables 21.4 and 21.5 are DM losses and fermentation end-products for the six corn silages in the farm-scale silos. Chemical composition of these silages was consistent with results from the PVC silos. The DM loss was slightly lower for the inoculated silages in both trials; however, Cold-flo addition increased DM loss by about 4 percentage units over Biomate or control silages.

Performance by calves during the 84-day growing trials is presented in Table 21.6. Rates and efficiencies of gain were exceptional, due to the high grain content of the two corn hybrids and the mild weather during the feeding period. In Trial 1, DM intakes were similar for the three silage rations and, although calves fed Ecosyl and Foraform silages gained about 5 to 6% faster and more efficiently than those fed control, these differences were not statistically significant. In Trial 2, calves fed the three silage rations had similar gains, but those receiving Biomate silage were 6.6% more efficient than those fed control silage because of an unexpected lower feed intake coupled with nearly equal gain.

When the data for farm-scale silage recoveries (Table 21.6) were combined with cattle performance, Ecosyl, Foraform, and Biomate-treated silages produced 7.2, 6.2, and 7.9 lb more gain per ton of crop ensiled, respectively, compared to control silages. Adding Cold-flo to the inoculated silage reduced gain per ton by over 10 lb compared to Biomate silage.

Trials 3 and 4. Ensiling temperatures, as change from initial forage temperature, are shown in Table 21.7. The initial temperatures were about 84 F in Trial 3, and TriLac-treated silage was consistently 1.5 to 3.0 F cooler compared to its control during the first 7 days post-filling. Although Silagest-treated silage was always numerically cooler than its control, the treated material had a 6.0 F lower initial temperature, which could have accounted for this difference.

Silage fermentation dynamics for the silages in the two trials are shown in Table 21.8. In Trial 3, fermentation was delayed in the 60 F silages, especially during the first 24 to 48 hours post-filling. Both 90 F silages reached a pH of about 4.10 in 48 hours, while both 60 F silages did not reach pH 4.10 until 7 days. Although all four silages were well preserved, the TriLac 60 and 90 F silages had significantly lower acetic acid and ethanol values than their control counterparts. In Trial 4, both silages fermented rapidly but the Silagest-treated silage had a significantly lower pH and/or higher lactic acid content at three opening times during the first week and lower acetic acid at 90 days.

Performance by calves during the 75-day growing trials is presented in Table 21.9. TriLac and control silages supported similar performance in Trial 3, but calves fed Silagest-treated silage in Trial 4 gained faster ($P<.05$) and more efficiently ($P<.05$) than those fed control. Both inoculants increased silage DM recoveries by about 1.0 percentage unit, which increased gain per ton of crop ensiled by 3.0 lb for TriLac-treated silage and 5.4 lb for Silagest.

Table 21.1. Ensiling Temperatures as Change from Initial Temperature for Control and Treated Corn Silages in Trials 1 and 2

	Trial 1			Trial 2		
Days Post-filling	Control	Ecosyl	Foraform	Control	Biomate	Biomate + Cold-flo[1]
	- - - - - - - - - Initial Forage Temperature, F - - - - - - - - - - - -					
	92.9	90.0	91.6	84.6	84.3	87.8
	- - - - - - - - - - - Change from Initial Temperature, F - - - - - - - -					
1	+9.6	+9.3	+3.9	+7.3	+8.2	+8.8
2	+11.4	+11.0	+6.1	+10.5	+11.5	+13.5
3	+11.9	+11.6	+7.3	+11.3	+12.2	+16.3
4	+11.7	+11.8	+8.0	+11.5	+12.3	+17.3
5	+11.2	+11.8	+8.2	+11.1	+11.1	+16.9
6	+10.6	+11.6	+8.2	+11.4	+12.4	+16.8
7	+9.7	+10.7	+7.2	+10.0	+11.6	+14.7
10	+8.5	+10.0	+6.9	+9.1	+9.1	+17.2
14	+6.2	+8.8	+5.6	+7.8	+8.9	+12.0
21	+1.1	+3.1	-.1	+5.5	+7.8	+6.0
28	-1.4	-.2	-1.2	+1.1	+2.8	+2.4

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[1] Mean of only six wires, as difficulties in placing the thermocouples gave inaccurate readings for several wires.

Table 21.2. pH and Chemical Composition over Time for the Corn Silages in Trial 1

Time Post-filling and Item[1]		Replication 1: August 11			Replication 2: August 12		
		Control	Ecosyl	Foraform	Control	Ecosyl	Foraform
Initial:	pH	5.79	5.76	4.52	5.80	5.78	4.56
Hour 6:	pH	5.09	5.09	4.48	4.95	4.94	4.51
	Lactic	.44	.45	.15	.52	.63	.14
Hour 12:	pH	4.55	4.49	4.56	4.61	4.60	4.59
	Lactic	1.01	1.00	.17	1.10	1.19	.16
Hour 24:	pH	4.18	4.17	4.54	4.30	4.28	4.61
	Lactic	2.40	2.70	.15	2.34	2.40	.12
Hour 48:	pH	4.05	4.04	4.55	4.01	3.98	4.60
	Lactic	3.61	3.64	.36	3.56	3.63	.32
Day 4:	pH	3.89	3.89	4.39	3.89	3.88	4.41
	Lactic	4.27	4.77	1.10	4.47	4.74	1.58
Day 90:	pH	3.92	3.91	4.08	3.91	3.91	4.09
	Lactic	4.24	4.30	2.41	4.16	4.12	2.21
	Acetic	1.07	1.04	.45	1.01	.96	.47
	Ethanol	.87	.78	1.67	1.17	1.16	1.83
	NH_3-N	.063	.061	.117	.058	.058	.133

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[1] Acids, ethanol, and NH_3-N are reported as a % of the silage dry matter.

Table 21.3. pH and Chemical Composition over Time for the Corn Silages from the Concrete Stave Silos in Trial 2

Time Post-filling and Item[1]		Replication 1: Aug. 19			Replication 2: Aug. 12	
		Control	Biomate	Biomate + Cold-flo	Control	Biomate
Initial:	pH	5.98	5.98	8.68	5.97	5.98
Hour 5:	pH	5.31	5.31	8.63	5.79	5.75
	Lactic	.31	.33	.22	.18	.30
Hour 10:	pH	4.73	4.73	8.44	4.70	4.61
	Lactic	.56	.60	.29	.80	1.04
Hour 20:	pH	4.23	4.19	6.15	4.25	4.20
	Lactic	1.45	1.53	.90	2.44	2.61
Hour 40:	pH	3.91	3.90	4.93	3.97	3.96
	Lactic	3.63	3.75	3.46	3.76	4.33
Day 7:	pH	3.79	3.78	4.04	3.88	3.88
	Lactic	4.10	4.24	7.16	4.43	5.05
Day 90:	pH	3.81	3.79	4.00	3.91	3.91
	Lactic	5.05	5.36	7.83	6.15	6.35
	Acetic	1.27	1.19	1.11	1.96	.94
	Ethanol	1.41	1.15	.15	.88	.84
	NH_3-N	.070	.068	.494	.050	.045

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[1] Acids, ethanol, and NH_3-N are reported as a % of the silage dry matter.

Table 21.4. Dry Matter Losses and Fermentation End-products for the Corn Silages from the Concrete Stave Silos in Trial 1

Treatment and Location in the Silo		No. of Samples	DM Loss[1]	DM, %	pH	Lactic Acid	Acetic Acid	Ethanol	NH_3-N
						% of the Silage DM			
Control:	Top	11	6.89	40.78	4.17	4.27	.92	.87	.076
	Middle	16	6.10	40.41	4.10	4.45	1.33	.68	.083
	Bottom	11	4.41	37.45	4.00	4.99	1.63	.81	.077
	Avg.	38	5.80	39.60	4.09	4.57	1.30	.77	.079
Ecosyl:	Top	10	4.32	41.45	4.10	4.61	.95	.74	.070
	Middle	13	4.62	39.71	4.06	4.70	1.01	.43	.076
	Bottom	13	3.61	38.71	4.01	5.11	1.70	.52	.087
	Avg.	36	4.18	39.55	4.06	4.82	1.23	.56	.078
Foraform:	Top	11	7.17	37.59	4.15	3.52	.75	1.04	.123
	Middle	16	5.58	40.75	4.17	3.10	.53	1.14	.120
	Bottom	9	7.36	38.45	4.15	3.60	.86	1.43	.131
	Avg.	36	6.70	39.19	4.16	3.22	.68	1.16	.127

[1] Percent of the dry matter ensiled.

Table 21.5. Dry Matter Losses and Fermentation End-products for the Corn Silages from the Concrete Stave Silos in Trial 2

Treatment and Location in the Silo		No. of Samples	DM Loss[1]	DM, %	pH	Lactic Acid	Acetic Acid	Ethanol	NH_3-N
						% of the Silage DM			
Control:	Top	11	10.08	37.01	3.91	5.60	1.27	.90	.073
	Middle	12	8.94	34.77	3.78	6.06	2.61	.53	.103
	Bottom	13	3.70	36.10	3.79	5.94	3.09	1.13	.114
	Avg.	36	7.57	35.91	3.82	5.88	2.37	.86	.098
Biomate:	Top	9	9.56	35.14	3.79	5.68	1.20	1.26	.076
	Middle	12	8.59	34.50	3.80	6.07	2.52	.69	.101
	Bottom	13	3.28	35.99	3.77	6.11	3.00	.81	.110
	Avg.	34	7.14	35.26	3.78	6.00	2.35	.88	.097
Biomate + Cold-flo	Avg.	41	11.84	35.52	4.24	7.66	2.65	.23	.731

[1] Percent of the dry matter ensiled.

Table 21.6. Performance by Cattle Fed Control and Additive-treated Corn Silages in Trials 1 and 2

	Trial 1				Trial 2			
Item	Control	Ecosyl	Foraform	SE	Control	Biomate	Biomate + Cold-flo	SE
No. of Cattle	15	15	15		15	15	15	
Initial Wt., lb	568	573	567		556	567	557	
Final Wt., lb	732	746	739		746	755	746	
Avg. Daily Gain, lb	1.95	2.06	2.05	.07	2.26	2.24	2.25	.07
Daily Feed Intake, lb [1]	15.52	15.49	15.22	.40	17.08[a]	15.78[b]	16.81[ab]	.40
Feed/lb of Gain, lb [1]	7.95	7.52	7.44	.23	7.55	7.05	7.48	.23
Silage DM Recovery, % of the DM Ensiled	94.2	95.8	93.6		92.4	93.2	88.1	
Silage Fed, lb/Ton Ensiled [2]	1884	1916	1872		1848	1864	1762	
Silage/lb of Gain, lb [2]	19.92	18.82	18.58		18.91	17.63	18.70	
Cattle Gain/Ton of Crop Ensiled, lb [2]	94.6	101.8	100.8		97.7	105.7	94.2	

[1] 100% dry matter basis.

[2] Adjusted to 35% dry matter.

[a b] Means in the same row within a trial with different superscripts differ ($P<.05$).

Table 21.7. Ensiling Temperatures as Change from Initial Temperature for the Control and Inoculated Forage Sorghum Silages in Trials 3 and 4

Days Post-filling	Trial 3 Control	Trial 3 TriLac	Trial 4 Control	Trial 4 Silagest
	-------- Initial Forage Temperature, F ---------			
	83.7	84.7	72.3	66.3
	----- Change from Initial Temperature, F --------			
1	+ 8.0	+ 6.5	+ 9.5	+ 3.3
2	+ 9.4	+ 7.7	+10.1	+ 9.8
3	+11.5	+ 9.5	+ 14.7	+13.8
4	+ 12.4	+ 9.8	+ 16.5	+ 16.4
5	+ 13.0	+ 10.0	+18.1	+ 16.9
6	+ 12.7	+ 10.5	+ 17.1	+ 16.6
7	+ 12.0	+ 10.2	+ 16.3	+ 16.0
8	+ 12.2	+ 10.8	+16.1	+ 15.6
9	+ 10.2	+9.6	+ 15.8	+ 15.2
10	+ 9.3	+ 8.7	+15.1	+ 14.9
14	+ 8.4	+ 7.2	+ 14.0	+13.3
18	+ 4.0	+ 3.5	+12.1	+11.6
21	+ 2.1	+ .5	+10.1	+ 9.6
28	- 1.4	- 2.2	+ 4.8	+ 4.7
35	- 6.3	- 7.3	+ 2.5	+ 2.2

Table 21.8. pH and Chemical Composition over Time for the Control and Inoculated Forage Sorghum Silages in Trials 3 and 4

Time Post-filling and Item[1]		Trial 3				Trial 4	
		Control		TriLac			
		60F	90F	60F	90F	Control	Silagest
Initial:	pH	5.97	5.98	5.97	5.96	5.89	5.90
Hour 6:	pH	5.92	5.80	5.91	5.68[y]	5.78	5.76
	Lactic	.23	.27	.26	.30	.58	.58
Hour 12:	pH	5.91	4.78	5.79[x]	4.66[y]	5.71	5.69
	Lactic	.31	1.12	.33	1.40[y]	.57	.58
Hour 24:	pH	5.44	4.44	5.29[x]	4.34[y]	4.48	4.40[z]
	Lactic	.51	2.27	.61	2.81[y]	1.42	1.53
Hour 48:	pH	4.59	4.11	4.49[x]	4.07	4.24	4.20
	Lactic	1.25	3.90	1.49	4.18	2.61	2.63
Day 4:	pH	4.33	3.96	4.23[x]	3.95	4.07	4.01[z]
	Lactic	2.56	5.79	4.05	5.92	4.19	4.99[z]
Day 7:	pH	4.11	3.94	4.08	3.93	3.93	3.88[z]
	Lactic	4.55	5.96	4.68	6.46[y]	5.26	5.50
Day 90:	pH	3.97	3.93	3.95	3.90	3.92	3.90
	Lactic	6.04	6.33	6.24	6.56	5.98	6.25
	Acetic	1.91	1.62	1.61[x]	1.31[y]	2.40	2.20[z]
	Ethanol	.624	.740	.589	.745	2.050	2.012
	NH_3-N	.038	.049	.039	.048	.041	.042

[1] Acids, ethanol, and NH_3-N are reported as a % of the silage dry matter.

[x] Control 60 F vs. TriLac 60 F means differed (P<.05).

[y] Control 90 F vs. TriLac 90 F means differed (P<.05).

[z] Control vs. Silagest means differed (P<.05).

Table 21.9. Performance by Heifers Fed the Control and Inoculated Forage Sorghum Silages in Trials 3 and 4

Item	Trial 3		Trial 4	
	Control	TriLac	Control	Silagest
No. of Heifers	15	15	15	15
Initial Wt., lb	607	604	602	600
Final Wt., lb	762	760	730	738
Avg. Daily Gain, lb	2.07	2.08	1.71[b]	1.84[a]
Daily Feed Intake, lb[1]	18.43	18.00	15.04	15.13
Feed/lb of Gain, lb[1]	8.94	8.70	8.82[b]	8.23[a]
Silage DM Recovery, % of the DM Ensiled	90.8	92.0	84.3	85.3
Silage Fed, lb/Ton Ensiled[2]	1,816	1,840	1,686	1,706
Silage/lb of Gain, lb[2]	26.00	25.27	25.68	24.01
Cattle Gain/Ton of Crop Ensiled, lb[2]	69.8	72.8	65.7	71.1
Silage DM, %	30.11	30.19	31.97	31.92
Silage pH	4.09	4.00	3.93	3.89

[1] 100% dry matter basis.

[2] Adjusted to 30% dry matter.

[a b] Control vs. Silagest means differed (P<.05).

EFFECT OF COMMERCIAL INOCULANTS ON FERMENTATION OF 1988 SILAGE CROPS

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Introduction

We have measured silage fermentation dynamics in over 50 crops since the development of a 4 x 14 inch PVC pipe, laboratory-scale silo in 1984. In many of these experiments, our objective was to determine how inoculants or inoculant/enzyme combinations affected the rate and efficiency of the ensiling process.

Twenty-five different inoculants have been tested over a wide range of ensiling conditions. Results show that the majority of silage inoculants available today are able to supply a high number of lactic acid bacteria (LAB) and to improve silage fermentation in most crops (KAES, Reports of Progress 494, 514, and 539).

Preliminary results of 17 experiments conducted in 1988 to determine the efficacy of 12 commercial inoculants are summarized here. An additional objective in six experiments was to study the effect of numbers of LAB supplied to the crop by inoculants on fermentation response. In two alfalfa experiments, combinations of inoculant and dextrose (fermentable sugar) and inoculant and enzyme (to increase fermentable sugar) were compared.

Experimental Procedures

The 12 inoculants evaluated and active ingredients as listed by the manufacturer or distributor are shown in Table 22.1. All silages were made from crops grown near Manhattan in 1988. A description of the crops used, harvest date, stage of maturity or cutting, chemical composition, and microorganism profile are presented in Tables 22.2, 22.3, and 22.4.

The laboratory silos were 4 x 14 inch PVC pipes closed with Jim-Caps on each end. One Jim-Cap was fitted with a Bunsen valve to allow gases to escape. For filling, 100 to 125 lbs of fresh crop were placed on a plastic sheet, and the inoculant was applied and mixed thoroughly. All inoculants (and enzymes) were applied as liquids and used within 3 to 4 weeks after being received from the manufacturer. After all silage treatments were prepared, the silos were filled on an alternating schedule, which distributed the time from harvest through silo filling equally across all treatments. The silos were packed with a hydraulic press, which excluded air and filled all silos to similar densities. Silos were stored at approximately 85 F. Two or three silos per treatment were opened at various times post-filling during the first week, and end-product silages were evaluated at 90 days.

Chemical Analyses of the Pre-ensiled Crops and Silages. Pre-ensiled crops were analyzed for dry matter (DM), pH, total nitrogen, water soluble carbohydrates, acid detergent fiber, neutral detergent fiber, and buffer capacity. Silages fermented from 3 hours to 7 days were analyzed for pH and lactic acid; end-product silages were analyzed for pH, lactic acid, volatile fatty acids, ethanol, and ammonia-nitrogen.

Microbiological Evaluations. Post-harvest, pre-ensiled samples of the crops and inoculants were weighed, mixed in a high-speed blender, and diluted in sterile buffer. The following microorganism counts were made after appropriate dilutions with sterile buffer:

> Mesophilic count. That count provided an index of the number of aerobic and facultative anaerobic bacteria. Samples were added to Standard Plate Count agar (DIFCO) and incubated for 3 days at 32 C.
>
> Yeast and mold count. Potato Dextrose agar was used with tetracycline and chloramphenicol (100 ug/ml each) to kill bacteria. The plates were incubated at 21 C for 3 days.
>
> Lactic acid bacteria count. This measured the natural populations of lactic acid bacteria (LAB) present on the crops and the LAB provided by inoculants at the time they were applied to the crops. Samples were added to Bacto Lactobacilli MRS Broth to which 1.5% agar (Difco) was added and incubated 3 days at 32 C.

All counts were converted to colony-forming units per gram of crop or per gram or ml of inoculant.

Statistical Analyses. Mean responses of each inoculated crop were compared to the mean response of the untreated (control) crop by the analyses of variance procedure for a complete block design.

Summary of Results

Only a summary of the results from the 17 trials is presented here. Details from all 1987 and 1988 silage experiments will be included in a KAES bulletin to be published later this year.

Most of the commercial silage inoculants evaluated supplied a high number of lactic acid bacteria (LAB) per gram of crop--39 of 42 inoculants provided more than 10^5 (100,000) viable LAB per gram. Microorganism profiles showed that all six row crops (corn and sorghum) had at least 10^7 (10,000,000) naturally-occurring LAB per gram when ensiled. The forage crops (wheat, oats, alfalfa, and sudangrass) also had high numbers of indigenous LAB, ranging from 190,000 to 60,000,000 per gram.

As was observed in the 1987 silage crops, the whole-plant corns ensiled rapidly and all were at or below pH 4.0 by 48 hours post-filling. However all inoculants applied to corn and sorghum (Biomate, BioTal, Ecosyl, 1129, 1174, and TriLac) gave significantly lower pH values at several opening times during the first 4 days post-filling. Increasing the numbers of LAB supplied by the inoculants (BioTal or TriLac) to 1 million or more per gram, produced only a slight increase in the rate of pH decline.

Wheat, oats, and sudangrass were highly responsive to the inoculants--preliminary results showed higher lactic acid content and lower pH, acetic acid, ethanol, and ammonia-nitrogen values for inoculated vs. control silages. Increasing the numbers of LAB supplied by Biomate from 100,000 or 300,000 per gram to 500,000 or 1,000,000 did not improve the inoculant response in wheat (Trial 3) or oats and vetch (Trial 5).

In contrast to 1987 when all alfalfa silages were improved by inoculants, inoculants alone produced better silages in only two of the five 1988 alfalfa experiments (Trials 6 and 8). All eight silages in Trial 7 (both control and inoculated) were of very poor fermentation quality, with high pH values (5.3 to 5.8) and high acetic acid and ammonia-nitrogen contents (about 5.0% and .70%, respectively). Increasing the numbers of LAB supplied by the inoculants (Biomate, KemLac, Medipharm, or 1174), adding dextrose (fermentable sugar), or adding amylase enzymes in subsequent experiments (Trials 9 and 10) were much less effective in improving the fermentation than adding a combination of inoculant and dextrose. The results clearly showed the importance of having the inoculant present to achieve a rapid and efficient fermentation of the added substrate. The drought conditions likely contributed to the difficulties in successfully ensiling alfalfa in 1988.

Table 22.1. List of the 12 Inoculants Evaluated in Selected 1988 Trials, Their Manufacturer or Distributor, and Their Lactic Acid Bacteria Content

Inoculant	Manufacturer or Distributor	Lactic Acid Bacteria
AGMASTER ALFALFA SILAGE INOCULANT (AgMaster)	Marschall Products Division of Miles Laboratories, Madison, WI	*Lactobacillus plantarum* and *Pediococcus acidilactici*
SIL-ALL SILAGE INOCULANT (Sil-All)	Alltech, Nicholasville, KY	*L. plantarum, L. acidophilus,* and *Streptococcus faecium*
BIOMATE LAB CONCENTRATE (Biomate)	Chr. Hansen's Laboratory, Inc.,[1] Milwaukee, WI	*L. plantarum* and *P. cerevisiae*
BIOPOWER	BioTechniques Laboratories, Inc., Redmond, WA	*S. faecium* and *L. plantarum*
BIOTAL SILAGE INOCULANT (BioTal)	BioTal, Inc.[1] Minnetonka, MN	*L. plantarum* and *P. acidilactici*
ECOSYL	C-I-L Inc.[1], London Ontario, Canada	*L. plantarum*
KEMLAC	Kemin Industries, Inc.,[1] Des Moines, IA	*L. plantarum, L. bulgaricus,* and *L. acidophilus*
MEDIPHARM PF SOLUBLE (Medipharm)	Medipharm USA[1], Des Moines, IA	*S. faecium* M-74, *L. acidophilus, Pediococcus sp.,* and *L. plantarum*
PIONEER BRAND 1129 FORAGE SORGHUM SILAGE INOCULANT (1129)	Pioneer Hi-Bred International, Inc.,[1] Des Moines, IA	*L. plantarum* (multiple strains) and *S. faecium*
PIONEER BRAND 1174 WATER SOLUBLE SILAGE INOCULANT (1174)	Pioneer Hi-Bred International, Inc., Des Moines, IA	*L. plantarum* (multiple strains) and *S. faecium*
SI CONCENTRATE 40 A/F (SI Conc)	Great Lakes Biochemical Co., Inc., Milwaukee, WI	*L. plantarum, L. brevis, P. acidilactici, S. cremoris,* and *S. diacetylactis*
TRILAC	Quali Tech, Inc.,[1] Chaska, MN	*L. plantarum* and *P. cerevisiae*

[1] Indicates companies who provided partial financial assistance.

Table 22.2. Description, Harvest Date, Chemical Composition, and Microorganism Profile for the Crops Used in Trials 1 to 5

Item	Trial 1	Trial 2	Trial 3	Trial 4	Trial 5
	Wheat				
Variety	Siouxland	Siouxland	Arkan	Ogle Oats	Ogle & Vetch
Harvest Date, 1988	May 16	June 3	June 10	June 3	June 22
Stage of Maturity	Heading	Early-dough	Late-dough	Early-dough	Late-dough
Dry Matter, %	33.2	41.5	48.6	29.8	38.0
Water Soluble Carbohydrate, % of DM	6.0	9.4	3.9	9.1	7.2
Buffer Capacity[1]	---	18.3	34.5	28.8	23.2
Indigenous Microbes:	CFU[2]/gram of crop				
Mesophilic	1.1×10^8	3.0×10^8	8.2×10^7	1.5×10^8	2.5×10^8
Lactic Acid Bacteria	5.8×10^5	5.6×10^5	4.5×10^5	5.1×10^6	6.0×10^7
Yeast and Mold	$< 10^3$	1.0×10^5	4.1×10^4	3.6×10^3	5.5×10^4

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[1] Milliequivalents of NaOH per 100 grams of crop DM required to raise the pH of the fresh material from 4.0 to 6.0.

[2] Colony-forming units.

Table 22.3. Harvest Date, Cutting, Chemical Composition, and Microorganism Profile for the Crops Used in Trials 6 to 11

	Alfalfa					Sudangrass
Item	Trial 6	Trial 7	Trial 8	Trial 9	Trial 10	Trial 11
Hybrid/Variety	Cody	Cody	Cody	Cody	Apollo II	Trudan 6
Harvest Date, 1988	May 17	June 8	June 10	July 13	August 2	July 29
Cutting No.	1st	2nd	2nd	3rd	4th	1st
Dry Matter, %	46.6	33.9	49.5	38.1	46.5	26.6
Water Soluble Carbohydrate, % of DM	7.8	3.9	3.6	4.5	5.3	18.7
Buffer Capacity[1]	---	54.0	51.5	46.8	---	34.8
Indigenous Microbes:	CFU[2]/gram of Crop					
Mesophilic	2.3×10^7	---	---	---	5.9×10^6	1.0×10^8
Lactic Acid Bacteria	2.3×10^6	2.7×10^6	8.0×10^4	1.9×10^5	6.7×10^5	2.6×10^7
Yeast and Mold	$<10^2$	---	1.2×10^4	---	1.1×10^4	2.6×10^4

---

[1] Milliequivalents of NaOH per 100 grams of crop DM required to raise the pH of the fresh material from 4.0 to 6.0.

[2] Colony-forming units.

Table 22.4. Description, Harvest Date, Chemical Composition, and Microorganism Profile for the Crops Used in Trials 11 to 17

Item	Trial 12	Trial 13	Trial 14	Trial 15	Trial 16	Trial 17
	Whole-plant Corn				Shelled Corn	Forage Sorghum
Hybrid	Pioneer 3377	Pioneer 3379	Funk's 1505	Pioneer 3379	------	DeKalb 25E
Harvest Date, 1988	August 11	August 15	August 16	August 18	Sept. 2	Oct. 13
Stage of Maturity	2/3 Milk Line	2/3 Milk Line	Black Layer	1/3 Milk Line	Black Layer	Late-dough
Dry Matter, %	38.4	35.2	40.0	32.5	76.0	28.4
Water Soluble Carbohydrate, % of DM	------	------	5.4	13.4	-----	6.1
Buffer Capacity[1]	31.5	26.7	-----	32.6	------	28.8
Indigenous Microbes:	- - - - - - - - - - - - - - - -CFU[2]/gram of Crop - - - - - - - - - - - -					
Mesophilic	2.4×10^8	2.9×10^8	5.1×10^8	2.7×10^8	2.7×10^8	3.9×10^7
Lactic Acid Bacteria	3.6×10^7	2.8×10^7	1.2×10^7	9.7×10^6	1.3×10^7	1.1×10^7
Yeast and Mold	2.5×10^4	8.0×10^3	1.5×10^5	2.6×10^4	2.7×10^4	2.5×10^5

---

[1] Milliequivalents of NaOH per 100 grams of crop DM required to raise the pH of the fresh material from 4.0 to 6.0.

[2] Colony-forming units.

EFFECT OF FORAFORM® ON FERMENTATION OF ALFALFA, CORN, AND FORAGE SORGHUM SILAGES [1,2]

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Summary

Foraform® was evaluated in four trials using alfalfa, corn, and two forage sorghums harvested in 1987 and ensiled in PVC laboratory silos. There was a dramatic crop by Foraform interaction, with Foraform delaying and restricting the fermentations, as expected, in alfalfa and corn. In both forage sorghum hybrids, although the ensiling process was delayed about 24 hours by the Foraform treatment, end-product silages had lower pH values and equal or higher lactic acid levels than untreated silages. Foraform was effective at both 60 to 90 F temperatures in alfalfa, with treated silages having lower lactic and acetic acids, ethanol, and ammonia-nitrogen contents and higher lactic to acetic acid ratios than untreated alfalfa silages. Similar results occurred in corn, except Foraform-treated silage had a twofold higher ethanol content than control. Although overall silage fermentation in the forage sorghums was apparently not reduced by Foraform, treated silage did have higher lactic to acetic acid ratios and lower ethanol levels, which are both indications of improved preservation.

Introduction

The relatively high fermentable sugar content of corn and sorghum has often produced silages with high organic acid levels and signs of excessive heating. In contrast, the relatively low sugar content of alfalfa, when combined with high moisture conditions, can produce silages that have high pH's, high butyric acid and/or ammonia-nitrogen levels, and low intake potential and nutritive value when fed.

In the wet climatic conditions of Northern Europe, the United Kingdom, and Scandinavia, mineral (i.e., sulfuric) and organic (i.e., formic) acids have been used throughout much of the 20th century to preserve grass as silage through direct acidification. Safer, less corrosive, easier to handle forms of these "acid" additives are available, but how these "acid-salts" affect the preservation of the traditional silage crops in Kansas is not known.

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[1] Foraform contains ammonium tetraformate, a salt of formic acid, and is a product of BP Chemicals, LTD, London, England.

[2] Partial financial assistance was provided by BP Chemicals, LTD.

[3] International Commercial Development Manager, BP Chemicals, LTD.

Our objective was to determine how Foraform, a complex liquid salt of formic acid, would affect the ensiling dynamics and silage fermentation end-products of alfalfa, corn, and forage sorghum. The effect of Foraform on preservation and feeding value of corn silage is presented on page 54 of this report.

Experimental Procedures

The PVC laboratory silo used in these trials, the treatment methods, the silo-filling techniques, and the chemical and microbiological analyses were similar to those described on page 67 of this report. Foraform was applied as a liquid at 5.0 liters per ton. In Trial 1, the alfalfa was field-wilted 3 to 4 hours; temperature was approximately 80 F when ensiled. The control and Foraform-treated silos were stored at 60 and 90 F.

In all four trials, triplicate silos per treatment were opened at 12, 24, and 48 hours and 4, 7, and 90 days post-tilling.

Results and Discussion

Presented in Table 23.1 is a description of the crops, harvest dates, chemical compositions, and micoorganism profiles. Each crop was representative of those produced in the I987 growing season.

Shown in Table 23.2 are pH's, fermentation dynamics, and chemical compositions for the Foraform-treated and control silages in the four trials. Trials 1 and 2, with alfalfa and corn, produced contrasting results to Trials 3 and 4, with forage sorghums.

Foraform gave a consistent response at both 60 and 90 F in alfalfa, with treated silages having lower lactic and acetic acids, ethanol, and ammonia-nitrogen contents than untreated alfalfa. Similar results were obtained with corn--a sharply restricted fermentation and a lower total acid end-product silage. However, Foraform-treated corn silage had a twofold higher ethanol content than control.

There was a dramatic difference when Foraform was applied to the two forage sorghums. Foraform delayed and restricted the fermentations in alfalfa and corn, but end-product forage sorghum silages had lower pH values and equal or higher lactic acid levels compared to untreated controls. Although the ensiling process was delayed for only about 24 hours in the sorghums, the Foraform-treated silages underwent more efficient fermentations, as evidenced by greater lactic to acetic acid ratios and lower ethanol values.

Table 23.1. Description, Harvest Date, Chemical Composition, and Microorganism Profile for the Crops Used in Trials 1 to 4

Item	Trial 1	Trial 2	Trial 3	Trial 4
Crop	Alfalfa	Corn	Forage Sorghum	Ibag Sorghum
Hybrid/Variety	Kansas Common	Oldhe 0-230	DeKalb FS-5	Pioneer 947
Harvest Date, 1987	June 19	Aug 11 & 12	Aug 28	Sept 4
Dry Matter, %	32.5	40.1	28.8	35.2
Buffer Capacity[1]	52.6	20.2	26.6	27.7
	- - - - - - - - - - % of the Crop DM - - - - - - - - - - - -			
Crude Protein	20.7	6.3	8.3	8.4
Acid Detergent Fiber	33.7	24.7	28.0	27.2
Water Soluble Carbohydrates	5.4	7.0	8.6	8.1
<u>Indigenous Microbes:</u>	- - - - - - - - - - - - - CFU[2] /gram of Crop - - - - - - - - - -			
Mesophilic	3.8×10^7	1.6×10^8	3.4×10^7	4.4×10^7
Lactic Acid Bacteria	6.2×10^5	1.1×10^7	4.4×10^5	5.8×10^6
Yeast and Mold	7.0×10^3	6.2×10^5	5.5×10^4	4.0×10^4

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[1] Milliequivalents of NaOH per 100 grams of crop dry matter required to raise the pH of the fresh material from 4.0 to 6.0.

[2] Colony-forming units.

Table 23.2. pH and Chemical Composition over Time for the Foraform-treated and Control Silages in the Four Trials

Time Post-filling and Item[1]	Trial 1: Alfalfa[2]				Trial 2: Corn[3]		Trials 3 and 4: Forage Sorghum[3]			
	Control		Foraform				DeKalb FS-5		Pioneer 947	
	60 F	90 F	60 F	90 F	Control	Foraform	Control	Foraform	Control	Foraform
Initial:										
pH	5.5	5.95	5.05	5.05	5.78	4.48	5.92	5.36	5.93	5.24
Hour 12:										
pH	5.97	5.53	5.05	5.11	4.57	4.58^{x}	4.93	5.40	4.75	5.25
Lactic	.42	1.45	.23	.30	1.06	.17	.94	.28	1.04	.24
Hour 24:										
pH	5.63	5.39	5.11	4.94	4.24	4.63	4.40	4.92	4.64	5.04
Lactic	.76	1.71	.21	.32	2.37	.15	1.52	.57	1.87	.58
Hour 48:										
pH	5.41	5.09	5.02	4.92	4.03	4.63	4.14	4.01	4.41	4.40^{x}
Lactic	1.52	3.40	.25	.98	3.58	.34	3.02	2.86^{x}	3.68	2.70
Day 4:										
pH	5.20	4.92	5.04	4.79	3.89	4.40	3.91	3.84^{x}	4.21	4.05
Lactic	2.20	4.20	.43	1.38	4.37	1.33	5.42	5.80^{x}	4.80	5.06^{x}
Day 7:										
pH	4.95	4.82	5.02^{x}	4.60	---	---	3.85	3.83	4.18	4.01
Lactic	3.42	5.27	.88	1.96	---	---	6.84	6.34	4.70	5.24^{x}
Day 90:										
pH	4.59	4.58	4.41	4.38	3.91	4.08	3.86	3.84^{x}	4.10	3.99
Lactic	3.54	4.41	3.03	3.01	4.20	2.31	6.01	7.67	5.60	5.62^{x}
Acetic	3.78	3.23	1.37	1.41	1.04	.46	1.56	.83	1.42	1.00
Ethanol	.332	.400	.101	.093	1.020	1.750	1.579	1.046	.695	.371
NH_3-N	.269	.312	.208	.254	.060	.125	.040	.055^{x}	.071	.086

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[1] Acids, ethanol, and NH_3-N are reported as a % of the silage dry matter.

[2] Statistical analyses showed control vs Foraform means at the same temperature differed ($P<.05$), unless the Foraform mean has a superscript (x).

[3] Statistical analyses showed control vs. Foraform means within a trial differed ($P<.05$), unless the Foraform mean has a superscript (x).

EVALUATION OF INTERSEEDED GRAIN SORGHUM AND SOYBEANS AS A SILAGE CROP

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Summary

Interseeded grain sorghum and soybeans have been evaluated as a silage crop over a 3-year period. In the first 2 years, maximum dry matter (DM) yields occurred at the late-dough stage of the grain sorghum, and interseeded silages had higher crude protein (CP) and acid detergent fiber contents than non-interseeded late-dough stage, grain sorghum control silages. In year 2, seeding grain sorghum and soybeans in alternating 15-inch rows increased DM yield, CP content, and the proportion of soybean plants in the mixture compared to drilled (6-inch spacing) interseeding. Digestibilities of most nutrients were similar in all silages; however, cattle fed control silage consumed the most DM in year 1, but not in year 2.

In both years, calves fed the control silages had faster gains than those fed drilled sorghum-soybean silages. Adding grain improved gain and intake only for calves fed the interseeded silage in year 1. In year 3, seeding grain sorghum and Williams 82 soybeans in alternating rows did not increase DM yield over the drilled interseeding. However, the drilled mixture had a much higher proportion of soybean plants compared to the first two years. All mixtures had higher CP content than control grain sorghum.

Introduction

Interseeded combinations of grain sorghum and soybeans have been used as silage for dairy and beef cattle for several years in many of the southeastern states. Under good management, selected hybrids or varieties of grain sorghum and soybeans have produced as much DM per acre as corn. A series of experiments was started here in 1986 to investigate various methods of seeding these crops for optimum yield and nutritive value. Additional objectives were to determine the effects of stage of maturity at harvest and soybean variety on silage yield and quality. Preliminary results of Trials 1 and 2 in year 1 were contained in the KAES Report of Progress 539 last year.

Experimental Procedures

Trial 3: 1987-88. Field plots were planted in four replications on June 1, 1987. Grain sorghum (DeKalb 41Y) and soybeans (Pershing) were interseeded in alternate rows with a 15-inch row spacing. The mixture was harvested at the late-dough stage of the grain sorghum kernels. The other three treatments were drilled sorghum and soybeans harvested in either the milk or late-dough stages and the control grain sorghum. Biomate-inoculated material from each harvest was ensiled in pilot silos. Voluntary intakes and nutrient digestibilities were determined, using eight individually fed steers per silage.

Trial 4: 1987-88. On June 2, 1987, an additional acreage of drilled (6-inch row spacing) grain sorghum and soybeans and control grain sorghum were seeded. Each was harvested when the sorghum kernels reached the late-dough stage and ensiled in AgBags®. Each silage was full-fed for 84 days to 15 crossbred steer and heifer calves, with an initial average weight of 560 pounds.

Trial 5: 1988-89. Field plots were established in three replications on June 5, 1988. The following nine treatments are being compared: control, DeKalb 42Y grain sorghum seeded in (1) 30-inch rows, (2) 15-inch rows, and (3) 6-inch (drilled) rows; control, Williams 82 soybeans seeded in (4) 30-inch rows, (5) 15-inch rows, and (6) 6-inch (drilled) rows; DeKalb 42Y and Williams 82 interseeded in (7) alternate 15-inch rows and (8) 6-inch (drilled) rows; and (9) DeKalb 42Y and Pershing soybeans interseeded in alternate 15-inch rows. All plots that contained grain sorghum were harvested when the sorghum kernels reached the late-dough stage, and control Williams 82 plots were harvested on the same day as the respective interseeded plots.

Seeding rates, fertilizers, herbicides, and procedures for estimating the grain sorghum to soybean plant ratios used in Trials 1, 3, and 5, and nutrient digestibility and cattle growth study procedures used in Trials 1 to 4 are detailed on pages 183 and 184 of KAES Report of Progress 539 (1988).

Results and Discussion

Trial 2: 1986-87 and Trials 3 and 4: 1987-88. Effects of stage of maturity at harvest and interseeding method on DM yield, chemical composition, fermentation characteristics, and nutritive value of the four silages in Trial 3 are shown in Table 24.1. The DM yield and the proportion of soybean plants in the mixture were greatest when the two crops were interseeded in alternate 15-inch rows as compared with the two drilled (6-inch spacing) interseedings. The alternate row silage had the highest CP content, and the control grain sorghum had the lowest ADF of the four silages. Voluntary intakes and most nutrient digestibilities were similar for the four silage rations; however, DM and starch digestibilities for the alternate row silage were higher compared to those for the drilled silage at the same maturity.

Performance of calves fed the four silage rations in Trial 2 and the two silage rations in Trial 4 is shown in Table 24.2. In Trial 2, dry matter intake was greater for the two grain sorghum rations than for the two sorghum-soybean silage rations. Cattle fed the interseeded silage without grain made the slowest gains, and adding grain increased gain and intake for calves fed the interseeded silage, but not for those fed the grain sorghum silage. Feed efficiency was not affected by grain addition to either silage. Although not statistically significant, daily gain, DM intake, and feed efficiency were 17.0, 9.5, and 8.6% higher, respectively, for the grain sorghum silage.

Trials 5: 1988-89. Effects of interseeding methods on DM yield and CP content of the nine forages are shown in Table 24.3. The DM yield of the mixtures was lower than the grain sorghums for both seeding methods, and the DM yield of the grain sorghum in the 6-inch rows was higher than in the 30-inch rows. For the mixtures, DM yield of the sorghum and Pershing soybean interseeded in alternate 15-inch rows was higher than that of sorghum and Williams 82 interseeded in 6-inch rows. The proportion of soybean plants in the mixtures was much higher than in the first 2 years. Soybeans had the lowest DM yields, but the highest CP values.

Table 24.1. Yield, Plant Ratio, Chemical Composition, Fermentation Characteristics, and Nutritive Value of Sorghum-soybean and Grain Sorghum Silages in Trial 3

	Sorghum-soybean			
Item	Milk (Drilled) 6-inch Rows	Late-dough (Drilled) 6-inch Rows	Late-dough 15-inch Rows	Grain Sorghum
Harvest Date, 1987	August 17	August 23	August 22	August 22
Dry Matter, %	34.9	36.7	34.4	33.0
DM Yield, Tons/Acre	3.74	4.02	4.48	4.93
Sorghum : Soybean Whole-plant Ratio	3.1:1	5.3:1	2.2:1	---
Silage pH	4.08	4.11	4.12	4.13
	----------------------------	---% of the Silage DM---	----------------------------	
Crude Protein	12.8^b	11.9^c	14.0^a	10.7^d
Acid Detergent Fiber	28.5^a	28.4^a	29.1^a	23.7^b
Lactic Acid	6.10^a	6.59^a	6.23^a	5.02^b
Acetic Acid	2.09	2.53	3.12	3.07
Ammonia-nitrogen	.14^b	.13^b	.13^b	.16^a
DM Recovery, % of the DM Ensiled	96.9	95.0	94.0	90.8
No. of Steers	8	8	8	8
Initial Wt., lb	681	681	679	676
Daily DM Intake, lb	15.47	14.90	14.37	15.18
	----------------------------	---Ration Digestibility, %---	----------------------------	
Dry Matter	69.6^a	67.4^b	70.5^a	69.5^a
Crude Protein	70.6	65.4	68.6	69.3
Starch	79.3^a	66.7^b	79.5^a	73.3^a
Acid Detergent Fiber	60.2	57.5	61.5	61.7

^{abcd}Means on the same line with different superscripts differ ($P<.05$).

Table 24.2. Performance of Calves Fed Sorghum-soybean and Grain Sorghum Silage Rations in Trials 2 and 4

	Trial 2				Trial 4	
	Sorghum-soybean[1]		Grain Sorghum		Sorghum-soybean	Grain Sorghum
Item	w/o	w	w/o	w	w/o	w/o
No. of Calves	8	8	8	8	15	15
Avg. Daily Gain, lb	1.75^{b}	2.08^{a}	2.13^{a}	2.28^{a}	1.72	2.03
Daily Feed Intake, lb[2]	14.81^{c}	17.52^{b}	19.83^{a}	19.32^{a}	16.33	17.85
Feed/lb of Gain, lb[2]	8.74	8.45	9.29	8.56	9.50	8.80
Silage Analysis:						
Dry Matter, %	46.6		42.7		39.2	38.0
pH	4.61		4.16		4.18	3.93
	--------------------------------% of the Silage DM------------------------------					
Crude Protein	9.1		8.8		12.3	9.1
Acid Detergent Fiber	36.4		23.6		32.3	24.6
Lactic Acid	5.77		4.46		6.86	6.29
Acetic Acid	2.52		1.57		1.67	1.30
Ethanol	.20		.39		.32	.37
Ammonia-nitrogen	.31		.10		.14	.11

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[1] w/o = 87.6% silage and 12.4% supplement; w = 62.6% silage, 25.0% dry-rolled grain sorghum, and 12.4% supplement (DM basis).

[2] 100% dry matter basis.

[abc] In Trial 2, means on the same line with different superscripts differ ($P<.05$).

Table 24.3. Yield, Plant Ratio, and Dry Matter and Protein Contents of Sorghum-soybean, Grain Sorghum, and Soybean Silages in Trial 5

Hybrid/variety and Planting Method	Harvest Date, 1988	Dry Matter, %	DM Yield, Tons/Acre	GS:SB Ratio[1]	Crude Protein, %
					(DM basis)
DeKalb 42Y					
1. 30-inch Rows	Aug. 24	34.7	4.77^{b}	---	11.5^{c}
2. 15-inch Rows	Aug. 25	33.2	4.95^{ab}	---	11.5^{c}
3. 6-inch Rows	Aug. 25	32.0	5.24^{a}	---	11.0^{c}
Williams 82					
4. 30-inch Rows	Aug. 26	32.7	2.72^{e}	---	21.2^{a}
5. 15-inch Rows	Aug. 26	32.9	2.92^{e}	---	21.9^{a}
6. 6-inch Rows	Aug. 29	33.7	2.18^{f}	---	20.9^{a}
DeKalb 42Y and Williams 82					
7. 15-inch Rows	Aug. 25	35.4	3.99^{cd}	1.8:1	15.4^{b}
8. 6-inch Rows	Aug. 29	33.8	3.58^{d}	1.6:1	16.6^{b}
DeKalb 42Y and Pershing					
9. 15-inch Rows	Aug. 26	35.4	4.21^{c}	1.8:1	15.2^{b}

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[1] Grain sorghum (GS) to soybean (SB) whole-plant ratio (DM basis).

[abcdef] Means in the same column with different superscripts differ ($P<.05$).

INFLUENCE OF PLANT PARTS ON *IN VITRO* DRY MATTER DISAPPEARANCE OF FORAGE SORGHUM SILAGES

J. White and K.K. Bolsen

Summary

Five mid- to late- season forage sorghum hybrids were used to plot the changes in silage *in vitro* dry matter disappearance (IVDMD) when their proportions of grain, leaf, sheath, and stalk were altered. The average IVDMD of the parts were: grain 76.9%, leaf 57.7%, sheath 52.7%, and stalk 60.8 percent. The grain proportion had a large positive effect on silage IVDMD dynamics, whereas the sheath plant part had a negative effect.

Introduction

Historically, Kansas has been the leading state in forage sorghum silage production. Forage sorghum silage is often the feed of choice for producers who are over-wintering cows and stockers. Numerous studies indicate that grain sorghum silage is nutritionally superior to forage sorghum silage. It has a higher protein content and is more digestible than forage sorghum silage. Our previous trials have shown that only high-grain producing forage sorghum hybrids approach the feeding value of grain sorghum hybrids when they are fed in high-silage growing rations.

This experiment was conducted to examine the influence of the grain fraction on the in vitro dry matter disappearance (IVDMD) of forage sorghum silages. It was hypothesized that the IVDMD of the silage would be the sum of the IVDMD of the ensiled plant parts. Our objectives were to: 1) monitor changes in IVDMD as the ensiled plant parts were blended to comprise various proportions of the reconstituted silage dry matter; 2) develop regression equations to predict the IVDMD of forage sorghum silages based on plant part ratios; and 3) determine which plant part(s) concentrations would be the most useful criteria when selecting for improved silage digestibility.

Experimental Procedures

Five mid- to late-season forage sorghum hybrids were planted on June 3, 1987 and grown under dryland conditions on a Smolan silty clay loam soil near the Kansas State University campus in Manhattan. The hybrids included were Cargill 455, DeKalb 25E, Funk's 102F, Golden Acres-TE Silomaker, and Northrup King 300. One month prior to planting, 100 lb/acre of anhydrous ammonia was applied. A pre-plant soil test indicated that phosphorus and potassium were adequate. Furdan 15G® (Carbofuran, 1.0 lb/acre) was applied in the furrow at planting, and Atrazine® (2.5 lb/acre) was used as the pre-plant herbicide. Cygon (Dimethoate, .5 lb/acre) was used to control greenbugs, spider mites, and grasshoppers. A randomized complete block design with three replications was used, with each plot containing six rows, 30 inches apart and 200 feet in length.

All plots were harvested at the hard-dough state of kernel maturity. Stage of maturity was determined by visual and physical evaluation of several heads per plot. Silage yield was determined by harvesting three inside rows of each plot with a precision forage chopper. Grain yield was determined by clipping all heads from a random 60 foot section of the remaining inside row of each plot and threshing the heads in a stationary thresher. Three subsamples of five plants each were taken from the remaining inside row at harvest to determine plant part ratios. Plants were cut 2 inches above the soil surface, separated into grain, leaf blade (removed at the collar), sheath (removed at the node), and stalk. Separated materials were manually chopped to about 3/8-inch in length. Samples containing l/4 to l/2 pound of separate plant parts were then placed in nylon bags with a pore size of 1 mm. The nylon bags containing the plant part samples were ensiled along with their respective whole-plant material in plastic-lined, 55 gallon pilot silos, with two silos per hybrid. The silos were stored at outside ambient temperature for 120 to 135 days prior to opening. At opening, the nylon bags were recovered for chemical analyses. The pH was determined on the individual plant part samples and the surrounding silage. Samples were dried in a forced air oven at 130 F for 72 hours and then ground in a Wiley mill to pass a 1 mm screen.

The IVDMD of each silage sample was determined in triplicate. Earlier research in our laboratory (KAES Report of Progress 539) has shown a high correlation between silage IVDMD and *in vivo* apparent dry matter digestibility. To determine IVDMD dynamics for sorghum hybrids having different proportions of plant parts, each of the five forage sorghum silages and plant parts within each hybrid were combined in such a way that the samples had a specific plant part increased in 50 mg increments from the initial infield proportion to 1.0. These samples were adjusted to weigh 500 mg of DM ± 10 mg and were digested in duplicate. The IVDMD of each plant part of each hybrid was determined in triplicate.

Using plant part ratio data, the silages of the hybrids were reconstituted using the ensiled plant parts. The reconstituted silage IVDMD was determined in triplicate. The summation IVDMD of a hybrid was calculated by multiplying the proportion of the DM per part by the IVDMD of the respective part and then adding the four values.

Results and Discussion

Agronomic data for the five forage sorghum hybrids are shown in Table 25.1. The hybrids reached half bloom 71 to 77 days after planting and were harvested 108 to 118 days after planting (data not shown). Silomaker had the lowest grain yield, and NK 300 had the lowest silage yield. There were no significant differences among the hybrids for the proportion of the whole-plant DM as leaf or sheath. DeKalb 25E had the highest proportion of stalks and the highest forage to grain ratio.

All whole-plant silages and ensiled plant parts were well preserved, as indicated by the terminal pH values of approximately 4.0 and no observed spoilage or off odors (Table 25.2). The pH values of the grain were the highest. There were significant differences among the hybrids for IVDMD of the ensiled plant parts (Table 25.3). For all hybrids, the grain proportion had the highest IVDMD, whereas the sheath had the lowest. Our data suggest that increasing the grain proportion of forage sorghum would improve silage digestibility to a greater extent than increasing leaf proportion in forage sorghum hybrids.

The effects of increasing the proportion of each ensiled plant part in the reconstituted silages on IVDMD response are shown in Figures 25.1 to 25.4. For all silages, plots of IVDMD against increasing proportions of grain were positive (Figure 25.1), whereas plots of IVDMD against the proportion of sheath were negative (Figure 25.2). Plots of IVDMD against proportion of leaf (Figure 25.3) and stalk (Figure 25.4) produced less variation than did those against grain or sheath.

Only small differences in IVDMD were observed among the whole-plant silages, but significant differences in IVDMD occurred among the ensiled plant parts. These data indicate that the IVDMD of a forage sorghum silage is not the sum of the IVDMD of its ensiled plant parts. However, the IVDMD of the reconstituted silages were very close to the sum of the IVDMD of the ensiled plant parts (Table 25.4). There appeared to be an associative effect, i.e., a non-linear IVDMD response, when ensiled plant parts were blended to various proportions of the reconstituted silages. The proportion of grain in an ideal forage sorghum hybrid would be limited by such associative effects. Other research has demonstrated that 15 to 30% grain in a sorghum grain and silage-based ration increased digestibility and DM intake, but higher proportions of grain (45 to 60%) did not result in further improvement.

Regression equations were generated for predicting the influence of plant parts on the IVDMD of each of the live hybrids (Table 25.5). In all cases, grain entered the model first, providing additional evidence that the proportion of grain in forage sorghum hybrids has the greatest influence on the subsequent IVDMD of the whole-plant silage.

Table 25.1. Dry Matter Yields and Plant Part Percentages of the Five Forage Sorghum Hybrids

	DM Yield		Plant Part			
Hybrid	Grain	Silage	Grain	Leaf	Sheath	Stalk
	- - Tons/Acre - -		--- % of the Whole-plant DM - - -			
Cargill 455	2.9^{a}	8.8^{a}	37.1^{ab}	20.8	12.4	29.5^{bc}
DeKalb 25E	2.7^{a}	9.2^{a}	28.2^{a}	21.0	10.7	40.1^{d}
Funk’s 102F	2.9^{a}	8.2^{b}	37.4^{ab}	21.0	12.7	28.9^{bc}
GA-TE Silomaker	2.4^{b}	8.0^{b}	39.9^{ab}	21.5	13.3	25.3^{abc}
NK 300	2.8^{a}	7.7^{b}	41.3^{b}	22.9	17.0	19.5^{ab}
LSD (P = .05)	.21	.50				
SE			4.42	1.78	1.99	2.30

[abcd] Means within a column with different superscripts differ (P<.05).

Table 25.2. pH Values for the Whole-plant and Plant-part Silages of the Five Forage Sorghum Hybrids

Hybrid	Whole-plant	Plant Part			
		Grain	Leaf	Sheath	Stalk
		-----------------pH-----------------			
Cargill 455	4.06^{c}	4.32^{ab}	4.18^{c}	4.02^{b}	4.10^{b}
DeKalb 25E	3.88^{a}	4.42^{a}	4.04^{a}	3.97^{a}	3.80^{a}
Funk’s 102F	4.07^{c}	4.36^{abc}	4.22^{d}	4.26^{d}	4.16^{c}
GA-TE Silomaker	3.98^{b}	4.41^{bc}	4.28^{e}	4.16^{c}	4.14^{bc}
NK 300	4.06^{c}	4.68^{d}	4.10^{b}	4.06^{b}	4.24^{d}
SE	.011	.017	.010	.012	.013

^{abcde} Means within a column with different superscripts differ (P<.05).

Table 25.3. IVDMD of the Plant-part Silages of the Five Forage Sorghum Hybrids

Hybrid	Plant Part			
	Grain	Leaf	Sheath	Stalk
	------------- % of the DM --------------			
Cargill 455	72.4^{aw}	56.6^{by}	49.0^{az}	60.8^{bx}
DeKalb 25E	77.5^{bw}	61.4^{cx}	54.2^{by}	60.4^{bx}
Funk’s 102F	78.2^{bw}	56.5^{aby}	53.2^{by}	55.3^{ay}
GA-TE Silomaker	77.3^{bw}	60.1^{bcy}	57.2^{cz}	65.3^{cx}
NK 300	79.2^{bw}	54.0^{ay}	49.6^{az}	62.2^{bx}
Mean	76.9^{bw}	57.7^{by}	52.7^{bz}	60.8^{bx}
SE	-------------1.03---------------			

^{abcd} Means within a column with different superscripts differ (P<.05).
^{wxyz} Means on the same line with different superscripts differ (P<.05).

Table 25.4. IVDMD of Whole-plant Silage, Reconstituted Silage, and the Sum of the Plant Parts

Hybrid	Whole-plant Silage	Reconstituted Silage	Sum of the Plant Parts Silage
	- - - - - - - - - - - - - - - **% of the DM-**	- - - - - - - - - - - - -	
Cargill 455	58.4^{by}	63.3^{bz}	62.8^{z}
DeKalb 25E	58.2^{by}	66.4^{az}	64.8^{z}
Funk’s 102F	58.8^{by}	63.4^{bz}	63.8^{z}
GA-TE Silomaker	61.5^{ay}	67.7^{az}	67.9^{z}
NK 300	61.7^{ay}	63.9^{bz}	65.6^{z}
SE	.238	.662	

^{ab}Means within a column with different superscripts differ (P<.05).
^{yz}Means on the same line with different superscripts differ (P<.05).

Table 25.5. Regression Equations for Predicting Silage IVDMD of the Five Forage Sorghum Hybrids

Hybrid	Intercept	Grain	Leaf	Sheath	Stalk	SE	R^2
Cargill 455	54.9	14.5	---	-7.8	1.6	.49	.97
DeKalb 25E	55.2	19.1	---	-4.0	.2	1.03	.89
Funk’s 102F	50.9	27.2	2.4	---	---	.77	.95
GA-TE Silomaker	53.2	20.1	3.7	---	1.1	1.40	.77
NK 300	50.8	30.4	----	-1.9	9.3	1.04	.95

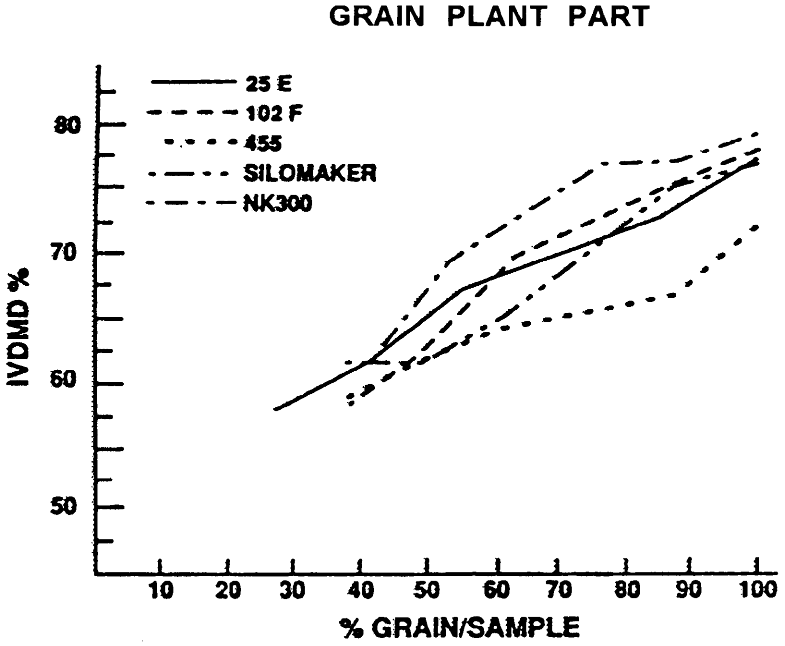

Figure 25.1. Effect of Increasing the Proportion of Grain in the Reconstituted Silages on IVDMD.

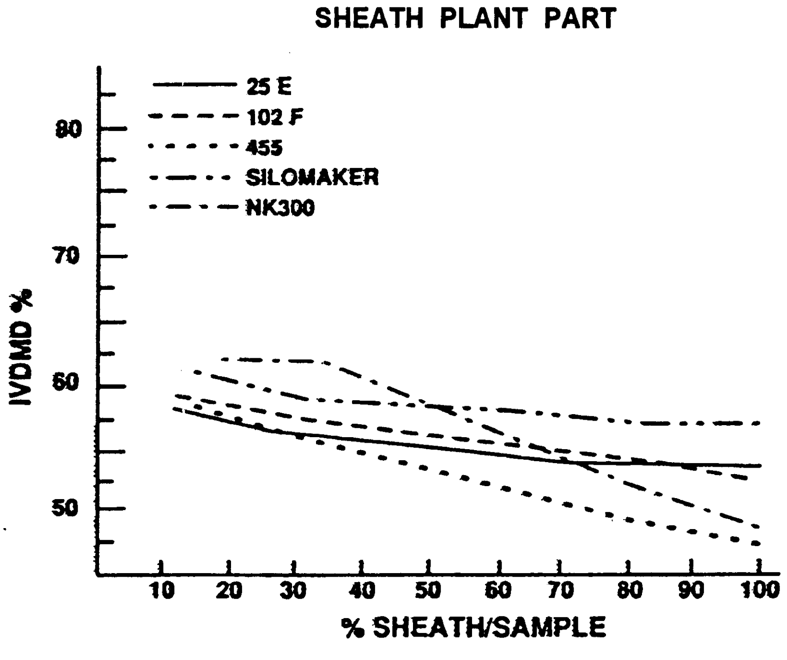

Figure 25.2. Effect of Increasing the Proportion of Sheath in the Reconstituted Silages on IVDMD.

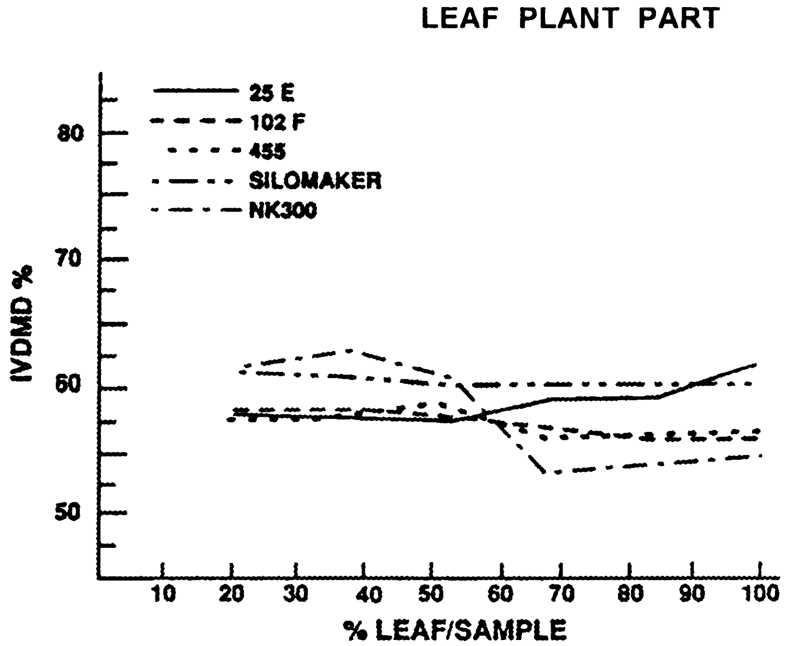

Figure 25.3. Effect of Increasing the Proportion of Leaf in the Reconstituted Silages on IVDMD.

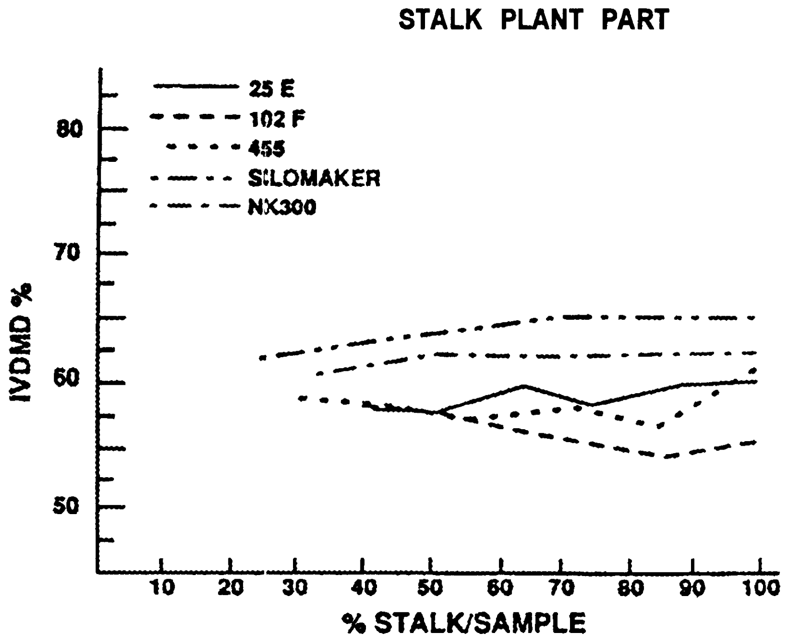

Figure 25.4. Effect of Increasing the Proportion of Stalk in the Reconstituted Silages on IVDMD.

NEAR-INFRARED REFLECTANCE SPECTROSCOPY CALIBRATIONS FOR SORGHUM SILAGE

P.C. Dubois, G. Garcia,
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Summary

Calibrations for near-infrared reflectance spectroscopy (NIRS) analysis of sorghum silage and sheep feces samples were developed, with mixed success. For sorghum silage, the standard errors of calibration (SEC) and correlation coefficients of calibration (R^2) for crude protein (CP) were .405% and .927; for acid detergent fiber (ADF), 1.667% and .943; and for neutral detergent fiber (NDF), 1.589% and .964, respectively. The statistics for crude protein were not as good as similar work reported in the literature, but the data for the fiber components was as good as or better than similar reported work.

For sheep feces, the SEC and R^2 for CP were .300% and .949; for ADF, 1.438% and .875; and for NDF, 2.016% and .846, respectively. These statistics are similar to other reports. Calibration should improve as we add more calibration samples.

Introduction

Research at Kansas State University generates thousands of varied samples annually. The feasibility of incorporating NIRS analysis into research on sorghum silages and sheep feces generated by sorghum silage digestion trials is being investigated. Successfully implementing NIRS analysis has the potential of saving large amounts of time and money.

An NIRS unit was recently acquired, along with calibration software. The calibrations purchased include those for grass hay, mixed hay, legume hay, small grain silage, corn silage, and mixed feed. Since those calibrations were developed using calibration sets with laboratory data acquired elsewhere, they needed to be verified under our conditions. In NIRS terminology, the equations needed to be re-biased.

The corn silage and hay equations were all successfully biased to our laboratory reference methods, and they satisfactory predict protein and fiber. However, the small grain silage calibration, which was developed using a wide variety of silages, including wheatlage, oatlage, and ryelage, failed to work satisfactorily with sorghum silages (Table 26.1), even after biasing. Thus, we wanted to develop a calibration specifically for sorghum silages. In addition, a calibration was developed for sheep feces from sorghum silage digestion trials. Successful application of such a calibration would allow considerable time and cost savings.

Experimental Procedures

Two hundred seventy forage and grain sorghum silages were collected from K-State research plots from four different growing seasons, encompassing a wide range of growing conditions and cultivars. One hundred six sheep feces samples were collected from three separate forage and grain sorghum digestion trials. These samples had previously been ground with a Wiley mill through a 1 mm screen. To minimize particle size effects, all the samples were re-ground with a Udy cyclone mill through a 1 mm screen.

The samples were then scanned with a Pacific Scientific 4250 NIR scanner, equipped with three tilting filters that provide a continuous scan (291 data points) from 1900 to 2320 nm. The spectral data were stored as Log 1/R, where R is percent reflectance. The data were analyzed using software purchased with the instrument, and samples with similar spectral data were grouped, allowing selection of calibration sets with maximum spectral variability. Fifty-one sorghum silage samples and 31 fecal samples were selected from the two groups for use as calibration samples. In addition, 37 silage, and 14 fecal samples were randomly selected for validation.

The selected samples were then analyzed for dry matter (DM), crude protein (CP), acid detergent fiber (ADF), and neutral detergent fiber (NDF) according to Association of Official Agricultural Chemists procedures, with very tight restrictions on replications to ensure precise laboratory data. Despite this, one or two laboratory values were omitted for some of the constituents because of poor replication, even after re-runs. A summary of the laboratory data for the calibration and validation sets of sorghum silage and feces is shown in Table 26.2.

The laboratory values were compared (via the software) with the spectral data for each of the samples in both calibration and validation sets. Multiple step-wise linear regression was then used to select the wavelengths and coefficients in the equations that provided the best statistics: highest R^2 and lowest standard error of calibration (R^2 and SEC) and highest R^2 and standard error of prediction (R^2 and SEP). The "best" equations for each of the constituents for both silage and feces were then stored into system equation files, for use in subsequent routine analysis.

Results and Discussion

Calibration and validation results for sorghum silage and fecal matter are listed in Table 26.3. The sorghum silage calibration we generated contains five wavelengths for both CP and ADF and six wavelengths for NDF. This high number indicates the complexity of the problem and is consistent with research conducted elsewhere with similar forages. The calibration equation worked well with the group of unknowns used for validation. The correlations and standard errors of prediction were very close to those of calibration, indicating that the equations adequately predict composition of the validation samples. However, a SEP of ± .417% for protein is higher than expected and needs more work. The correlation coefficients and standard error terms for both ADF and NDF are acceptable, considering the variability and nature of these two measures.

For the fecal calibration, the relatively small sample set had a negative effect on the resulting calibration. Generally, a minimum of 40 to 50 samples is needed for a calibration set. Eight to 10 samples are needed per term in the equation. With only 31 samples in our calibration set, this limited the maximum number of terms to three to four and may have hindered our ability to calibrate for a substance as complex as fiber. With the exception of the NDF numbers, however, the statistics are similar to those in the literature. The low R^2 and high SEP for NDF in the validation set (.697 and 2.459%, respectively) could be partially explained by the size of the validation set. A small validation set (n=14) is susceptible to outliers, and the bias value of 1.14 (Table 26.3) indicates that it might contain one or two fairly large outliers. Although the calibration is generally sound, we expect improvement as more calibration samples are added.

Table 26.1. Analysis of Sorghum Silage Validation Set Using Pacific Scientific Small Grain Silage Calibration[a]

Item[b]	n	SEP, %	R^2	Bias, %
CP	37	.850	.725	-.35
ADF	35	3.943	.858	1.33
NDF	37	4.438	.764	.50

[a] Calibration previously biased for DM, CP, ADF, and NDF using 40 sorghum silages and 10 rye silages.

[b] CP = crude protein, ADF = acid detergent fiber, NDF = neutral detergent fiber.

Table 26.2. Composition[a] of Sorghum Silage and Sheep Fecal Matter as Determined by Standard Laboratory Methods

	Calibration Set				Validation Set			
Item[b]	n	Mean	SD, %	Range	n	Mean	SD, %	Range
Sorghum Silage								
CP	51	6.86	1.57	3.62-12.10	37	6.66	1.49	3.68- 9.28
ADF	49	32.71	7.00	19.78-50.50	35	33.89	6.58	21.47-48.50
NDF	50	51.94	8.41	35.25-73.25	37	52.96	8.12	39.94-71.95
Fecal Matter								
CP	31	12.19	1.33	9.50-14.68	14	12.38	0.80	10.80-13.89
ADF	30	39.02	4.07	30.08-45.83	13	40.26	3.40	35.04-43.84
NDF	30	64.90	5.13	52.59-73.09	14	67.06	2.19	64.30-71.08

[a] All data reported on 100% dry matter basis.

[b] CP = crude protein, ADF = acid detergent fiber, NDF = neutral detergent fiber.

Table 26.3. Sorghum Silage and Sheep Fecal Matter Calibration and Validation Data for NIRS[a] Analysis

	Calibration Set					Validation Set			
Item[b]	n	WL[c]	Math[d]	SEC (%)[e]	R2[f]	n	SEP (%)[g]	R2[h]	Bias (%)
Sorghum Silage									
CP	51	5	1	.405	.927	37	.417	.934	.03
ADF	49	5	2	1.667	.943	35	1.752	.928	-.16
NDF	50	6	1	1.589	.964	37	1.838	.960	-.26
Fecal Matter									
CP	31	4	1	.300	.949	14	.298	.874	.07
ADF	31	4	2	1.438	.875	13	1.532	.797	-.21
NDF	30	4	1	2.016	.846	14	2.459	.697	1.14

[a] NIRS = near infrared reflectance spectroscopy.
[b] CP = crude protein, ADF = acid detergent fiber, NDF = neutral detergent fiber.
[c] Number of wavelengths (terms) in calibration equation.
[d] Mathematical treatment of spectral data: 1 = first derivative, 2 = second derivative.
[e] Standard error of the calibration group (SEC).
[f] Correlation coefficient of calibration.
[g] Standard error of prediction (corrected for bias) (SEP).
[h] Correlation coefficient of NIR predicted vs. lab values.

DIETARY FAT AND CALCIUM LEVEL EFFECT ON FEEDLOT PERFORMANCE AND CARCASS MERIT IN STEERS[1]

B. Bock, R.T. Brandt, Jr., and D.L. Harmon

Summary

Feeding fat increased feed intake and average daily gain, but feed efficiency was not affected. Feeding high levels of calcium (.9%) had no overall effect, but may tend to increase intake when fed with diets that contain primarily vegetable fat or highly unsaturated fat products.

Introduction

The most commonly reported problems associated with feeding fat to finishing cattle are decreased feed intake and depressed fiber digestibility. Increased calcium levels help alleviate depressed fiber digestibility, possibly because calcium reacts with the fatty acids in the rumen to form calcium soaps. Because these soaps are insoluble in the rumen, the fatty acids cannot interact with rumen microbes. As the soap passes out of the rumen, it becomes soluble, allowing normal fat absorption. By the same mechanism, fats that are high in unsaturated fatty acids (i.e., vegetable oils) would be protected from saturation in the rumen by the microflora. Such protected fats would be absorbed in the unsaturated form and could cause higher levels of unsaturated fatty acids in tissue. Rumen fat-bypass methods that have been studied are encapsulating fats with a formaldehyde-protein complex or feeding calcium salts of long-chain fatty acids; both are fairly expensive. Adding calcium to high fat diets would be cheap and practical. This paper presents the results of a feeding trial that investigated the efficacy of feeding two types of fat (Table 27.1) with two levels of calcium in finishing diets.

Experimental Procedures

The finishing study, conducted at the Southwest Kansas Experiment Station, began on June 1, 1988. One hundred thirty-eight steers were used in a complete block design, with weight as a blocking factor, and allotted to six treatments with four pens per treatment and five to six animals per pen. The heaviest group averaged 855 pounds; the lightest group averaged 743 pounds.

The six dietary treatments were: 1) 0% fat, .5% calcium; 2) 0% fat, .9% calcium; 3) 3.5% tallow, .5% calcium; 4) 3.5% tallow, .9% calcium; 5) 3.5% soybean oil soapstock, .5% calcium; and 6) 3.5% soybean oil soapstock, .9% calcium. Soapstock is a by-product of edible oil refining. The fatty acid composition is very similar to the original oil but is much higher in nonesterified fatty acids.

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[1] Appreciation is expressed to Iowa Limestone Co. for providing limestone and funding.

Starting and ending weights were the average of two consecutive, early morning, full weights. Starting weights were obtained 12 days into a 22 day step-up period, after which the cattle were put on the final diet (Table 27.2). The cattle were weighed at 28-day intervals until slaughter (111 days).

Results and Discussion

Neither fat nor calcium affected feedlot performance during the first 28 days (Table 27.3). However, during days 29-56, animals consuming the soybean oil soapstock with .9% calcium had increased intake but decreased efficiency, whereas control and tallow-fed animals on .9% calcium consumed less feed but utilized it more efficiently ($P<.05$). During days 57-84, calcium level and fat interacted ($P<.07$) for average daily gains; soapstock-fed animals gained more, whereas animals fed tallow gained less on the .9% calcium diets. During the last period (days 85-111), calcium had no effect, but fat-fed animals had higher dry matter intakes, corresponding with higher average daily gains and better feed efficiencies. Over the entire trial, average daily gain and dry matter intake were improved ($P<.03$) by added fat. Feed efficiency was not different between treatment groups.

Table 27.4 lists the effects of fat and calcium on carcass characteristics. Fat increased final live weights, hot carcass weights, backfat, and percent carcasses grading Choice. These effects would be expected, considering the increased average daily gain from adding fat to the diet. The increased backfat and Choice carcasses might also be expected from the increased energy density. The higher level of calcium, when fed with tallow, depressed hot carcass weights and corresponding dressing percentages; when fed with soapstock, it increased the percent carcasses grading Choice. The reasons for these effects are not clear.

Table 27.1. Composition of Final Diets[1]

Ingredients	Control	Added Fat
Steamflaked wheat	80.86	80.72
Corn silage	5.00	5.00
Chopped alfalfa hay	5.00	5.00
Supplement	4.14	4.28
Tallow/soybean oil soapstock	----	3.50
Blended molasses	5.00	1.50

[1] Dry matter basis. Formulated to contain 12.5% minimum CP, .35% P, .65% K, and limestone added to provide .5% or .9% Ca of each diet.

Table 27.2 Dietary Fat and Calcium Effect on Feedlot Performance

	No Fat + Ca%		Soybean Soapstock + Ca%		Tallow + Ca%		
Item	.5	.9	.5	.9	.5	.9	SE
Period 1 (0-28d)	3.48	3.33	3.60	3.30	3.80	3.42	.18
DMI, lb	18.57	17.87	18.65	19.17	19.14	18.41	.37
G/F	.188	.187	.194	.174	.200	.185	.01
Period 2 (29-56d)							
ADG[a]	3.53	3.96	4.13	4.27	4.14	4.24	.16
DMI[b]	21.39	20.09	21.28	22.76	21.96	21.23	.53
G/F[b]	.165	.197	.195	.187	.190	.200	.007
Period 3 (57-84d)							
ADG[c]	3.23	3.29	2.85	3.46	3.55	3.01	.23
DMI	21.93	21.44	22.42	22.92	23.35	22.50	.65
G/F	.147	.154	.128	.152	.152	.134	.01
Period 4 (85-111d)							
ADG[a]	2.67	2.66	3.33	3.12	3.02	3.30	.16
DMI[d]	19.69	21.48	21.52	22.03	21.99	21.48	.52
G/F[d]	.136	.125	.156	.141	.137	.154	.007
Overall (0-111d)							
ADG[a]	3.23	3.32	3.48	3.54	3.63	3.49	.08
DMI[a]	20.40	20.21	20.96	21.72	21.61	20.90	.37
G/F	.159	.164	.166	.164	.169	.167	.003

[a] Fat effect ($P \leq .03$)
[b] Fat x Ca interaction ($P \leq .05$)
[c] Fat x Ca interaction ($P \leq .07$)
[d] Fat effect ($P < .07$)

Table 27.3 Dietary Fat and Calcium Effect on Carcass Characteristics

	No Fat + Ca%		Soybean Soapstock + Ca%		Tallow + Ca%		
Item	.5	.9	.5	.9	.5	.9	SE
No. steers	23	23	23	23	23	23	
Initial wt, lb	810	805	808	806	808	807	1
Final wt, lb[a]	1168	1172	1193	1194	1210	1194	9
Hot carcass wt, lb[ab]	716	732	741	747	760	735	6
Dressing %[b]	61.3	62.0	62.0	62.4	62.7	61.7	.3
Backfat, in[c]	.47	.47	.52	.51	.55	.50	.02
Marbling score[d]	210	202	199	214	218	206	14
Yield grade	2.62	2.87	3.25	3.04	3.21	2.97	.21

[a] Fat effect, $P < .01$.
[b] Fat x Ca interaction, $P < .05$.
[c] Fat effect, $P < .05$.
[d] Small=200-300 or choice quality grade.

DIETARY INFLUENCES ON PANCREATIC AMYLASE AND SMALL INTESTINAL DISACCHARIDASE ACTIVITIES IN CATTLE

K.K. Kreikemeier, D.L. Harmon,
K. Gross, and C. Armendariz.

Summary

Pancreatic alpha-amylase activity was 54% higher in cattle fed at twice maintenance energy than in cattle fed at maintenance and was 52% greater in hay-fed than grain-fed cattle. Increased pancreatic alpha-amylase activity probably represents increased secretion as well. Alpha-amylase activity in small intestinal digesta was greater with increased energy intake and with hay feeding. Small intestine mucosal disaccharidase activities in cattle were unaffected by diet. Lactase activity was highest in the proximal segment of the small intestine and low in both mid and distal segments. Maltase and isomaltase activities were low in the duodenum, but increased toward the jejunum and remained elevated through the terminal ileum.

Introduction

Previous research at Kansas State University demonstrated that starch hydrolysis in the small intestine of steers is limited. Low enzyme activity in the small intestine may be the rate-limiting process, so an increase in one or more carbohydrate-hydrolyzing enzymes might improve starch digestion. We conducted this experiment to see if enzyme activity in the pancreas and small intestine is influenced by either diet (alfalfa hay vs. grain) or energy intake (1 vs. 2 times maintenance).

Experimental Procedures

Twelve Holstein steers, four Longhorn cross steers, and four Longhorn cross heifers were fed high grain diets from weaning (6 weeks) till they were 7 months old. They were then blocked by weight, breed, and sex into five groups of four animals. For the next 140 days, they were individually fed either 90% alfalfa hay or 90% concentrate (50% dry rolled sorghum, 50% dry rolled wheat) at either maintenance or twice maintenance energy. Monensin and tylosin were fed at equal intakes on a body weight basis. Cattle fed at twice maintenance were weighed, and their intakes were adjusted biweekly.

We slaughtered one animal per day, one block (four animals) per week, for 5 consecutive weeks. After an overnight fast, the animal was stunned, bled, and eviscerated. The pancreas was removed and assayed for alpha-amylase and glucoamylase activity. Beginning 6 inches distal from the pylorus and ending 6 inches proximal to the ileo-cecal junction, five, equally spaced, 12-inch segments were removed from the small intestine. Mucosa was assayed for lactase, isomaltase, and maltase activity. Small intestinal digesta was also collected and assayed for alpha-amylase activity.

Results and Discussion

As expected, cattle fed at twice maintenance were heavier at slaughter than those fed at maintenance (Table 28.1), and there was no weight difference between hay and grain fed cattle.

The pancreas was heavier in cattle fed at twice maintenance, but was proportional to animal slaughter weight. Pancreatic alpha-amylase activity; expressed as units per g of pancreas, was 54% greater in cattle fed at twice maintenance than in cattle fed at maintenance, and 52% greater in hay-fed cattle than grain-fed cattle. Pancreatic glucoamylase activity increased 10% in cattle fed increased energy intake and was also 10% greater in hay-fed than grain-fed cattle.

The small intestine was 18 feet longer in cattle fed at twice maintenance, probably because of differences in weight at slaughter. There were 3 more pounds of digesta in the small intestine of cattle fed twice maintenance, and 2 more pounds in the small intestine of hay-fed than grain-fed cattle. The alpha-amylase activity in small intestinal digesta paralleled that of the pancreas; greater with increased energy intake and greater in hay-fed cattle. Therefore, we may speculate that increased pancreatic alpha-amylase activities are associated with greater pancreatic alpha-amylase secretions. The differences in alpha amylase are even more pronounced when activities per gm of pancreas or digesta are multiplied by organ or digesta weight, to yield to total amount of enzyme per animal.

Small intestinal disaccharidase activity was unaffected by diet consumed, so this is listed according to small intestinal sampling site (Table 28.2). Lactase activity is mostly concentrated in the first part of the small intestine. On the other hand, maltase and isomaltase activities are low in the duodenum, increase toward the jejunum, and remain elevated through the terminal ileum. This suggests that the potential for starch hydrolysis continues through the entire length of the small intestine.

According to our data, pancreatic alpha-amylase activity increases with increased energy intake. However, any increase is offset by the negative effects of grain feeding. If these opposing effects could be alleviated or offset, the capacity of the small intestine to hydrolyze starch should improve.

Table 28.1. Energy Intake and Diet Effects on Pancreatic Weight, Alpha-amylase, Glucoamylase, and Small Intestinal Length and its Digesta

Item	Energy Intake		Diet Consumed		SE
	Maintenance	Twice Maintenance	Hay	Grain	
Animal slaughter wt, lbs[a]	482	779	645	615	33
Pancreas weight, g[a]	232	323	292	264	18
Pancreatic alpha amylase activity[1] units/g pancreas[ab]	328	508	504	332	51
Pancreatic glucoamylase activity[2] units/g pancreas[ab]	1.0	1.1	1.1	1.0	.04
Small intestinal length, ft[a]	70	88	81	77	3.4
Small intestinal contents					
Digesta weight, lbs[ac]	7.0	10.1	9.5	7.5	0.9
Digesta pH[ab]	7.4	7.1	7.3	7.1	.04
Alpha amylase activity[1] units/g digesta[b]	4.8	5.5	6.1	4.2	0.6

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[1] One unit of activity equals liberated reducing sugars corresponding to 1 micromole of glucose per minute.

[2] One unit of activity equals one micromole of glucose liberated per minute.

[a] Energy levels differ, P<.05.

[b] Hay and grain differ, P<.05.

[c] Hay and grain differ, P<.10.

Table 28.2. Small Intestinal Disaccharidase Activities per Inch of Intestine

Item	Small Intestinal Sampling Site					SE
	Duodenum	Jejunum I	Jejunum II	Jejunum III	Ileum	
Lactase	2.5[a]	4.8[b]	0.3[c]	0.1[c]	0.2[c]	0.3
Isomaltase	0.1[a]	0.6[b]	1.0[c]	0.7[b]	1.0[c]	0.1
Maltase	1.0[a]	2.5[b]	3.0[b]	2.0[b]	3.4[b]	0.3

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[1] One unit of activity equals one micromole of substrate hydrolyzed per minute.

[abc] Means in the same row with different superscripts differ (P<.01).

EFFECTS OF FINAPLIX® IN COMBINATION WITH RALGRO® AND SYNOVEX® ON PERFORMANCE AND CARCASS CHARACTERISTICS OF STEERS AND HEIFERS[1]

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Summary

Five field trials were conducted with 762 steers and heifers to evaluate Finaplix® in combination with Ralgro® or Synovex® for growing and finishing programs. Effects on cattle performance and carcass characteristics were inconsistent across trials. However, in general, implanting cattle with Finaplix and either Ralgro or Synovex tended to result in increased gain, final weight, and carcass weight, with little effect on backfat, loin eye area or kidney, heart, and pelvic fat. Marbling score and the percentage of cattle grading choice tended to be reduced slightly, although this was not usually significant.

Introduction

The recent clearance of Finaplix®, a synthetic testosterone-like implant for growing-finishing cattle, has stimulated a great deal of interest relative to its growth-promoting effects when used in conjunction with estrogenic implants. There has been considerable speculation that the use of Finaplix may reduce carcass quality by reducing marbling, and increase the incidence of dark cutters. Additionally, some packers have suggested that cattle implanted with Finaplix may have heavier hides that pull harder, resulting in problems during slaughter. Thus, these trials were conducted to compare cattle performance and carcass characteristics using Finaplix in combination with Ralgro® or Synovex® implants under commercial feeding conditions.

Experimental Procedures

Five field trials were conducted to compare Finaplix with Ralgro and/or Synovex reimplant programs for growing and finishing steers and heifers in four cooperating commercial feedlots.

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[1] Sincere appreciation is expressed to John and Kerry Cromer, Pratt; Pratt Feeders, Pratt; Black Diamond Custom Feeders, Herington; Ellis County Feeders, Hays; and Cooper Pre-Conditioning Yard, McDonald, for providing cattle, facilities and management expertise; and to IBP, Inc., Emporia and Finney County, and Excel Corp., Dodge City, for carcass evaluation. Sincere thanks also to Gary Goldy, Twig Marston, Albert Maddux, and County Extension Agricultural Agents Joe Wary and Evan Winchester for assistance in data collection.

[2] Extension Livestock Specialist, South Central Kansas.

[3] Extension Livestock Specialist, Northwest Kansas.

In Trial 1, 176 Hereford steer calves averaging 490 lbs. were allotted randomly to implant treatments 1) Synovex-S alone or 2) Synovex-S plus Finaplix-S on November 14, 1987 and pastured on wheat for 108 days. At the start of the drylot-silage growing phase on March 1, 1988, and at the start of the finishing phase on May 26, 1988, steers were allotted within previous implant treatments and reimplanted with either Synovex-S alone or Synovex-S plus Finaplix-S, such that all possible implanting alternatives were studied during the wheat pasture, growing, and finishing phases. Carcass data were collected at slaughter.

In Trial 2, 273 yearling crossbred steers were allotted to four summer finishing treatment groups as follows: 1) Ralgro, 2) Ralgro plus Finaplix-S, 3) Synovex-S, and 4) Synovex-S plus Finaplix-S. Complete carcass data were obtained on 64 steers slaughtered after 99 days and 209 head slaughtered after 109 days on feed.

In Trial 3, 101 yearling crossbred steers were assigned randomly to four finishing implant groups as follows: 1) Ralgro, 2) Ralgro plus Finaplix-S, 3) Synovex-S, and 4) Synovex-S plus Finaplix-S. Steers were fed for 97 days, with carcass information collected at slaughter.

In Trial 4, 126 yearling heifers averaging 724 lbs. were implanted with Synovex-H at the beginning of the 127-day finishing period. After 49 days on feed, heifers were reimplanted as follows: 1) no implant, 2) Synovex-H, 3) Finaplix-H, or 4) Synovex-H plus Finaplix-H. All heifers were fed MGA® throughout the feeding period, and carcass data were collected at slaughter.

In Trial 5, 86 crossbred steer calves were allotted to two implant treatments: 1) Ralgro alone or 2) Ralgro plus Finaplix-S. Steers were fed a silage-based ration during the 77-day growing trial.

Results and Discussion

In Trial 1, Synovex plus Finaplix (S+F) increased ($P<.05$) gain over Synovex (S) alone during the wheat pasture phase (Table 29.1). In the subsequent drylot-growing phase, the S+F combination tended ($P=.11$) to increase performance compared to S alone. In the finishing phase, there were no significant differences in daily gain and carcass characteristics across the six implant treatments, indicating that prior implant treatment had no effect on finishing performance. However, when only the finishing implant (S vs S+F) was considered, steer gain, final weight, and carcass weight were increased ($P<.05$) by implanting with S+F. Correspondingly, lifetime gain was increased ($P<.05$) by implanting with S+F in the finishing phase.

In Trial 2, implant treatment had no effect on gain, carcass weight, backfat, percentage kidney fat, or loin eye area (Table 29.2). Finaplix use did not affect carcass quality. However, Synovex-implanted cattle had lower marbling scores and fewer graded choice ($P<.05$) compared to Ralgro steers. In Trial 3, implant treatment had no significant effect on gain or any carcass characteristic, as shown in Table 29.3.

In Trial 4, reimplanting heifers with either S or S+F had no effect on gain or carcass characteristics, except for the percentage grading choice, which was reduced ($P<.05$) in the F and S+F groups compared to controls (Table 29.4). Hide weights and hide pull scores tended to be increased slightly by treatments including Finaplix. In Trial 5, implanting growing steers with Ralgro plus Finaplix increased daily gain by 5.3% compared to Ralgro alone, as shown in Table 29.5.

Table 29.1. Evaluation of Synovex or Synovex plus Finaplix Combinations in Steers during Wheat Pasture, Drylot Growing, and Finishing Phases

Wheat Pasture Treatments:	S[1]	S+F[1]
No. Steers	88	88
Initial Wt, lb	490	489
Ending Wt, lb	636	647
Daily Gain, lb	1.35[a]	1.46[b]

Drylot Growing Treatments:	S	S+F	S	S+F
No. Steers	60	28	31	57
Ending Wt, lb	898	917	899	915
Daily Gain, lb	3.06	3.17	2.90	3.11

Finishing Treatments:	S	S+F	S+F	S	S	S+F
No. Steers	30	30	28	31	26	31
Daily Gain, lb	3.18	3.38	3.22	3.15	2.94	3.28
Final Wt, lb	1131	1150	1156	1132	1130	1160
Carcass Wt, lb	711	723	727	712	711	730
Backfat, in	.53	.59	.56	.54	.56	.50
Ribeye Area, sq in	13.1	13.1	13.3	13.2	13.1	13.9
Kidney Fat, %	2.25	2.25	2.19	2.30	2.30	2.13
Marbling Score[2]	165	167	155	164	172	146
% Choice	13[a]	13[a]	11[a]	19[a]	31[b]	10[a]
Overall Daily Gain, lb.	2.39	2.47	2.49	2.38	2.39	2.52

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[1] Steers were implanted successively with either Synovex-S alone (S) or Synovex-S plus Finaplix-S (S+F).

[2] 100-199 = slight, 200-299 = small, 300-399 = modest degrees of marbling.

[ab] Values with unlike superscripts differ ($P<.05$).

Table 29.2. Effect of Ralgro and Synovex, with or without Finaplix, on Performance of Feedlot Steers

Item	Ralgro	Ralgro + Finaplix	Synovex	Synovex + Finaplix
No. Steers	67	70	71	65
Inital Wt, lb	808	807	807	806
Final Wt, lb	1149	1150	1145	1155
Daily Gain, lb	3.28	3.30	3.25	3.36
Carcass Wt, lb	723	724	720	727
Backfat, in	.54	.53	.53	.50
Kidney Fat, %	1.87	1.85	1.85	1.84
Ribeye Area, sq in	12.3	12.3	12.4	12.7
Marbling Score[1]	211^{a}	202^{ab}	192^{bc}	181^{c}
% Choice	48^{a}	49^{a}	31^{b}	27^{b}

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[1] 100-199 = slight, 200-299 = small, 300-399 = modest degrees of marbling.

[abc] Values in the same row with unlike superscripts differ ($P<.05$).

Table 29.3. Effect of Ralgro and Synovex Alone and in Combination with Finaplix on Finishing Steer Performance

Item	Ralgro	Synovex	Ralgro + Finaplix	Synovex + Finaplix
No. Steers	24	26	25	26
Inital Wt, lb.	832	832	831	832
Final Wt, lb.	1202	1191	1213	1207
Daily Gain, lb.	3.82	3.70	3.94	3.87
Carcass Wt, lb.	769	762	777	773
Backfat, in.	.47	.47	.47	.49
Kidney Fat, %	1.94	2.09	2.25	1.91
Ribeye Area, sq. in.	13.1	13.5	13.4	13.2
Marbling Score[1]	194	185	167	190
% Choice	50	46	44	54

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[1] 100-199 = slight, 200-299 = small, 300-399 = modest degrees of marbling.

Table 29.4. Effect of Finaplix and Synovex Implants Used Singly or in Combination on Performance of Heifers

Item	Initial Implant + Reimplant Synovex None	 Synovex Synovex	 Synovex Finaplix	 Synovex Syn. + Fin.
No. Heifers	33	31	31	31
Initial Wt, lb.	724	724	724	724
Reimplant Wt, lb.	857	857	857	857
Final Wt, lb.	1103	1095	1093	1100
Daily Gain, lb.	3.16	3.05	3.03	3.12
Carcass Wt, lb.	675	670	666	673
Backfat, in.	.46	.45	.47	.51
Kidney Fat, %	2.41	2.51	2.05	2.37
Ribeye Area, sq. in.	13.4	12.9	13.3	13.1
Marbling Score[1]	323	280	256	278
% Choice	97[a]	94[ab]	87[bc]	77[c]
Hide Pull Score[2]	2.0	2.0	2.3	2.2
Hide Wt, % of Live Wt	5.9	6.2	6.5	6.2

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[1] 100-199 = slight, 200-299 = small, 200-299 = modest degrees of marbling.

[2] Difficulty of mechanically pulling hides at slaughter appraised visually on a 1 to 5 scale, 5 = most difficult.

[abc] Values with unlike superscripts differ (P<.05).

Table 29.5. Influence of Ralgro and Finaplix on Growing Steer Gains

Item	Ralgro Alone	Ralgro + Finaplix
Initial Wt., lb.	501	500
Final Wt., lb.	688	697
Total Gain, lb.	187	197
Daily Gain, lb.	2.43	2.56

MANAGING FAST- VS. SLOW-GROWTH GENOTYPES TO OPTIMIZE QUALITY AND YIELD GRADES

R.R. Schalles, M.E. Dikeman, and K.O. Zoellner

Summary

Fast-growth genotype steers placed on a high energy ration a month after weaning were compared to a slow-growth genotype on a growing ration for 155 days, followed by a finishing ration for 62 days. The fast-growth genotype produced heavier, higher quality carcasses in less time than the slow-growth genotype, with similar energy conversion. Using contemporary prices, the fast-growth genotype cattle broke even, and the slow-growth genotype lost $124 per head.

Introduction

Considerable variation exists in the growth genotypes of beef cattle. With the availability of growth EPD's (Expected Progeny Differences) for cattle of the major breeds, selection for growth rate can be very effective. However, as growth rate and cattle size change, nutrition and management must change (Schalles, Bolsen and Dikeman, 1983 Cattlemen's Day Report, Comparison of Cattle Types and Management Systems). The purpose of our study was to evaluate two management systems that would produce carcasses of acceptable weight, quality, and composition from cattle of two different genotypes.

Experimental Procedures

Sixteen Simmental steers with an average frame score of 6.2 and weighing 668 lbs represented the fast-growth genotype, and 15 Angus x Hereford calves with an average frame score of 3.7 and weighing 595 lbs represented the slow-growth genotype. Steers started the trial 27 days after weaning at an average age of 239 days. Steers of each genotype were fed in three groups. The fast-growth genotype was placed on a high energy (83% TDN) ration and permitted to grow as rapidly as possible, whereas the slow-growth genotype was placed on a silage-based growing ration (64% TDN) for 155 days (until April 12) followed by a 62 day finishing period. Steers were slaughtered at IBP, Emporia, Kansas, at an average fat thickness of 0.38 in, measured with ultrasonics. Five of the fast-growth genotype steers were slaughtered on April 25, at an average age of 413 days; the other 11 were slaughtered on May 26, at an average age of 440 days. The slow-growth genotype steers were slaughtered on June 30, at an average age of 473 days. Carcass information was collected at the plant.

Results and Discussion

Production and efficiency data are shown in Table 30.1. The fast-growing steers were fed to gain about a pound per day faster than the slow-growing steers during the first 155 days of the trial. This was done to allow the slow-growth genotype to grow without excess of fat, in an effort to produce carcasses of an acceptable weight and yield grade. When the slow-growth genotype steers were put on the finishing ration, they gained 2.93 lbs per day and increased in fat thickness from 0.19 to 0.38 inches in 55 days. The fast-growth genotype steers were slaughtered an average of 44 days sooner, with the same backfat thickness, and weighed 151 lbs more. The dressing percent (calculated from live weights at the slaughter plant) of the fast-growth genotype was 62.5% vs 60.4% for the slow-growth genotype. The fast-growth genotype steers had 2 sq in larger loin eyes and 29% more graded choice. They required slightly more energy (TDN) per lb of gain because of the higher maintenance requirements.

Economic data are shown in Table 30.2. The fast-growth genotype had greater economic merit because of the younger age at slaughter (which reduced yardage and interest costs) and a higher percent grading Choice. Feed cost was higher for the slow-growth genotype because of the slower rate of gain during the growing period. The slow-growth genotype would have lost money, even if silage had been free.

The slow-growth genotype steers probably would have had a higher percent grading Choice if they had been fed the finishing ration longer. This could have been accomplished by starting the finishing phase earlier, which would have produced lighter carcasses at the same fatness. On the other hand, this genotype could also have been started on the finishing ration at the same time and fed somewhat longer. However, this would have increased the amount of fat in the carcasses, producing a less desirable yield grade.

With the management described, these results indicate that the larger-frame, faster growing steers that were heavier at the start of the trial were worth more per lb at weaning than the lighter weight, slower growing steers.

Table 30.1. Least Squares Means of Growth and Carcass Traits of Two Genotypes

Trait	Fast-growth Genotype	Slow-growth Genotype
No. of Head	16	15
Adjusted 205-day Wt., lb	649^{a}	507^{b}
Nov. 9 Age, days	242^{a}	236^{a}
Nov. 9 Wt., lb	668^{a}	595^{b}
Nov. 9 Ht., in	47.9^{a}	42.8^{b}
Frame Score	6.25^{a}	3.73^{b}
Nov. 9 Backfat Scanned, in	0.01^{a}	0.01^{a}
Apr. 12 Wt.[1], lb	1162^{a}	850^{b}
ADG Wn. to Apr. 12, lb	2.81^{a}	1.84^{b}
Apr. 12 Backfat Scanned, in	0.29^{a}	0.19^{b}
Slaughter Wt., lb	1272^{a}	1047^{b}
Scanned Slaughter Backfat, in	0.38a	0.38^{a}
ADG Wn. to Slaughter, lb	2.88^{a}	2.06^{b}
ADG Apr. 12 to Slaughter, lb	3.11^{a}	2.51^{a}
Slaughter Age, days	429^{a}	473^{b}
TDN Consumed, lb	3579^{a}	3006^{b}
Protein Consumed, lb	520^{a}	499^{b}
TDN/gain, lb	6.02^{a}	6.77^{b}
Slaughter Wt./Day, lb	2.98^{a}	2.22^{b}
Carcass Wt.[2], lb	760^{a}	604^{b}
Carcass Backfat, in	0.31^{a}	0.37^{a}
Carcass Loin Eye Area, in^{2}	13.2^{a}	11.3^{b}
Yield Grade	2.53^{a}	2.58^{a}
Percent Choice	93^{a}	64^{b}
Carcass Wt./Day, lb	1.78^{a}	1.28^{b}

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^{ab}Means with different superscripts are different ($P<.05$)

[1] The slow-growth steers were changed to a finishing ration on April 12.

[2] One carcass of each genotype was not available for carcass information.

Table 30.2. Economic Results of Genotypes as Affected by Management

Trait	Fast-growth Genotype	Slow-growth Genotype
EXPENSES/HEAD:		
Starting value ($85 and $89/cwt.)	$567.80	$529.55
Interest on cattle (11% per year)	31.99	37.81
Feed cost	220.00	182.29
Yardage ($0.15 per day)	28.05	35.55
Total expenses	$847.84	$785.20
INCOME/HEAD:		
Carcass value (Choice = $112/cwt., Select = $105/cwt.)	$847.48	$661.26
PROFIT (LOSS)/HEAD:	($ 0.36)	($123.94)
FEED INPUTS/HEAD:		
Silage DM, lb	755.9	2811.0
Cost, at $50/ton DM	$18.90	$70.28
Milo DM, lb	3427.6	1297.9
Cost, at $4.80/cwt.	$164.52	$62.30
Supplement DM, lb	257.4	349.8
Cost, at $14.21/cwt.	$36.58	$49.71
TOTAL FEED COST/HEAD	$220.00	$182.29

FECAL THIAMINASE IN FEEDLOT CATTLE

T. D. Hays and B. E. Brent

Summary

Fecal thiaminase was measured on 152 feedlot cattle at three locations and on a variety of rations. No animals showed signs of polioencephalomalacia. Thiaminase activities ranged from 0.6 to 430 μmol thiamin destroyed per minute per liter of feces (μmol/min/l). Eighty-two percent of the thiaminase activities were below 20 μmol/min/l, and only 3 percent were less than 2 μmol/min/l. High levels of fecal thiaminase were apparently not related to ration. Thiaminase was detected in all animals studied, but one location had only minimal levels. When high levels of thiaminase were found, the samples were re-assayed, and the enzyme was confirmed to be thiaminase type I. Polioencephalomalacia, a central nervous system disease in ruminants, involves gastrointestinal destruction of thiamin, and the creation, through the action of thiaminase I and a cosubstrate, of a thiamin analog that inhibits thiamin-requiring metabolic reactions. Our data suggest that substantial numbers of feedlot cattle have the enzyme in their gastrointestinal tracts, but do not develop polioencephalomalacia because the appropriate cosubstrate is absent.

Introduction

Polioencephalomalacia (PEM) is a central nervous system disease of feedlot cattle that responds dramatically to large doses of injected thiamin, provided the treatment is given early. This response to thiamin seems peculiar, since the ruminant animal receives thiamin as a natural component of feed, and it is synthesized by rumen bacteria. Research in the United States, Great Britain, and Australia has shown that one factor in the etiology of PEM is an enzyme, thiaminase I, that breaks the bond between thiamin's two organic rings and replaces the thiazole ring with a nitrogen-containing "cosubstrate." A number of compounds will fill the cosubstrate role, but the specific cosubstrate involved with PEM has not been identified. Research at Kansas State has shown that the rate at which thiaminase operates is controlled largely by the amount of cosubstrate.

British researchers have shown that when thiaminase I is present in the rumen, it is also present in the feces, even from "normal" animals. The data reported here were collected in an attempt to find out how prevalent thiaminase I is in the gastrointestinal tracts of feedlot cattle.

Experimental Procedures

Our fecal thiaminase I assay utilized small amounts of radioactive thiamin and high levels of both thiamin (the primary substrate) and aniline, a cosubstrate. *Clostridium sporogenes*, a bacterium known to produce large amounts of thiaminase I, was included in each sample set to verify that the assay was working properly.

Fecal grab samples were collected at random, diluted 1:1 with distilled water, squeezed through cheesecloth, and assayed. Samples were collected at the KSU Beef Research Center, the Fort Hays Branch Experiment Station, and at Ellis County Feeders, Hays, KS. All cattle appeared normal.

No information is available as to what constitutes "normal" versus "abnormal" fecal thiaminase activities. Based on examination of our data, a level that destroyed 20 μmol thiamin per minute per liter fresh feces (μmol/min/l) was arbitrarily chosen as the breaking point. Thiaminase activities over 100 μmol/min/l were designated as "high".

Animal and ration details are shown in Table 31.1.

Results and Discussion

Examination of Table 31.1 shows that there is little, if any pattern to the occurrence of "abnormal" or "high" ruminal thiaminase. Although at the KSU Beef Research Unit, all pens fed high levels of milo had animals with high thiaminase levels, a similar diet yielded the lowest thiaminase levels at Fort Hays. High levels of thiaminase occurred frequently in steers fed steam-flaked corn at the Fort Hays Branch Station; however, just a few miles away at Ellis County Feeders, animals fed cracked corn showed only low thiaminase levels.

Thiaminase I activities varied, from 0.6 to 430 μmol thiamin/min/l. All fecal samples showed at least some thiaminase I activity. If one sorts the thiaminase I levels from the entire experiment from low to high activity, then plots the ranking of each sample versus its thiaminase I activities (Figure 31.1), a fairly logical break is found at an activity of about 20 μmol/min/l; 82 percent of the samples had lower and 18 percent had greater concentrations.

Whenever an abnormal level of thiaminase activity was found, the sample was reassayed without added cosubstrate. In nearly all cases, little activity was found, indicating that no native cosubstrate was present in the sample. However, absence of cosubstrate in the feces may not indicate absence in other regions of the gastrointestinal tract. The known cosubstrates of thiaminase I are relatively small molecules and should be absorbed as they pass down the tract.

The assay we used is unable to discriminate directly between enzymatic and chemical thiamin destruction. In the rumen, the sulfate ion is converted to sulfide. However, sulfite is an intermediate in the process, and the sulfite ion is a potent destroyer of thiamin. PEM-like signs have been caused by high levels of sulfate in water or feeding gypsum (calcium sulfate) as a feed intake regulator. Chemical breakdown of thiamin by the sulfite ion was not a factor in our data because reassay of our high-activity samples in the absence of cosubstrate showed little, if any, activity. If sulfite had been present, thiamin destruction would have taken place, even in the absence of thiaminase I.

Although several nitrogen-containing organic bases can serve as thiaminase I cosubstrates, no one has yet established the specific cosubstrate responsible for PEM. For PEM to develop, thiaminase I must act on both thiamin and the specific "PEM cosubstrate" to create a specific thiamin analog. Earlier studies at KSU have shown that there is probably always enough thiamin available to let the reaction operate at maximum speed. According to the results of the present experiment, a substantial number of feedlot cattle contain thiaminase I in their gastrointestinal tracts, some at high levels. The fact that so few animals develop PEM indicates that the limiting factor in the reaction is specific cosubstrate availability.

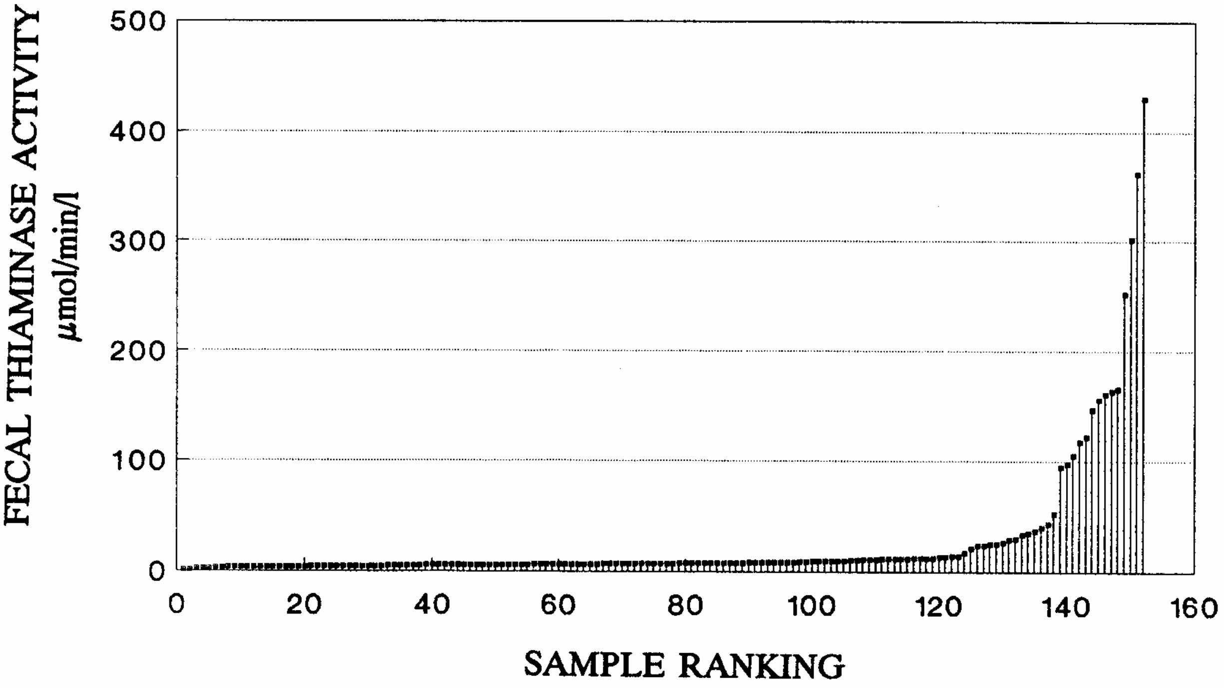

Figure 31.1. Plot of sorted fecal thiaminase activities.

Table 31.1. Numbers and Percentages of Cattle with Abnormal (over 20 μmol/min/l) Thiaminase I Activities and Maximum Activity

		μmol Thiamin Destroyed/min/l		
Description	No. Sampled	20-100	100 +	Max. Act.
KSU Beef Research Center				
	- - No. of Cattle - -			
780 lb steers fed an 84% milo diet with corn silage as the roughage. On the diet 17 days.	11	3[a]	2	161
545 lb heifers fed a 35% milo diet with equal parts of milo and corn silage. On the diet 11 days.	11	0	0	6
625 lb heifers fed an 84% milo diet with corn silage as the roughage. On the diet 14 days.	9	3	1	121
285 lb mixed calves fed a 75% milo diet with whole plant milo silage as the roughage. On the diet 7 days.	4	0	0	4
750 lb Holstein steers fed an 84% milo diet with corn silage as the roughage. On the diet 21 days.	2	1	0	52
Fort Hays Branch Experiment Station				
1200 lb steers finished on a high-concentrate diet based on steam-flaked corn.	22	3	7	361
1200 lb steers finished on a high-concentrate diet. Concentrate mix was 50% steam-flaked corn, 50% ground milo.	20	1	1	163
1200 lb steers finished on a high-concentrate diet based on ground milo.	24	2	0	24
650 to 725 lb heifers fed a high-concentrate diet based on ground milo.	9	1	0	28
575 lb heifers fed a high-concentrate diet based on ground milo.	7	1	1	430
Ellis County Feeders				
670 lb steers on a starting diet containing 10% cracked corn. Steers had arrived in the yard 4 days earlier.	18	1	0	23
800 to 850 lb steers on a finishing diet of 90% cracked corn. They had been on the diet 21 days.	15	0	0	9

[a] Number of cattle in each category.

EFFECT OF LIQUAMYCIN® AND SYNTABAC PLUS® ON GAIN AND HEALTH OF STOCKERS PURCHASED AS STEERS OR BULLS[1]

F. Brazle[2] and G. Kuhl

Summary

Steer calves gained faster (P<.001) and required fewer treatments per animal (P<.01) than newly castrated bull calves during a 29-day receiving period. Liquamycin® (LA-200) injection at arrival increased steer gains (P<.08) and reduced treatments required per animal (P<.08). The combined use of LA-200 and Syntabac Plus® increased gains (P<.08) of newly castrated calves.

Introduction

Research has shown that stockers purchased as bulls and castrated at arrival have slower gains, higher mortality and need more treatments per animal compared to steers. The objective of this study was to determine whether Liquamycin® (LA-200) and Syntabac Plus®, alone or in combination, would reduce the stress on steers and newly castrated bull calves during the receiving period, as measured by animal health and gain.

Experimental Procedures

Nine hundred and eighty-four, mixed-breed, steer and bull calves averaging 394 lbs. were purchased over a 27-day period in the fall from 11 locations in Kansas, Missouri, Arkansas, Tennessee, and Mississippi. At arrival, the calves were individually weighed; vaccinated for IBR, BVD, PI3, and 7-way Blackleg; and treated for internal and external parasites with Ivomec®. Calves with horns were tipped, and bulls were castrated with a knife. The calves were randomly allotted to treatment at processing. The 508 newly castrated calves and 476 steers were allotted separately to four treatments: 1) Liquamycin (LA-200) injected subcutaneously at 5 ml per 100 lbs. body weight, 2) Syntabac Plus administered orally at 10 ml per animal, 3) both LA-200 and Syntabac Plus, and 4) unmedicated controls.

The cattle were started on 2.5 lbs. of whole shelled corn and .5 lb. of a 40% protein pellet containing 250 mg Bovatec® per head daily, plus free choice hay consisting of 50% prairie grass and 50% alfalfa. During the 29-day receiving period, the cattle were treated when they appeared sick. Treatment was continued until appearance improved or body temperature

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[1] Sincere appreciation is expressed to Syntex Animal Heath, Inc., Des Moines, IA and Pfizer, Inc., Lee's Summit, MO for providing support for this study. Appreciation is also expressed to Richard Porter, Reading, KS for providing cattle, facilities and collecting the data.

[2] Extension Livestock Specialist, Southeast Kansas.

returned to normal. Choice of medications was determined by the local veterinarian and producer. The cattle performance data were subjected to statistical analysis, and the results are expressed as least squares means.

Results and Discussion

Four-weight calves purchased as steers gained faster (1.30 vs .94 lbs. per day, $P<.001$) and required fewer ($P<.01$) treatments at both days 1 to 5 and days 6 to 29 than calves purchased as bulls and castrated at arrival.

LA-200, when injected at arrival, resulted in better steer gains (1.39 vs 1.27 lbs. per day, $P<.08$) during the first 29 days, but had little affect on newly castrated calves. Overall, LA-200 reduced the number of treatments required per steer purchased, as shown in Table 32.1. Syntabac Plus alone did not improve calf performance. However, LA-200 and Syntabac Plus in combination resulted in improved ($P<.08$) gains in both steers and newly castrated calves compared to unmedicated controls. This combination resulted in a trend toward fewer treatments required per animal in the newly castrated bull calves. These results suggest that with newly castrated calves, which normally are more highly stressed than steers, best results can be achieved with the combined use of LA-200 and Syntabac Plus during the receiving period.

Health problems in this set of calves were higher than normal because of a virus outbreak, with approximately 65% of all calves requiring treatment. The degree of stress and the type of health problems that occur likely would influence the response to these products.

Table 32.1. Effect of LA-200 and Syntabac Plus on Gain and Health of Calves Purchased as Steers or Bulls

	Newly Castrated Calves				Steers Calves			
Item	LA-200	La-200 + Syn.Plus	Syn.Plus	Control	LA-200	LA-200+ Syn.Plus	Syn.Plus	Control
Daily Gain, lb	.84^{a}	1.04^{b}	.93^{ab}	.82^{a}	1.39^{d}	1.46^{d}	1.00^{b}	1.27^{c}
No. Treatments/Animal:								
Days 1 to 5	1.27^{bc}	.93^{ab}	1.39^{c}	1.21^{bc}	.69^{a}	.89^{ab}	.95^{ab}	.88^{ab}
Days 6 to 29	3.23^{g}	3.34^{g}	3.41^{g}	3.37^{g}	2.02^{e}	2.33^{ef}	3.13^{fg}	2.87^{f}
Overall	4.50^{cd}	4.29^{c}	4.80^{d}	4.58^{d}	2.71^{a}	3.22^{a}	4.07^{b}	3.75^{b}

[abcd] Means in a row with unlike superscripts differ ($P<.08$).
[efg] Means in a row with unlike superscripts differ ($P<.04$).

LIVER FLUKE INFESTATION IN KANSAS FED SLAUGHTER CATTLE

S.B. Laudert[1]

Summary

Feedlot cattle from 1,687 pens totaling 290,183 head were evaluated at slaughter for the presence of liver flukes. Overall, 4.92% of the cattle were found to be infected. Only 15.2% of all pens of cattle were found to be completely free of flukes. However, only 5.3% of the pens had greater than 15% of the cattle infested. Beef steers had a higher level of infestation (5.2%) than beef heifers (4.4%). Holstein steers had an overall infestation rate of 4.4%.

Introduction

The economic impact of liver flukes is substantial in pens of feedlot cattle known to be heavily infected with the parasite; daily gain can be reduced up to 20% and feed conversion increased up to 25%. The total dollar loss to the industry is difficult to determine, however, because research data on performance losses is minimal and most cattle thought to be completely free of the parasites, in fact, may be infested at low rates. This study was conducted to acertain the incidence of liver flukes in slaughter cattle fed in Kansas feedlots.

Experimental Procedures

Periodically throughout 1986 and 1987, random pens of cattle were monitored during slaughter. Following eviseration, USDA Food Safety and Inspection Service employees evaluated livers for evidence of liver fluke infestation. All livers were evaluated, except for severely abscessed livers that were condemned prior to fluke evaluation. Thus, the order of inspection may have introduced a slight negative bias in the incidence of flukes. No differentation was made between livers with live flukes or with fluke damage or between species of fluke; all were reported as infested. All pens of cattle evaluated in this study were classified as beef-type steers or heifers or Holstein steers. Only pens of 30 head or more were evaluated.

Results and Discussion

Results of the slaughter survey are presented in Table 33.1. Only 13.6% of all pens of beef steers were entirely free of liver fluke infestation. However, 67.0% of the 1062 beef steer pens surveyed had less than 5% of the animals with flukes. Beef heifers and Holstein steers had similar infestation patterns. Overall, the presence of flukes in beef steers, heifers, and

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[1] Former Extension Livestock Specialist, Southwest Kansas; currently at Lilly Research Labs, Greenfield, IN.

Holstein steers was 4.73, 4.12, and 3.34% in 1986 and 5.76, 4.74, and 5.20% in 1987, respectively.

These date indicate that although liver flukes in feedlot cattle are widespread, the frequency of occurrance is small; only 29 of 1687 pens had greater than 25% of the cattle per pen infested.

Table 33.1. Incidence of Liver Flukes in Kansas Fed Slaughter Cattle

Class of Cattle	% of Cattle/Pen With Flukes	Number of Pens		Total Cattle		Percent of Pens	
		1986	1987	1986	1987	1986	1987
Beef Steers	0.0	72	72	8,414	7,172	15.7	12.0
	0.1 - 5.0	247	321	46,268	60,002	53.8	53.2
	5.1 - 10.0	96	118	20,960	23,475	20.9	19.6
	10.1 - 15.0	25	49	4,675	10,067	5.4	8.1
	15.1 - 25.0	15	29	2,824	5,084	3.3	4.8
	Over 25.1	4	14	819	2,434	0.9	2.3
	TOTAL	459	603	83,960	108,234	100.0	100.0
Beef Heifers	0.0	46	41	5,622	4.127	18.0	17.7
	0.1 - 5.0	147	114	28,535	19,751	57.4	49.3
	5.1 - 10.0	40	54	8,040	10,385	15.6	23.4
	10.1 - 15.0	12	14	2,167	2,676	4.7	6.1
	15.1 - 25.0	8	3	1,229	382	3.1	1.3
	Over 25.1	3	5	610	531	1.2	2.2
	TOTAL	256	231	46,203	37,852	100.0	100.0
Holstein Steers	0.0	22	4	1,812	322	24.4	8.3
	0.1 - 5.0	51	29	5,597	3,184	56.7	60.4
	5.1 - 10.0	10	4	982	419	11.1	8.3
	10.1 - 15.0	5	5	454	502	5.6	10.5
	15.1 - 25.0	1	4	80	418	1.1	8.3
	Over 25.1	1	2	64	100	1.1	4.2
	TOTAL	90	48	8,989	4,945	100.0	100.0

PERFORMANCE, CARCASS, AND MEAT PALATABILITY TRAITS OF OPEN AND 30-MONTH OLD HEIFERS THAT PRODUCED ONE CALF

A.W. Waggoner, M.E. Dikeman, and J.R. Brethour[1]

Summary

Eighty-seven 3/8 Simmental x 5/8 Hereford heifers calved at 2 years of age and were designated as Single-Calf-Heifers (SCH). Twenty-six heifer mates that did not calve were designated as 2-year-old open heifers (2-OH), and 22, 1 year-old open heifers (1-OH) from the same source served as controls. All heifer groups were fed a high-grain diet for 112 to 137 days before slaughter. The SCH were started on feed about 1 month after calving, and their calves were weaned early about 5 weeks prior to slaughter. Thirty-three of the SCH were implanted with Synovex-H® after calving. Carcass data were obtained, and rib steaks were collected and evaluated for palatability.

Our results indicate that it is possible to produce carcasses with desirable weights, USDA quality and yield grades, and taste panel palatability ratings from heifers that have produced one calf, and then were fed a high-grain diet and slaughtered by 30 months of age. However, ribeye steaks of SCH were not as tender as those from 1-OH. Implanting heifers that have calved may result in more "hard-boned" carcasses, but likely will increase dressing percent. Cattlemen willing to provide intensive management may find that the SCH system has considerable potential.

Introduction

During the last 40 years, heifers in the U.S. slaughter mix have nearly doubled. A unique system for managing heifers for slaughter is the Single-Calf-Heifer (SCH) system, which involves retaining surplus heifers, breeding them to produce one calf, then placing the heifers and their calves in a feedlot beginning shortly after calving.

The SCH system is very efficient because it combines reproduction and meat production into one system. This system results in a dramatically higher salvage value of the heifer, relative to mature cows, and virtually eliminates maintenance costs generally associated with traditional cow-calf operations.

Preliminary results indicated that when the traditional cow-calf system was replaced with the SCH system, estimated returns increased about 3.8 times. Also, carcasses produced from the SCH system received USDA quality and yield grades similar to those of heifers of similar ages that had not calved. Because little is known about the effects of pregnancy, parturition, and lactation on physiological maturity, meat tenderness, and other palatability traits, our objectives were to evaluate those traits from cattle produced by the SCH system.

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[1] Fort Hays Branch Experiment Station.

Experimental Procedures

One hundred and thirteen 3/8 Simmental x 5/8 Hereford heifers, born in the spring of 1985, were pasture exposed to bulls at 14 to 16 months of age. Eight-seven heifers calved at about 2 years of age and were designated as Single-Calf-Heifers (SCH); 33 were implanted (I-SCH) with Synovex-H® and 54 were not implanted (NI-SCH). Twenty-six of the 113 heifers that did not calve were designated as 2-year-old open-heifers (2-OH) and served as controls. Additionally, 22, 1-year-old open heifers (1-OH), born in the spring of 1986 from the same source, were utilized for comparitive purposes as the standard heifer-production system.

The 1-OH and 2-OH groups were fed a high-grain diet for 137 and 112 days, respectively, before slaughter. Heifers that calved were started on the same high-grain diet about 1 month after calving and were fed for 137 days. The I-SCH were implanted when started on the high-grain diet. Calves were early-weaned about 5 weeks prior to slaughter, so the heifers would dry up.

Because of the normal range in calving dates, the SCH were sorted into two groups, started on feed about 1 month apart, and consequently slaughtered in two groups about 1 month apart.

After slaughter and chilling, carcasses were evaluated for USDA yield and quality grades. Fifteen wholesale ribs were randomly selected from each treatment group and vacuum aged for 7 days. Three steaks, 1 inch thick were removed from the 10th, 11th, and 12th rib-regions. Steaks from the 10th and 11th rib region were cooked to 158 F for Warner-Bratzler shear (WBS) force determinations and trained taste panel evaluations. Steaks from the 12th rib region were utilized for total and soluble collagen measurements. Six thoracic buttons from each wholesale rib were collected and analyzed for calcium content.

Results and Discussion

Performance characteristics of treatment groups are given in Table 34.1. Feedlot average daily gains were highest ($P<.05$) for 2-OH, and no differences ($P>.05$) occurred among the other treatments. Apparently, the 2-OH were able to convert most of their energy intake above maintenance to gain, whereas I-SCH and NI-SCH had to use energy above maintenance for both gain and milk production. The advantage in gain for 2-OH over 1-OH likely was due to their larger size and greater feed capacity.

Both I-SCH and 2-OH had heavier ($P<.05$) carcasses than 1-OH; whereas, NI-SCH were intermediate in carcass weights. The NI-SCH exhibited the lowest ($P<.05$) dressing percentages (60.7%),whereas there were no differences among the other treatments (range of 62.7 to 63.7%). Single-calf-heifers had acceptable average daily gains and carcass weights when compared to 1-OH. However, we have no explanation for the low dressing percentages of our NI-SCH.

There were no differences ($P>.05$) in ribeye firmness, incidence of heat ring, USDA marbling scores, and quality grades among treatment groups (Table 34.2). As expected, 1-OH had the lightest ($P<.05$) colored ribeye, whereas there were no ribeye color differences among the other treatment groups. Except for color, visual quality traits of the ribeye from heifers that calved were equal to those of 1-OH and 2-OH.

Kidney, pelvic, and heart-fat percentages were highest ($P<.05$) for 1-OH, whereas no differences existed among the other treatments (Table 34.2). There were no differences ($P>.05$) in measured or adjusted fat thicknesses, ribeye areas, or USDA yield grades among treatment groups.

Data from Tables 34.1 and 34.2 demonstrate that carcass weights and USDA quality and yield grades were equally desirable for 2-OH, I-SCH, and NI-SCH. Therefore, having a calf had no negative effects on these traits.

The SCH had higher ($P<.05$) maturity scores than 1-OH for all eight maturity characteristics (Table 34.3). Also, I-SCH were more mature ($P<.05$) than 2-OH in five of the eight maturity characteristics. However, I-SCH did not differ ($P>.05$) from NI-SCH in any of the eight maturity characteristics. It should be noted that two of the I-SCH and one of the NI-SCH were classified as "C" bone maturity ("hard boned"), causing them to be graded "commercial" and decreasing their carcass values.

Cooking loss percentages and taste panel juiciness and flavor scores did not differ ($P>.05$) among treatment groups (Table 34.4). Tenderness scores were higher ($P<.05$) and WBS values were lower ($P<.05$) for ribeye steaks from 1-OH than from I-SCH and NI-SCH. Additionally, 1-OH had less ($P<.05$) detectable connective tissue than 2-OH. The 2-OH had lower ($P<.05$) WBS values than I-SCH, but not NI-SCH. These results indicate that the combined effects of implanting and having a calf did not decrease ribeye palatability, but increased WBS values. However, increased age increased detectable connective tissue, and the combined effects of increased age and having a calf were detrimental to all tenderness traits. Having a calf or implanting, independently, had no negative effects on taste panel tenderness.

The 1-OH heifers were superior in tenderness to SCH. However, tenderness and other palatability traits of SCH generally were equal to those of 2-OH. Therefore, the SCH system results in meat palatability comparable to that of similar-aged heifers that have not calved.

There were no differences ($P>.05$) in amount of soluble, insoluble, and total collagen or percent soluble collagen among treatment groups (Table 34.5). As expected, the 1-OH had a lower ($P<.05$) percentage of calcium in the thoracic buttons than any of the other treatment groups, which did not differ ($P>.05$) (Table 34.5).

Table 34.1. Least Squares Means for Performance Characteristics of 1-Year-Old-Open-Heifers, 2-Year-Old-Open-Heifers, and Implanted and Nonimplanted Single-Calf-Heifers

	Treatment			
Characteristics	1-OH	2-OH	I-SCH	NI-SCH
Number of Heifers	22	26	33	54
Days in Feedlot	137	112	137	137
Feedlot Gain, lb/d	2.42^{a}	2.87^{b}	2.21^{a}	2.21^{a}
Hot Carcass wt, lb	653^{b}	745^{c}	719^{c}	703^{bc}
Dressing Percent	63.7^{a}	63.0^{a}	62.7^{a}	60.7^{b}

^{ab}($P<.05$).

Table 34.2. **Least Squares Means for Qualtiy and Yield Characteristics of 1-Year-Old-Open-Heifers, 2-Year-Old-Open-Heifers, and Implanted and Nonimplanted Single-Calf-Heifers**

Characteristics	Treatments			
	1-OH	2-OH	I-SCH	NI-SCH
Lean Color[a]	2.0^{f}	2.6^{g}	2.6^{g}	2.5^{g}
Lean Firmness[b]	2.6	2.8	2.5	2.6
Heat-ring Incidence[c]	1.5	1.3	1.4	1.5
USDA Marbling Score[d]	Sm^{21}	Sm^{03}	Sm^{01}	Sm^{14}
USDA Quality Grade[e]	Ch^{0}	Se^{86}	Se^{88}	Se^{88}
Fat Thickness, in.	.28	.32	.36	.36
Adjusted Fat Thickness, in.	.28	.36	.36	.44
Kidney, Pelvic and Heart Fat, %	2.9^{f}	1.8^{g}	1.7^{g}	2.1^{g}
Longissimus Area, sq. in.	14.1	14.4	14.3	14.1
USDA Yield Grade	2.0	2.0	2.0	2.2

[a] Color of lean: 2 = cherry red, 3 = slightly dark red.

[b] Firmness of lean: 2 = firm, 3 = moderately firm.

[c] Presence of heat ring (dark coarse band): 1 = none, 2 = slight.

[d] Sm = Small. Minimum Small = Sm^{00}, Maximum Small = Sm^{99}.

[e] Ch = Choice, Se = Select. High Select = Se^{50} to Se^{99}, Low Choice = Ch^{0} to Ch^{33}.

[fg] ($P<.05$).

Table 34.3. **Least Squares Means for Maturity Characteristics of 1-Year-Old-Open-Heifers, 2-Year-Old-Open-Heifers, and Implanted and Nonimplanted Single-Calf-Heifers**

Ribeye Steak Characteristics	Treatment			
	1-OH	2-OH	I-SCH	NI-SCH
USDA Bone Maturity:				
Sacral[a]	75^{b}	89^{bc}	108^{d}	100^{cd}
Lumbar[a]	69^{b}	83^{bc}	101^{d}	94^{cd}
Thoracic[a]	64^{b}	88^{bc}	114^{d}	99^{cd}
Feather Bone[a]	80^{b}	101^{c}	106^{c}	114^{c}
Rib Bone[a]	89^{b}	100^{bc}	114^{c}	110^{c}
Overall Bone Maturity	74^{b}	93^{bc}	113^{d}	105^{cd}
USDA Lean Maturity[a]	55^{b}	81^{c}	87^{c}	79^{c}
USDA Carcass Maturity[a]	70^{b}	90^{c}	108^{d}	98^{cd}

[a] Scores based on: 0-99 = A maturity, 100-199 = B maturity, 200-299 = C maturity ("hard boned").

[bcd] ($P<.05$).

Table 34.4. Least Squares Means for Sensory Traits of Longissimus Steaks from 1-Year-Old-Open-Heifers, 2-Year-Old-Open-Heifers, and Implanted and Nonimplanted Single-Calf-Heifers

	Treatment			
Characteristics	1-OH	2-OH	I-SCH	NI-SCH
Juiciness[a]	5.6	5.7	5.7	5.5
Flavor Intensity[a]	6.0	6.1	6.1	5.9
Myofibrillar Tenderness[a]	6.3[c]	5.9[cd]	5.5[d]	5.4[d]
Connective Tissue Amount[a]	7.0[c]	6.6[d]	6.5[d]	6.5[d]
Overall Tenderness[a]	6.4[c]	6.1[cd]	5.7[d]	5.6[d]
Cooking Losses, %	19.2	19.9	20.9	20.0
Shear Force, kg[b]	6.8[c]	7.3[cd]	8.6[e]	7.7[de]

[a] A score of 7 = very juicy, intense, tender, practically none and tender; 6 = moderately juicy, intense, tender, moderate amount and tender; 5 = slightly juicy, intense, tender, slight amount and tender.

[b] Warner-Bratzler shear force determinations made on 1.27 cm diameter cores.

[cde] ($P<.05$).

Table 34.5. Least Squares Means for Collagen Characteristics of 1-Year-Old-Open-Heifers, 2-Year-Old-Open-Heifers, and Implanted and Nonimplanted Single-Calf-Heifers

	Treatment			
Characteristics	1-OH	2-OH	I-SCH	NI-SCH
Number of Heifers	15	15	15	15
Insoluble Collagen, mg/g	1.99	1.91	1.86	2.02
Soluble Collagen, mg/g	0.28	0.26	0.20	0.24
Total Collagen, mg/g	2.26	2.17	2.06	2.27
Soluble Collagen, %	13.53	12.47	10.15	10.91
Button Calcium, %	.52[a]	3.04[b]	3.87[b]	3.19[b]

[ab] ($P<.05$).

A COMPARISON OF FLAVOR AND TENDERNESS BETWEEN DRY-AGED AND VACUUM-AGED BEEF STRIP LOINS

K. Warren and C.L. Kastner

Summary

Starting 3 days postmortem, sections from eight USDA Choice or better, yield grade 4, strip loins were dry-aged (aged unpackaged) or vacuum-aged (aged in vacuum bags) for an additional 11 days. The dry-aged loins lost more ($P<.05$) weight during aging than vacuum-aged loins, and cooked faster, with less ($P<.05$) cooking loss than the unaged loins. Vacuum- and dry-aged samples were similar ($P>.05$) in tenderness, and both were more tender ($P<.05$) than unaged counterparts. A trained taste panel found no differences in subcutaneous fat flavor. However, lean from the vacuum-aged samples had a more intense sour flavor note and more intense bloody/serumy flavor and metallic notes than either of the other treatments. The lean of dry-aged samples was beefier and had more brown/roasted flavor than vacuum-aged or unaged counterparts.

Introduction

Aging is an established method of increasing tenderness and developing flavor in fresh beef. Traditionally, beef carcasses or primal cuts were stored in a cooler for the desired length of time, allowing for tenderization and development of the characteristic aged flavor. From this procedure came the term "dry-aging". However, since the advent of boxed beef, much of the aging process has occurred in vacuum bags during shipping of subprimals. As vaccum aging gained popularity because of convenience, higher yields, and longer shelf-life, traditional dry-aged beef became more of a specialty item. Although some prefer dry over vacuum aging, the comparisons of palatability between vacuum- and dry-aged product are not well documented and need to be more clearly defined.

Our objective was to determine if there are differences in aging loss, cooking characteristics, tenderness, and flavor between vacuum-aged, dry-aged, and unaged beef, and to characterize any differences in flavor.

Experimental Procedures

At 3 days postmortem, eight strip loins, yield grade 4 and Choice grade or better were randomly selected. Three 1-inch steaks were removed from the center of each loin for use as unaged controls. The remaining anterior and posterior portions were then weighed and randomly assigned to either the dry-aged or vacuum-aged treatment. The vacuum-aged portions were sealed in a vacuum package barrier bag. Both vacuum- and dry-aged portions were aged for 11 days (to 14 days postmortem) at 38 ± .5 F and 78 ± 3 % relative humidity. Air in the room was recirculated every 30 min and passed through ultraviolet light upon reentry to kill bacteria. At the end of aging, cuts were weighed, and steaks were removed from the central end of each portion. All sample steaks were individually vacuum packaged and immediately stored frozen at −60 F until evaluated. No additional trimming was done aside from "facing" the dry-aged strip loins before steak removal.

Sample Preparation

The steaks were allowed to thaw approximately 18h at 36±2 F in a refrigerator, weighed, and broiled to an internal temperature of 158 F. The cooked steaks were lightly blotted and weighed, and subcutaneous fat was separated from the lean.

Lean samples: All muscles except the longissimus (LD) were removed. The connective tissue under the subcutaneous fat also was removed from the LD. One cm-wide samples were cut across the muscle to ensure that each sample had a portion of the outer edge.

Fat samples: The subcutaneous fat was trimmed of all lean and cut into 1 cm samples.

Both lean and fat samples were evaluated for uniformity of doneness and brownness before serving. Samples were kept warm in covered beakers in a 150 F oven if not served immediately, with no samples warmed in the oven more than 5 min before serving and evaluation.

Taste Panel Training

A five-member, professional, trained taste panel from the Kansas State Univ. Sensory Analysis Center was used. The panelists were trained in open discussion sessions using extra samples from all three treatments to determine the potential flavor notes, their range of intensities, their descriptors, and tenderness (Table 35.1). The "training" steaks were prepared using the same cooking procedures as the sample steaks.

All evaluations were conducted in individual booths equipped with red lights. Water and apple slices were used between samples, and no more than six fat and six lean samples were presented at each session.

Results and Discussion

Aging losses, cooking times, and cooking losses are shown in Table 35.2. Vacuum-aged strip loin sections had less ($P=.0001$) loss during aging than dry-aged sections. Furthermore, dry-aged loins had shorter ($P<.05$) cook times and lower ($P<.05$) cook losses than unaged sections. However, cooking times and losses were similar between the two aging treatments.

Taste panelists determined that vacuum- and dry-aged samples were similar in tenderness and both were more tender ($P<.05$) than the unaged samples (Table 35.3). In the lean component, dry-aged samples had a more beefy flavor ($P=.0001$) and a more brown-roasted flavor ($P=.0001$) than vacuum-aged or unaged samples. Vacuum-aged samples had a more intense sour note ($P=.0002$) and more bloody-serumy flavor ($P=.0001$) than either the dry-aged or unaged samples. Also, the vacuum-aged samples had a more intense metallic note

(P<=.0001) than the dry-aged beef. The unaged samples tended to be intermediate in lean flavor traits. No differences (P=.56) existed between treatments for fat flavor intensity or the browned impression (P=.33) of the fat. However, dry-aged fat samples had a greater incidence of "other" flavors than the vacuum-aged or the unaged steaks. Some of the more common descriptions for dry-aged beef were "stale", "old", and "soapy." "Stale" was detected in the unaged beef, and "sour" and "stale" were detected in vacuum-aged beef. Frequency of other flavors in the lean were also noted more often for both the vacuum- and dry-aged samples than for unaged samples; common descriptions were "liver" and "bitter."

Whether vacuum- or dry-aging was used, tenderness was improved by aging. Both aging techniques gave equal tenderization, and preference for one aging treatment over the other based on tenderness is not justified. However, preference can be based on flavor differences. For example, if more intense beefy and brown/roasted flavor are assumed to be desirable, then dry aging could be preferred to vacuum aging or no aging. However, treatment preference must also consider other factors such as relative aging loss, incidence of spoilage, and cost per pound.

Table 35.1. Descriptors for Tenderness and Fat and Lean Flavor Notes

Tenderness[a]:	The force required to compress and penetrate the sample in the first 3 to 5 chews using the molars/biscuspids. Panelists were trained to exclude connective tissue influence, which was minimal in the longissimus. The outer edge of the sample was excluded to avoid the influence of surface drying.
Lean[a]:	
Beefy	Aromatic impression of beefiness ranging from mild as in veal to strong as in round steak from mature beef
Brown/Roasted	Aromatic impression associated with browned, cooked meat
Bloody/Serumy	Aromatic impression associated with the redness of rare meat
Metallic	Aromatic impression found when placing a silver spoon on the tongue
Sour	Acidic taste factor
Fat[a]:	
Fat flavor intensity	Overall intensity of fat aromatics, off notes, and brownness
Browned impression	Aromatic impression associated with grilled fat

[a] 1 - threshold; 2,3,4 - slight/mild; 5,6,7 - moderate; 8,9,10 - strong/very strong.

Table 35.2. Aging Loss, Cooking Loss, and Cooking Time Means by Treatment

Trait	Unaged	Vacuum-aged	Dry-aged
Aging loss, %	---	0.76^{a}	13.65^{b}
Cooking loss, %	32.63^{a}	30.84^{ab}	26.31^{b}
Cooking time, min	28.25^{a}	25.25^{ab}	21.88^{b}

[ab] Means in a row with different superscripts are significantly different ($P<.05$).

Table 35.3. Taste Panel Descriptor Means by Treatment

Trait	Unaged	Vacuum-aged	Dry-aged
Tenderness	5.84^{a}	6.96^{b}	6.81^{b}
Lean:			
Beefy	5.71^{a}	5.64^{a}	5.98^{b}
Bloody/Serumy	3.51^{a}	3.91^{b}	3.19^{a}
Brown/Roasted	5.04^{a}	4.74^{a}	6.01^{b}
Metallic	2.31^{ab}	2.50^{a}	2.18^{b}
Sour	2.63^{a}	2.96^{b}	2.58^{a}
Fat:			
Fat	5.98^{a}	5.91^{a}	6.04^{a}
Brown Impression	5.65^{a}	5.65^{a}	5.51^{a}
Frequency of Other Flavors[c]:			
Lean	5.0	30.0	32.5
Fat	25.0	32.5	57.8

[ab] Means in a row with different superscripts are different ($P<.05$).
[c] Expressed as a percentage to total responses for each treatment.

IMPACT OF CASH SETTLEMENT ON FEEDER CATTLE HEDGING RISK[1]

J.R. Mintert[2] and T.C. Schroeder[2]

Summary

One of the principal motivations for the introduction of cash settlement in feeder cattle futures contracts was to reduce basis risk. This study examined expected changes in hedging risk attributable to the adoption of cash settlement. The estimates of cash settlement futures hedging risks were generally smaller than estimates of hedging risks using the physical-delivery futures. The reduction in hedging risk was greatest for feeder steers meeting futures contract weight specifications, but reductions were also common for other weight classes and for heifers.

Introduction

The viability of the feeder cattle futures contract as a hedging mechanism has been a source of controversy for some time. Successful hedging requires that the hedger be able to accurately forecast basis (cash price minus futures price) on the expected sale date. Basis risk represents the inability to accurately forecast basis for the intended sale date. Concern has been expressed that the large amount of basis risk present at both futures contract delivery and non-delivery points discouraged cattle producers from hedging in the feeder cattle futures market. As a result, the Chicago Mercantile Exchange significantly modified its feeder cattle futures contract specifications in 1986. Settlement via physical delivery was eliminated and cash settlement was adopted beginning with the September 1986 feeder cattle futures contract. Under cash settlement, futures contracts still outstanding at contract expiration are settled at the Cattle-Fax U.S. feeder steer price (USFSP). The USFSP is an average of 600 to 800 lb feeder steer prices weighted by the census of feeder cattle in each of four U.S. regions (comprising a total of 27 states) on January 1.

It was predicted that cash settlement would alter basis, and that basis risk would be significantly reduced because the volatile incremental cost of making or taking delivery would be eliminated. Our study tested whether the change to cash settlement of feeder cattle futures was likely to impact hedging risk for 600-700 lb and 700-800 lb feeder steers.

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[1] Appreciation is expressed to Orlan Buller and Kevin Dhuyvetter for helpful comments on an earlier version of this manuscript.

[2] Department of Agricultural Economics.

Experimental Procedures

The relationship between feeder cattle cash and futures prices was examined using both delivery settlement feeder cattle futures prices and the USFSP. Basis risk was examined for nearby futures contracts only, covering the period from 4 weeks prior to contract expiration through the week of expiration.

The relationship between the cash and futures prices was estimated using the following equation:

$$\text{Cash Price} = b + h(\text{Futures Price})$$

The coefficient, h, is called the hedge ratio. The hedge ratio is an estimate of the relative price change between the futures and cash markets and is 1.0 if each dollar move in cash price corresponds to a 1 dollar move in futures. The hedge ratio indicates how large a hedger's futures market position should be relative to his cash market position. The b term in the equation could be referred to as a hedge ratio-weighted basis. If the hedge ratio (h) equals one, then b represents the standard basis definition; cash price minus futures price.

Estimates of hedging risk were computed using weekly Dodge City, Kansas cash feeder cattle prices for the delivery settlement and cash settlement feeder cattle futures contracts over the 1977 through August 1986 period. Since there was no cash settlement prior to the September 1986 contract, the USFSP was used as a substitute for the cash settled feeder cattle futures prices over this historical period. That price series is a good substitute for the nearby cash settlement futures price, since it is now used to settle any contracts outstanding at expiration.

Results and Discussion

Hedge ratios for 600 to 800 pound feeder steers generally were not significantly different from one, which was expected since these cattle match the feeder cattle futures contract specifications. Since the hedge ratio is approximately one for this class of cattle, changes in hedging risk essentially measure changes in basis risk. Cattle not meeting contract specifications, such as lighter weight steers and heifers, have hedge ratios that differ from one. In that case, estimated reductions in hedging risk assume that the hedger has weighted his futures market position relative to his cash market position by the hedge ratio. As a result, reductions in hedging risk for cattle not meeting feeder cattle futures contract specifications generally differ from a reduction in basis risk.

For all of the contract months, there was less hedging risk in the cash-settled feeder cattle futures for 600-700 lb (Figure 36.1) and 700-800 lb (Figure 36.2) steers than in the physical delivery futures contract. Seventy-five percent of the reductions in hedging risk were significantly different from zero ($P<.05$). The reductions in hedging risk attributable to the change to cash settlement were frequently greater than 15 percent.

Estimated reductions in hedging risk attributable to cash settlement vary by weight, sex, market location, and contract month. Results detailing the changes in hedging risk for cattle that do not meet futures contract specifications are available from the authors.

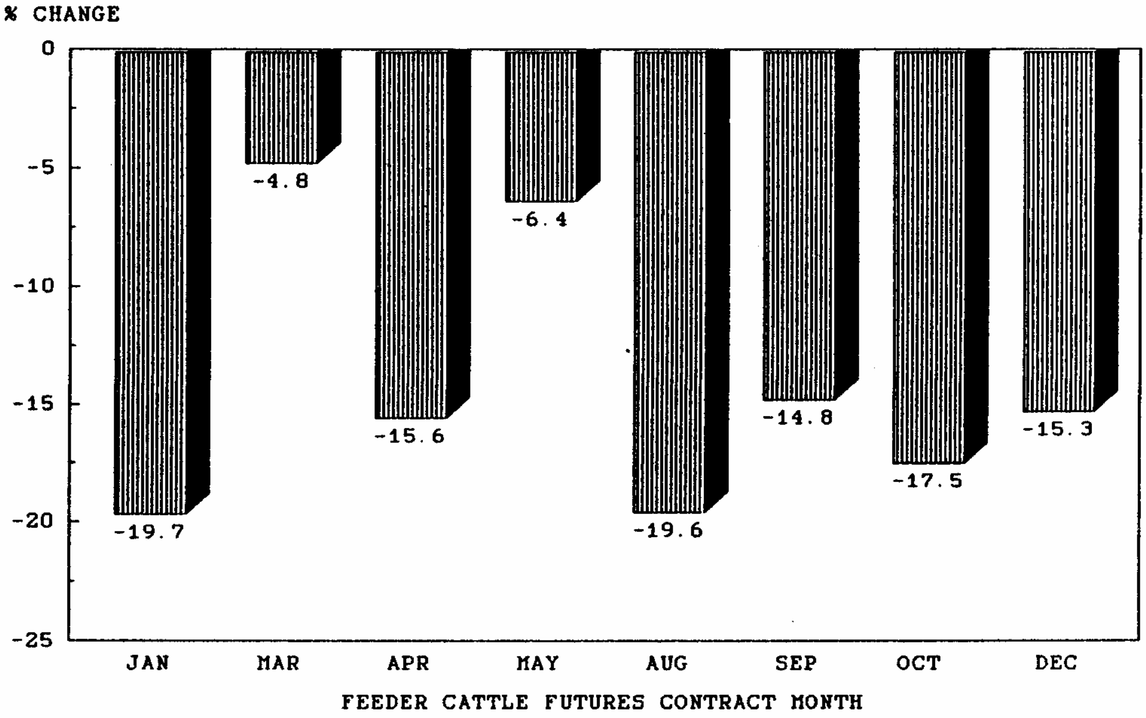


Figure 36.1. Changes in Hedging Risk Attributable to Cash Settlement, Dodge City 600-700 lb Steers.

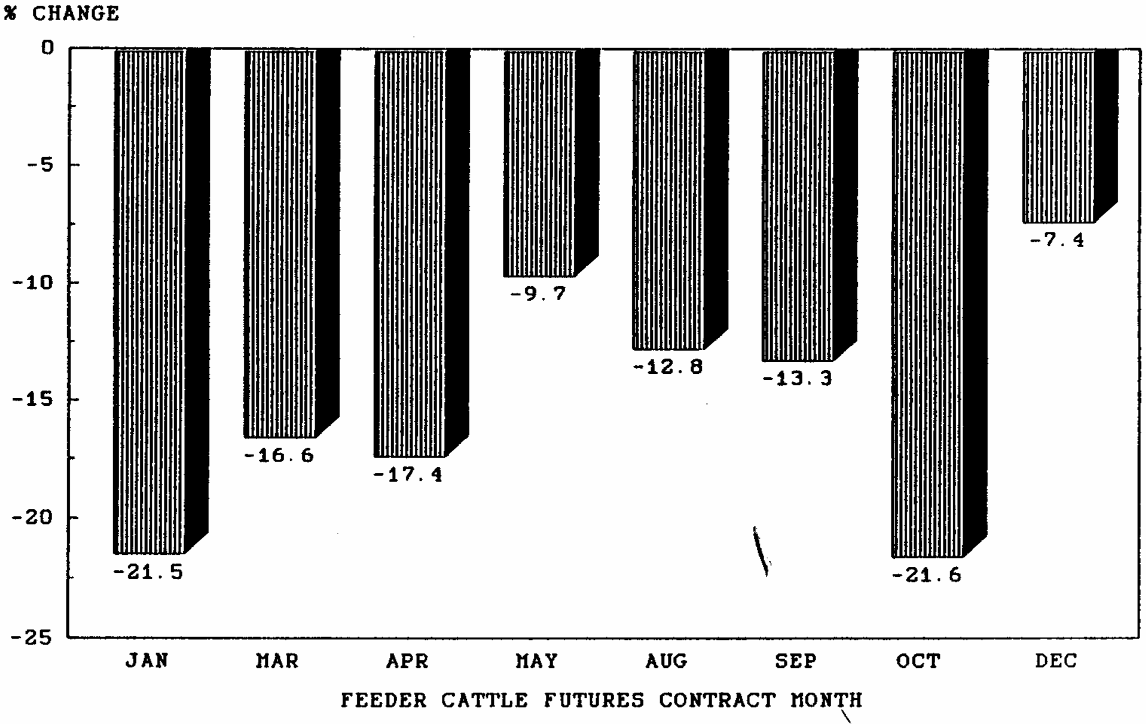


Figure 36.2. Changes in Hedging Risk Attributable to Cash Settlement, Dodge City 700-800 lb Steers.

BIOLOGICAL VARIABILITY AND STATISTICAL EVALUATION OF DATA

The variability among individual animals in an experiment leads to problems in interpreting the results. Cattle on treatment X may have higher average daily gains than those on treatment Y, but variability within treatments may mean that the difference was not the result of the treatments alone. Statistical analysis lets researchers calculate the probability that such differences were from chance rather than the treatments imposed.

In some articles, you will see notations such as "P<.05." That means the probability of the differences resulting from chance is less than 5%. If two averages are said to be "significantly different," the probability is less than 5% that the difference is due to chance. Thus, the probability exceeds 95% that the difference results from the treatment.

Some papers report correlations; measures of the relationship between traits. The relationship may be positive (both traits tend to get bigger of smaller together) or negative (as one trait gets better, the other gets smaller). A perfect correlation is one (+1 or -1). If there is no relationship, the correlation is zero.

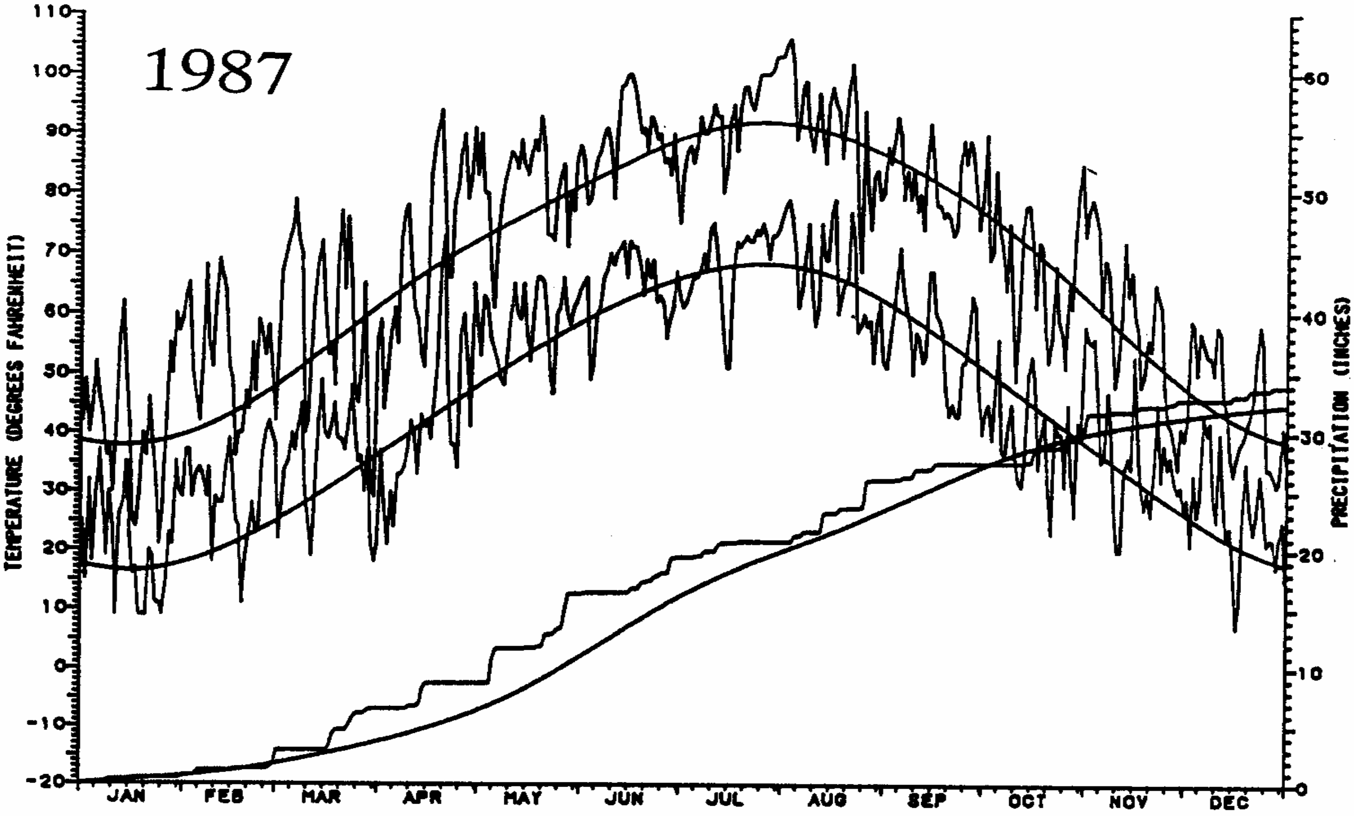
In other papers, you may see an average given as 2.50 ± .10. The .10 is the "standard error." The standard error is calculated to be 68% certain that the real mean (with unlimited number of animals) would fall within one standard error from the mean - in this case, between 2.40 and 2.60.

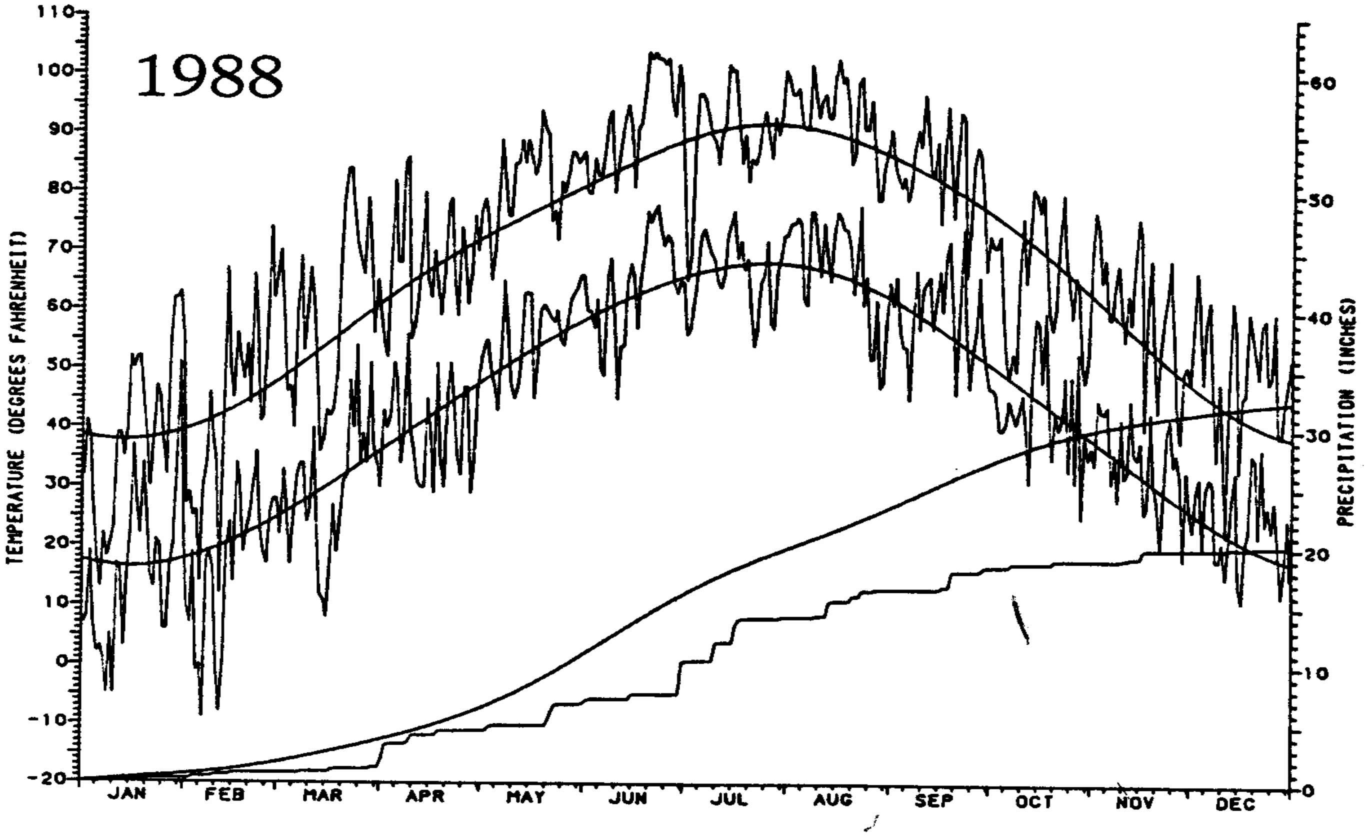
Many animals per treatment, replicating treatments several times, and using uniform animals increases the probability of finding real differences when they exist. Statistical analysis allows more valid interpretation of results, regardless of the number of animals used in a trial. In nearly all the research reported here, statistics are included to increase the confidence you can place in the results.

WEATHER DATA, 1987-1988

On the following page are graphs of 1987 and 1988 Manhattan weather, produced by the Kansas Agricultural Experiment Station Weather Data Laboratory, and Dr. L. Dean Bark, Experiment Station Climatologist. The smooth line that starts in the lower left hand corner of each graph is the normal accumulated precipitation. The rough line represents actual precipitation. A long horizontal section of that line represents time during which no precipitation occurred. A vertical section represents precipitation. The other two smooth lines represent average daily high and low temperatures, and the rough lines represent actual highs and lows.

These graphs are included because much of the data in this publication, especially data on animal maintenance requirements and forage yields can be influenced by weather. Weather graphs have been included in Cattlemen's Day publications for the past four years.





Graphical Weather Summary for Manhattan, Kansas

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Cattlemen's Beef Promotion and Research Board, Chicago, Illinois
Ceva Laboratories, Overland Park, Kansas
Chr. Hansen's Laboratories, Milwaukee, Wisconsin
Church & Dwight Company, Inc., Piscataway, New Jersey
C-I-L, Inc., London, Ontario, Canada
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Ellis County Feeders, Hays, Kansas
Excel Corporation, Wichita and Dodge City, Kansas
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Finnish Sugar Co., LTD, Espoo, Finland
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Hatchet Brand and Cattle, Pratt, Kansas
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InterBio, Inc., Naperville, Illinois
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Iowa Limestone Company, Des Moines, Iowa
Kansas Beef Council, Topeka, Kansas
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The Livestock & Meat Industry Council, Inc.

The Livestock and Meat Industry Council, Inc. (LMIC) is a nonprofit, educational, and charitable corporation, which receives and distributes funds that play an important role in programs of the Department of Animal Sciences and Industry. The council is controlled by industry people. Funds generated by the LMIC help accomplish many teaching and research goals.

Funds contributed to the Council are deposited with the Kansas State University Foundation and are used as directed by the Council's Board of Directors or by its Project Review Committee. Donors receive credit from both organizations.

The Council's individual projects are numerous. The LMIC has raised nearly $500,000 in money and gifts-in-kind for research and teaching equipment to complete the Weber Hall addition and rennovation. Our next goal is to raise $1,000,000 to the "The Don L. Good Endowment for Excellence in Animal Agriculture." Earnings from this fund will be used for teaching and research needs for the Department of Animal Sciences and Industry that will ultimately help the entire livestock industry.

If we are to continue research, our industry needs to supplement state and federal funds. Our industry also needs to help support its own research and teaching programs to train tomorrow's industry leaders.

The LMIC is asking livestock producers, agribusiness people, and friends of the livestock and meat industry for liberal contributions. Gifts can be cash, livestock, other gifts-in-kind, or land. Land gifts can be set up as a unitrust that affords the donor a tax deduction and provides for a life income. This offers you the opportunity to invest in your future and in your children's future. All contributions are tax deductible, and all contributors become Council members. Checks should be made to the KSU Foundation, LMIC Fund and mailed to:

Livestock and Meat Industry Council, Inc.
Weber Hall, Kansas State University
Manhattan, KS 66506

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