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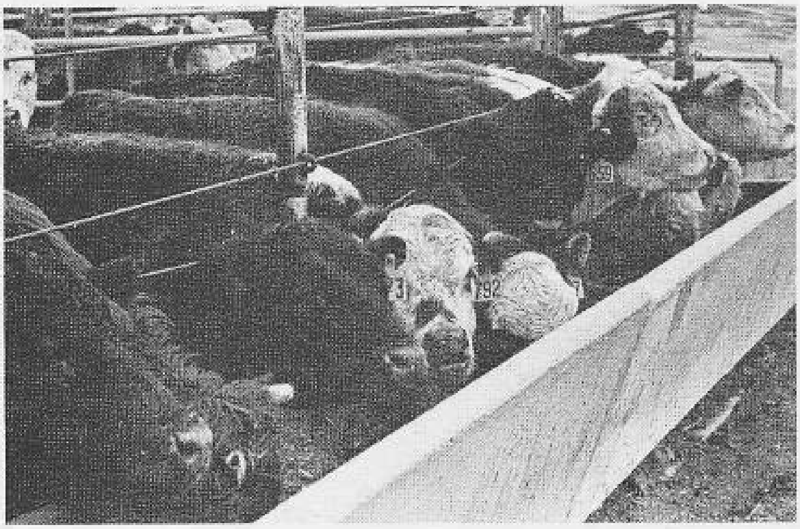

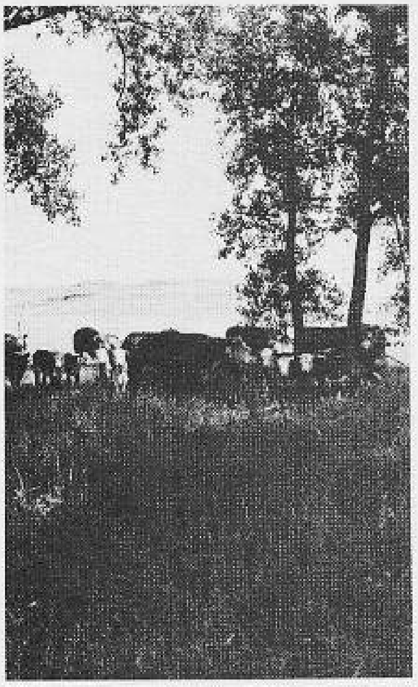

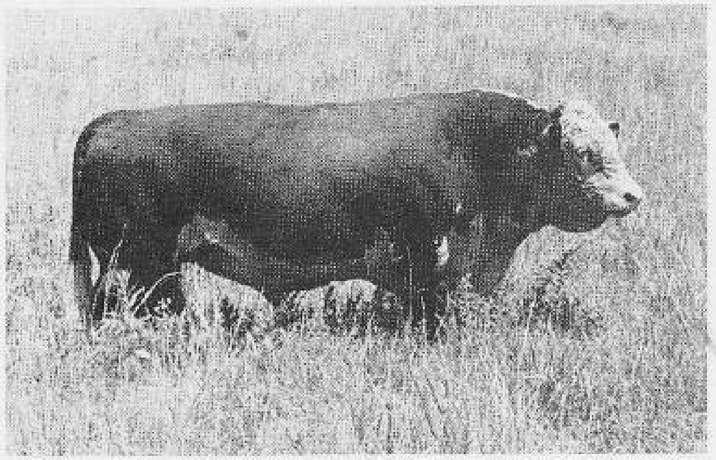

CONTENTS

Feedlot

Meats

Cowherds and Reproduction

Forages

Biological Variability and Chances of Error

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

In some of the articles that follow, you will see the notation "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 from chance--the probability exceeds 95% that the difference results from the treatment.

Some papers will report a correlation between two traits. Correlations are a measure of the relationship between traits. The relationship may be positive (both traits tend to get bigger or small together) or negative (as one trait gets bigger, 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 a mean given as 2.50±.10. The 2.50 is the mean; .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 (2.50-.10 = 2.40 and 2.50+.10= 2.60).

Many animals per treatment, replicating treatments several times, and using uniform animals increases the probability of showing the real differences resulting from treatments. The statistical analysis allows more valid interpretation of the results regardless of the number of animals. In nearly all the research reported here, statistical analyses are included to increase the confidence you can place in the results.

The Toxicity of Liquid Supplements Containing Urea

Erle E. Bartley

Summary

Liquid supplement manufacturers must provide a product that is effectively utilized and is nontoxic. Toxicity can be reduced if the supplement's pH is below 3.8, but low pH alone does not improve nutritive value. A good fermentable source of carbohydrate, like molasses or cooked starch, should be provided in adequate amount. When water or lignin sulfonates are substituted for good carbohydrate, urea utilization is reduced and the risk of toxicity is increased.

Cattle that are hungry or starved from blizzard conditions or feed restriction are much more susceptible to ammonia toxicity than cattle kept full, so limit the availability of liquid supplements to hungry cattle. Urea is safer if cattle are adapted to it. Always start cattle on urea-containing feeds slowly and keep them full of other feed.

Introduction

The present and future use of liquid supplements depends primarily on two factors: efficient utilization of the nonprotein nitrogen (NPN) source (usually urea) and freedom from toxicity. Ammonia toxicity is always possible when liquid supplements are improperly used. Ammonia toxicity cases from liquid supplements are brought to our attention regularly and many wind up in the courts. In recent years we have learned much about urea utilization in liquid supplements and how to reduce its potential toxicity.

Urea utilization in liquid supplements

Rumen bacteria convert such nonprotein sources as urea to ammonia. A good share of feed proteins also are converted to ammonia. This rumen ammonia "pool" is used by rumen microorganisms to make microbial protein, which is finally used in the small intestine.

Ammonia cannot be converted to microbial protein unless carbohydrate energy is available. But not all carbohydrates are equally useful. Cellulose from roughage is fermented too slowly. The best source appears to be starch, and cooked starch is better than raw. Molasses or hemicellulose extract (the carbohydrate in liquid supplements) are generally less effective than starch but are satisfactory.

In liquid supplements containing 10% urea and maximum molasses, energy for the microbes is marginal. So any attempt to cut costs by substituting water or lignin sulfonates for molasses may reduce urea utilization and increase the risk of ammonia toxicity. Lignin sulfonate, a byproduct of the wood pulp industry, has many of the physical properties of molasses, and has been substituted into liquid supplements. But our research shows it is a poor energy source. Water has also been added to liquid supplements, obviously cutting the supplements' energy.

Ammonia toxicity of liquid supplements

Urea consumed in large quantities over a short time can be toxic. Ammonia is produced in the rumen faster than it can be incorporated into microbial protein. The excess is absorbed into the blood, reaches the brain, and causes toxicity. The rumen must have a good energy source to allow the bacteria to convert the ammonia to microbial protein and to form volatile fatty acids (VFA) to lower the rumen pH. Ammonia occurs as free ammonia (NH_3) or the ammonium ion (NH_4^+), depending on pH. Low rumen pH shifts ammonia to the NH_4^+ form. Tissue membranes are permeable to NH_3 but are impermeable to NH_4^+, so more ammonia is absorbed when pH is high. In a study by a K-State team of researchers involving 244 cattle given 23 g urea per 100 lbs body weight, the urea was toxic to 125. In both toxic and nontoxic cases, total rumen ammonia concentration (NH_3 and NH_4^+) was the same. But rumen pH one hour after dosing averaged 7.41 in animals that showed toxicity and 7.16 for those that did not. The higher rumen pH for the toxic cases permitted about twice as much ammonia to be absorbed into the blood. The absorbed ammonia elevated the blood ammonia to .89 mg/100 ml blood in 60 min. In the nontoxic cases the free ammonia in the rumen was only approximately half that of the free ammonia in the toxic cases. Consequently the blood ammonia of the nontoxic cases reached only 0.53 mg in 60 min. Usually the blood ammonia needs to reach 0.8 mg before toxicity will occur. The rumen can handle considerable ammonia without toxicity, provided rumen pH is not much above 7.0.

If the rumen pH can be kept consistently below 7, ammonia toxicity from liquid supplements would be minimal. Low rumen pH can be achieved two ways: volatile fatty acid (VFA) production from carbohydrate fermentation, or adding acid (phosphoric) directly to the liquid supplement. Molasses-based supplements contain barely enough fermentable carbohydrate to sustain a low rumen pH through VFA production, so when molasses is diluted with water or with lignin sulfonates, the supplement may be toxic because fermentable carbohydrate is reduced.

Lowering a supplement's pH to 3.7 with phosphoric acid reduced rumen pH by .5 unit and prevented toxicity in animals fed 2 pounds of supplement per day. The 3.7 pH compared with a pH of 4.5 for the same supplement with less phosphoric acid.

We used rumen-fistulated adult cattle in 73 toxicity tests of 24 liquid supplements containing molasses, hemicellulose extract, or cooked starch as the major energy source (Table 1.1). Most supplements contained 10% urea. Phosphoric acid ranged from zero to 3%. All liquid supplements were added directly to the rumen at 23 g urea equivalent per 100 lb body weight The cattle were fasted 16 hr before dosing.

The results of the 73 tests are summarized in Table 1.2. The rumen ammonia concentrations at 60 min between the toxic and nontoxic supplements were similar (67.1 vs 72.9 mg/100 ml). Rumen pH remained below 7.0 for the nontoxic supplements, even when rumen ammonia increased 10-fold. When toxicity occurred, rumen pH increased, so free ammonia was readily absorbed into the blood.

Reducing phosphoric acid from 2.9 to 1.0% increased toxicity from 0 to 67% with a liquid supplement containing processed carbohydrate (cooked starch) and 10% urea (supplements 1 and 2, Table 1.1). Reducing phosphoric acid from 3.0 to 1.39, and molasses from 68.00 to 31.10% increased toxicity from 17 to 83% (supplements 3 and 4, Table .1). Undoubtedly both the reduction in acid and molasses contributed to the increased toxicity. Because reducing molasses alone (supplements 5 and 6, Table 1.1) did not affect toxicity, we can assume that the low pH of liquid supplements helped reduce their toxicity. Reducing the hemicellulose extract from 80 to 40% and increasing water from 10 to 40% increased toxicity from 25 to 75%. The response difference between molasses and hemicellulose extract probably stems from molasses being fermented faster than hemicellulose extract, as W. Anderson reported in a K-State thesis.

In another study (Table .3) we compared a liquid supplement with 69% molasses and 11% water (No. 1) with one containing 19% molasses and 61% water (No. 2). Though both contained 3% phosphoric acid, supplement No. 1 was toxic. Thus even with 3% phosphoric acid, there must be enough fermentable carbohydrate or toxicity will occur. Neither 20 or 40% lignin sulfonate (No. 3 and 4) provided enough fermentable carbohydrate to prevent toxicity.

Table 1.1. Composition and toxicity of liquid supplements

Ingredients	Supplement no. and composition (%)							
	1	2	3	4	5	6	7	8
Urea	9.90	9.90	10.00	10.00	10.00	10.00	10.00	10.00
Cane molasses	-	-	68.00	31.10	40.00	80.00	-	-
Hemicellulose extract	-	-	-	-	-	-	40.00	80.00
Processed carbohydrates	31.06	31.06	-	-	-	-	-	-
Phosphoric acid	2.91	1.00	3.00	1.39	-	-	-	-
Water	56.13	58.04	19.00	57.00	50.00	10.00	50.00	10.00
pH	3.8	4.3	3.3	4.1	5.2	5.1	4.5	4.6
				Toxicity				
No. toxic/no. tested	0/6	4/6	1/6	5/6	2/4	2/4	3/4	1/4
Percentage toxic	0	67	17	83	50	50	75	25

Table 1.2. Effects of urea containing liquid supplements on rumen pH, total rumen ammonia, free rumen ammonia, and jugular blood ammonia concentration.

Item	Time after liquid supplements were administered intra-ruminally (min)		
	0	30	60
		Rumen pH	
Nontoxic[a]	6.8	6.7	6.9
Toxic[b]	7.0	7.1	7.3
		Total rumen ammonia-N (mg/100 ml)	
Nontoxic	6.9	59.7	72.9
Toxic	7.0	68.3	67.1
		Free rumen ammonia-N (mg/100 ml)	
Nontoxic	.07	.47	.89
Toxic	.10	1.43	2.25
		Jugular blood ammonia-N (mg/100 ml)	
Nontoxic	.12	.36	.50
Toxic	.13	1.14	.88

[a] Mean of 53 observations.

[b] Mean of 20 observations.

Table 1.3. Effect on blood ammonia concentration of diluting molasses in liquid supplements with water or lignin sulfonate.

Formula	Blood ammonia
	mg/100 ml
1. 69% molasses, 11% water, 3% APP[a], 3% phos. acid	.29
2. 19% molasses, 61% water, 3% APP, 3% phos. acid	.78[b]
3. 49% molasses, 11% water, 3% APP, 3% phos. acid	.67[b]
4. 29% molasses, 11% water, 3% APP, 3% phos. acid 40% lignin sulfonate	.81[b]

[a] APP = ammonium polyphosphate

[b] Blood ammonia in the toxic range

Performance and Carcass Traits of Feeder Calves Scored for Muscling, Frame Size, and Condition

M. E. Dikeman, D. M. Allen and K. E. Kemp

Summary

Calves with different USDA frame sizes had similar carcass composition and quality when slaughtered within the recommended weight range for their frame size. Large-framed calves had higher dressing percentages and gained faster than medium- or small-framed calves. Condition score appeared more useful than muscling score to characterize calves' performance and carcass traits. Calves thin at weaning had poorer performance, lower marbling scores, less fat, and higher retail product percentages than calves in medium or fat condition at weaning. Medium condition calves gained faster, had less fat, higher retail product percentages, and lower marbling scores than fat calves. Calves with large frame, thick muscle, and medium condition scores performed best in the feedlot and produced more desirable carcasses.

Experimental Procedure

Twelve sire breeds differing in biological type were mated artificially to Hereford and Angus dams to produce the 1,669 crossbred steer calves we studied. Calves were born in 1970 through 1974 and were part of the Germ Plasm Evaluation project at the U.S. Meat Animal Research Center at Clay Center, Nebr. Calves were weaned when approximately 200 days old, and were scored for condition, muscling, and frame size at about 250 days. Steers were fed a corn silage-and-concentrate diet that averaged 72 to 76% TDN over the entire feeding period. One third of the steers in each sire breed group was slaughtered when Hereford x Angus crosses reached 950 lb., and the second and third groups were slaughtered 35 and 70 days later. The right carcass side of each animal was fabricated into boneless, trimmed retail cuts.

Results and Discussion

Table 2.1 presents the number of steers in each frame size and the slaughter weights, average daily gains, and dressing percentages. Only steers slaughtered within the weight ranges recommended by USDA for the different frame sizes were compared. For example, a small-framed steer slaughtered at 1150 lb., or a large-framed steer slaughtered at 975 lb., would not be included.

Slaughter weights increased almost 200 lb. with each increase in frame size, and dressing percentage increased significantly with each increase in frame size. Large-framed calves gained significantly faster than medium- or small-framed calves, but there was no significant difference between medium- and small-framed calves (likely due to few small-framed calves).

Table 2.1. Frame sizes and performance traits.

Frame size	No.	Slaughter wt, lb.	Dressing %	ADG
Large	82	1271^a	61.5^a	2.78^a
Medium	563	1080^b	60.8^b	2.51^b
Small	17	886^c	59.2^c	2.27^b

[a,b,c] Means within the same column with different superscripts differ statistically ($P<.05$).

Carcass traits for different frame sizes are presented in table .2. There were no significant differences between frame sizes for any of the carcass traits presented. Therefore, stratifying calves into frame sizes, and then slaughtering them at weights recommended by USDA, results in similar carcass composition and quality.

Table 2.2. Frame sizes and carcass traits.

Frame size	12th rib fat, in.	Kidney knob, %	%Retail product	%Bone	Marbling[1]
Large	.50	4.4	67.7	12.6	11.2
Medium	.54	4.2	67.0	12.3	11.9
Small	.50	4.0	67.8	13.3	11.5

[1] 10 = Small^-, 11 = Small^o, 12 = Small^+, etc.

Table 2.3 shows performance traits for calves stratified by muscling scores. We had no calves scored as thick muscled even though some Jersey crosses were included. Thick muscled calves were heavier at weaning and at slaughter, but gained slower than calves with medium muscling, which we cannot explain. Medium muscled calves were significantly fatter at slaughter, had higher marbling scores, and lower percentages of trimmed retail product (Table .4).

Table 2.3. Muscling scores and performance traits.

Muscling score	No.	Slaughter wt., lb.	Dressing %	ADG
1 (thick)	1394	1052^a	60.2	2.36^b
2	275	1033^b	60.1	2.43^a
3 (thin)	0	--	--	--

[a,b,c] Means within the same column with different superscripts differ statistically ($P<.05$).

Table 2.4. Muscling scores and carcass traits.

Muscling score	12th rib fat, in.	Kidney knob, %	%Retail product	%Bone	Marbling[1]
1 (thick)	$.47^b$	3.9^b	69.3^a	12.8	10.5^b
2	$.50^a$	4.8^a	65.6^b	12.7	12.9^a
3 (thin)	--	--	--	--	--

[a,b,c] Means within the same column with different superscripts differ statistically ($P<.05$).

[1] 10 = Small$^-$, 11 = Small^o, 12 = Small$^+$, etc.

We also scored calves for condition on a three-point scale (Table 2.5). Thin calves were significantly lighter at slaughter, partly because they were lighter at weaning, but they gained significantly slower, so compensatory gain probably was not involved. Calves thin after weaning had lower dressing percentages than their higher-condition counterparts. Interestingly, medium-condition calves gained significantly faster and had lower dressing percentages than fat-condition calves but,their slaughter weights were equal.

Table 2.5. Condition scores and performance traits.

Condition score	No.	Slaughter wt., lb.	Dressing %	ADG
1 (Thin)	385	1031^b	59.3^c	2.16^c
2	958	1053^a	60.3^b	2.45^a
3 (Fat)	326	1060^a	60.9^a	2.36^b

[a,b,c] Means within the same column with different superscripts differ significantly ($P<.05$).

As weaning condition scores progressed from thin to fat, fat thickness and marbling increased, and retail-product and bone percentages decreased significantly (Table 2.6).

Table 2.6. Condition scores and carcass traits.

Condition score	12th rib fat, in.	Kidney knob, %	%Retail product	%Bone	Marbling[1]
1 (Thin)	$.38^c$	3.5^b	72.5^a	13.2^a	8.9^a
2	$.47^b$	4.2^a	68.3^b	12.8^b	11.1^b
3 (Fat)	$.61^a$	4.1^a	65.0^c	12.1^c	12.7^c

[a,b,c] Means within the same column with different superscripts differ significantly ($P<.05$).

[1] 9 = Slight$^+$, 10 = Small$^-$, 11 = Small^o, 12 = Small$^+$, etc.

Intermittent Feeding of Chlortetracycline to Finishing Cattle

Jack Riley and Ron Pope

Summary

We used 168 yearling steers in a 139-day finishing trial to evaluate high levels of chlortetracycline (aureomycin[1]) fed for short periods at regular intervals during finishing. Since liver abscess rate was low for all treatments including the nonmedicated controls and health status was good, chlortetracycline (CTC) did not significantly affect abscess rate or feedlot performance.

Introduction

Continuous daily feeding of low level CTC reduces liver abscesses and improves gain and efficiency, but restrictions on the amount and number of feed additives that may legally be incorporated into one supplement have encouraged cattle feeders to use intermittent feeding (3, 5, or 7 days per month) of high level CTC (.5-2g/hd/day) instead of two different additive containing supplements. This project was to determine if intermittent high level CTC was as effective as continuous low level daily feeding.

Procedure

The 168 yearling Hereford steers we used were purchased from one source, were weighed individually at arrival, and allotted by weight to seven treatments. Individual shrunk weights were taken (after 12 hours off feed and water) at 28-day intervals during the 139-day trial, which began April 22 and ended September 8, 1980. Hot carcass weights and liver abscess data were collected at slaughter; carcass measurements, 24 hours later.

Steers were started on a 50% concentrate ration that was increased at weekly intervals until the final 80% ground milo, 15% sorghum silage, and 5% supplement ration (dry matter basis) was fed on day 29. The antibiotic was mixed with ground milo to obtain the desired level (Table 3.1). The final rations contained at least 11.5% crude protein, 0.4% calcium, and 0.3% phosphorus.

Results

The steers averaged 597 pounds initially and 993 pounds at slaughter. None of the treatments improved performance, carcass characteristics, or liver abscess incidence. Fastest and most efficient gains were when each steer was fed 1 gm CTC per day for 5 days each 28 day period. That treatment and 70 mg per steer daily, continuously, resulted in fewest abscesses (Table 3.1).

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[1] Aureomycin is registered trademark name for chlortetracycline, produced by American Cyanamid Co. Aureomycin and partial financial assistance provided by American Cyanamid Co., Princeton, NJ.

Table 3.1. Effect of Chlortetracycline on Steer Performance and Liver Abscesses.

CTC level per day per steer	Days fed per 28 days	No. steers	Initial wt. lbs.	Final wt. lbs.	ADG lbs	Lb. feed/ gain	Abscessed livers
0	all	24	599.4	1007.5	2.94	7.94	2
.5 g	5	24	595.9	990.6	2.84	7.99	3
1.0 g	5	24	595.8	1012.2	3.00	7.63	1
2.0 g	5	24	597.2	992.4	2.84	8.11	3
1.0 g	3	24	599.8	989.9	2.81	8.06	2
1.0 g	7	24	596.7	982.2	2.77	8.19	2
70 mg[1]	all	24	598.4	992.3	2.83	7.89	1

[1] Only level currently approved for improved growth rate and liver abscess control.

Combination Clearances

The Food and Drug Administration (FDA) is responsible for regulating the use of feed additives and implants. Numerous individual additives are approved for use in beef cattle feed, however, the mixing of two additives into the same supplement or mixed feed for resale purposes requires FDA approval for each combination. For example, the only antibiotic approved for use with Rumensin is Tylan. Another combination clearance is Chlortetracycline and Sulfamethazine (AS 700). Using additives in combination in the same supplement without proper FDA clearances is illegal. You are urged to check with your feed manufacturer for the latest information on legal feed additive combinations.

Effects of Protein Level, Calcium:Phosphorous Ratio and Monensin[1] on Performance of Finishing Steers

Susan Durham, Jack Riley, and Ron Pope

Summary

Ration crude protein levels of 10.4% and 12.0% were fed with or without monensin and with calcium-to-phosphorous ratios (Ca:P) of 1:2, 2:1, or 1:1. Steers fed 10.4% crude protein, a 1:1 Ca:P, and Monensin had highest average daily gains and were most efficient. Extra protein in the 12% ration or the extra calcium in the 2:1 ration produced no benefits. Phosphorous in the 1:2 Ca:P apparently was excessive, as indicated by depressed daily gain and poorer efficiency. Monensin significantly increased average daily gain and improved feed efficiency.

Introduction

Monensin may have a "protein-sparing" effect while improving feed efficiency. Other research has suggested that when fecal pH is near neutral, less starch is lost in feces, and performance improves. But, when calcium is used to buffer gut pH, the Ca:P ratio may be excessive. We conducted this study to examine these problems.

Procedure

We used two protein levels, 10.4% (1.96 lb. protein/day) and 12% (2.38 lb. protein/day), and three Ca:P ratios (1:2, 1:1, 2:1); each with and without Monensin. Rations were 75-82% corn, 15% corn silage, and 4-10% supplement (dry matter basis). Protein was adjusted by altering soybean meal. Ca:P ratios were adjusted by altering limestone, monosodium phosphate, and dicalcium phosphate. Monensin was initially fed at 200 mg/steer/day, then increased after 37 days to 300 mg. Rations were fed *ad lib* twice daily. Initial and final individual shrunk weights were taken after animals had no feed or water for 15 hours. Rumen samples and interim weights were taken 4 hours after morning feeding. Fecal samples were collected at 10-day intervals, with pH determined before samples were frozen. Average daily gain, feed consumption, and feed efficiency by pens, feed and fecal starch content, and fecal pH were measured.

Results and Discussion

Increasing crude protein from 10.4% to 12% improved neither rate nor efficiency of gain. There was no interaction between protein and monensin, perhaps because 10.4% protein was not low enough to cause protein stress that might have been overcome by Monensin's protein-sparing activity.

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[1] Monensin, trademark Rumensin, is a product of Elanco Division, Eli Lilly and Co., Indianapolis, IN.

Adding calcium to provide a 2:1 Ca:P ratio affected neither gain nor efficiency. Extra phosphorous in the 1:2 ratio may have been detrimental, as shown by animals receiving it having poorest gain and efficiency (table 4.2).

Monensin significantly improved gain and efficiency (table 4.3).

Steers fed 10.4% protein and a 1:1 calcium-to-phosphorous ratio had the fastest and most efficient gains. There were no interactions between monensin and protein level or monensin and calcium-to-phosphorous ratio.

Fecal starch (range 7.4-35.2) with any treatment did not differ significantly. Correlations between fecal starch and fecal pH were low (r = -.08), indicating a poor relationship between the two.

Table 4.1. Effect of ration crude protein level and daily protein intake.

Protein level, % Daily protein intake/steer, lb.	10.4 1.96	12 2.38
No. steers	30	30
Initial wt., lb.	767	781
Final wt., lb.	976	964
Avg. daily gain, lb.	2.32	2.35
Avg. daily feed, lb.	18.90^{a}	19.89^{b}
Feed eff., lbs., feed/lb. gain	8.15	8.46

[a,b] Means in the same row with different superscripts differ significantly (P<.10).

Table 4.2. Effect of calcium:phosphorous ratio on steer performance.

Ca:phos ratio	1:1	2:1	1:2
No. steers	20	20	20
Initial wt., lb.	776	773	772
Final wt., lb.	990	969	951
Avg. daily gain, lb.	2.54	2.33	2.13
Avg. daily feed, lb.	19.55	19.68	18.96
Feed eff., lbs. feed/lb. gain	7.70^{a}	8.45^{a,b}	8.90^{b}

[a,b] Means in the same row with different superscripts differ significantly (P<.05).

Table 4.3. Effect of Monensin on steer performance.

Treatment	Monensin	No Monensin
No. steers	30	30
Initial wt., lb.	772	776
Final wt., lb.	978	962
Avg. daily gain, lb.	2.46^{a}	2.21^{b}
Avg. daily feed, lb.	19.14^{c}	19.66^{d}
Feed eff., lbs. feed/lb. gain	7.78	8.90

[a,b] Means in the same row with different superscripts differ significantly (P<.10).

[c,d] Means in the same row with different superscripts differ significantly (P<.05).

Table 4.4. Effect of calcium:phosphorous ratio and protein level on steer performance.

Calcium:Phosphorous	1:1		1:2		2:1	
Protein level	10.4	12	10.4	12	10.4	12
No. steers	10	10	10	10	10	10
Initial wt., lbs.	784	769	779	765	779	767
Final wt., lbs.	1005	975	936	966	987	951
Avg. daily gain, lb.	2.63^{a}	$2.45^{a,b}$	1.87^{c}	$2.40^{a,b}$	$2.47^{a,b}$	$2.20^{b,c}$
Avg. daily feed, lb.	19.00	20.10	17.91	20.02	19.80	19.57
Feed eff., lbs. feed/lb.	7.22^{a}	$8.20^{a,b}$	9.58^{c}	8.34^{b}	$8.02^{a,b}$	$8.90^{b,c}$

[a,b,c] Means in the same row with different superscripts differ significantly (P<.10).

Effect of COMPUDOSE on Grazing Steers in Pasture, Then in Feedlot

Jack Riley, Larry Corah, and Ron Pope

Summary

Steers implanted with an estradiol removable implant (COMPUDOSE[1]) gained 14.8% faster during 121 days of grazing and 12.1% faster in the feedlot than control steers not implanted. Implanting improved feed efficiency 6.9% during finishing. Removing implants after grazing resulted in slowest and least efficient feedlot gains. Steers implanted only during the finishing phase gained the fastest and most efficiently in feedlot. Results of this 240-day test indicate that one implant stimulates performance at least 240 days.

Introduction

COMPUDOSE is the result of six years research at Eli Lilly Research Laboratories to develop an implant that controls release of oestradiol-17B (a naturally occurring hormone). The implant is an inert silicone rubber core surrounded by a silicone rubber matrix containing molecular oestradiol-17B. Size and shape of the implant permits removal, if desired, to positively terminate treatment. Extensive field research is being conducted at universities to determine the effectiveness of the implant in grazing and finishing steers. But the Food and Drug Administration has not yet approved the implant.

Procedure

We took individual weights of the 72 yearling Hereford steers used (from one source) on two consecutive days at the beginning and end of the grazing and feedlot phase. Steers were grazed on predominantly bromegrass pasture 121 days (March 25-July 24, 1980) supplemented with 2.7 pounds (dry matter) per steer per day of 12% C.P. range cubes. The experimental design is shown in Table 5.1. In the feedlot, each treatment was replicated three times, 6 steers per replicate. Each steer was checked 28 days after implanting to determine implant losses and to reimplant for losses. Observations were made for abnormal behavior such as "buller steers." The ration of 80% grain sorghum, 15% sorghum or corn silage and 5% supplement (dry matter basis) during the feedlot phase provided at least 11.5% crude protein, .4% calcium, .3% phosphorus, and 30 grams of Rumensin per ton. All steers were slaughtered at approximately the same average weight on two dates (14 days apart). Hot carcass weights were used to adjust final feedlot weights for possible fill differences. Each steer was checked for liver abscesses at slaughter, and carcass measurements were taken 24 hours later.

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[1] COMPUDOSE is to be trademark name for the estradiol implant produced by Elanco Products Co., Division of Eli Lilly Co., Indianapolis, IN 42606. Implants and partial financial assistance provided by Eli Lilly Co.

Results

During the 121-day grazing period, implanted steers gained 23.5 pounds more (14.8%) than those not implanted (Table 5.2). Four implants lost during the first 4 weeks were replaced at the 28-day weighing. Steers with implants during the feedlot phase gained 12.1% faster, required 14 fewer days on feed to make the same total gain, and were 6.9% more efficient.

Feedlot performances of the 4 treatment groups are shown in Table 5.4. Implant removal after grazing resulted in poorest gains and efficiency. Steers implanted only during the feedlot phase were fastest gaining and most efficient of any treatment group.

Performances for the combined grazing and feedlot phases are shown in Table 5.5. Steers implanted only for the feedlot phase and those with implants during both grazing and feedlot phases gained similarly. Most of the increased gain from implanting during grazing was lost when the implant was removed before the feedlot phase.

Number of "buller" steers or other mounting activity did not differ among treatment groups.

Table 5.1. Experimental Design

Grazing treatment	No implant		Implant	
No. steers	36		36	
Feedlot treatment	No implant	Implanted	Implant removed	Implant retained
No. steers	18	18	18	18

Table 5.2. Effect of COMPUDOSE on performance of grazing steers (March 25 - July 24, 1980)

	No implant	Implant
No. steers	36	33
No. days	121	121
Initial wt., lb.	516.8	515.8
Final wt., lb.	671.5	694.0
Gain, lb.	154.7	178.2
ADG, lb.	1.28	1.47

Table 5.3. Effect of COMPUDOSE on performance of feedlot steers (July 25 - November 24 or December 8, 1980)

	No implant	Implant
No. steers	34	32
Days in feedlot	136	122
Initial wt., lb.	689.6	676.4
Adj. final wt., lb[1]	1084.1	1073.0
Gain, lb.	394.5	396.6
ADG, lb.	2.90	3.25
Daily D.M., lb.	20.92	21.81
Feed/gain	7.21	6.71

[1] Adjusted from hot carcass weight and average 59.5 dressing percentage.

Table 5.4. Effect of grazing treatment on feedlot performance and carcass characteristics of steers

Grazing	No implant	No implant	Implant	Implant
Feedlot	No implant	Implant	No implant	Implant
No. steers	18	17	16	15
Days in feedlot	136	122	136	122
Initial wt., lb.	679.1	665.4	701.4	688.9
Adj. final wt., lb.[1]	1079.2	1072.9	1089.6	1073.1
Gain	400.1	407.5	388.2	384.17
ADG	2.94	3.34	2.85	3.15
ADF	21.14	21.24	20.70	22.38
F/G	7.19	6.36	7.26	7.10
Carcass:				
Hot wt., lb.	641.9	638.2	648.1	638.3
Fat, in.	.59	.49	.51	.52
LEA, sq. in.	11.21	11.98	11.53	12.19
USDA, grade	11.78	11.41	11.69	11.73
USDA, yield grade	3.37	2.87	3.09	2.88

[1] Adjusted to 59.5 dressing percentage.

Table 5.5. Effect of COMPUDOSE on total grazing and finishing performance (March 25 - November 24 or December 8, 1980)

Grazing	No implant	No implant	Implant	Implant
Feedlot	No implant	Implant	No implant	Implant
No. Steers	18	17	16	15
Days	257	243	257	243
Initial Wt., lb.	521.3	514.0	523.2	510.5
Adj. Final Wt., lb.	1079.2	1072.9	1089.6	1073.1
Gain	557.9	558.9	566.4	562.6
ADG	2.17	2.30	2.20	2.32

Response to Implants

According to a recent summary from the University of Nebraska, response of nursing calves to implants has averaged 8.8%, with more benefit in steers than heifers. During the growing phase, gains were increased 15.1%. During finishing, the gain advantage was 10.8%, with 6 to 10% less feed required per unit of gain.

Fat Thickness as an Alternative to Marbling in Beef Carcass Grading

M. E. Dikeman and K. E. Kemp

Summary

Data from 1669 steers show that equally palatable beef comes from carcasses with Choice marbling OR 0.4 inch of outside fat cover. Including cattle with 0.4 inch of fat and at least Slight marbling in a new Choice grade would cut 20 to 30 days from the feeding period.

Introduction

Marbling accounts for about 10% of the variation in cooked beef palatability, but marbling tells more about the nutritional background of cattle than about palatability of beef. Fat thickness also indicates nutritional background and predicts cooked beef palatability as well as marbling. It also affects the rate a carcass chills, which should determine whether or not cold toughening will occur.

We studied fat thickness as an alternative to marbling in a beef grading system, but not with the thought of eliminating marbling from grading. Instead, we wanted to evaluate fat thickness as an alternative to marbling for carcasses that have A maturity, and lean color, firmness and texture typical of Choice grade, but not enough marbling by present grade standards to qualify for Choice.

Experimental Procedure

We analyzed data from 1,669 steer carcasses from cattle from 12 sire breeds of different biological types mated to Hereford and Angus females. The 1,669 cattle were part of the Germ Plasm Evaluation project at the U.S. Meat Animal Research Center at Clay Center, Nebr. They ranged from 12 to 17 months old at slaughter, and had been fed, from weaning to slaughter, a moderately high energy ration primarily of high quality corn silage, corn grain, and supplement that averaged 72 to 76% total digestible nutrients (TDN). Cattle in each crossbred type each year were slaughtered in three equal groups: the first group when Hereford x Angus crosses averaged 950 lb.; the second and third groups, 35 and 70 days later. Carcasses were quality and yield-graded, and rib steaks were frozen for subsequent cooking and palatability evaluation. Steaks 1 1/8 in thick were cooked 350 F to an internal temperature of 151 F in a large gas oven. Cores 1/2 in. in diameter from one steak from each steer were sheared by the Warner-Bratzler shear, and cores from another steak from a subsample of 758 steers were evaluated by a trained taste panel for tenderness, flavor, and juiciness.

Results and Discussion

Table 6.1 presents marbling and palatability data for carcasses stratified into five fat thickness categories. As expected, their marbling scores differed significantly between fat thickness categories. Carcasses with less than 0.3 in. fat thickness were significantly less flavorful and less tender than carcasses with 0.3 in. or more fat. Warner-Bratzler shear force and flavor measurements did not differ among carcasses from 0.3 to more than 0.6 in. fat thickness. For taste panel tenderness, carcasses with a minimum of 0.5 in. fat thickness were rated more tender than those with 0.3 to 0.39 in., but no more tender than those with a minimum of 0.4 in. Palatability apparently does not improve as fat thickness increases beyond 0.4 in.

Figure 1 compares Warner-Bratzler shear and taste panel means for carcasses that qualified for Choice and Prime by present grade standards with those that had at least 0.4 in. of fat thickness. Carcasses that had at least 0.4 in. fat thickness were equal in palatability to those that graded low Choice or higher. Therefore, these data indicate that beef grade standards could be changed to allow carcasses to qualify for Choice by having EITHER 0.4 in. fat thickness OR Choice marbling. Two large studies by other universities have shown that 0.3 in. and Slight marbling gives equal palatability to the present choice grade. To prevent some grass-fed cattle from qualifying for Choice, the standards should specify "white" fat, and a minimum of Slight marbling. In this experimental group of 1,669 carcasses, 61.3% graded low Choice or higher by present grade standards. However, 77.5% had at least 0.4 in. of fat thickness OR low Choice or higher marbling. Thus, 16% more carcasses were recognized for their excellent palatability by using fat thickness as an alternative to marbling. Commercially fed cattle likely would show a similar percentage increase.

If the meat industry needs only the current percentage of Choice carcasses, feeders could cut 20 to 30 days of the feeding time under this system.

Table 6.1. Marbling and palatability data for carcasses in five fat thickness categories.

Fat thickness	Marbling[1]	A. B. shear, lb.	T. P. tend.[2]	T. P. juice[2]	T. P. flavor[2]
.00 to .29 in	7.8^{e}	7.78^{a}	6.84^{c}	7.14	7.33^{b}
.30 to .39 in	10.1^{d}	7.32^{bc}	7.20^{b}	7.15	7.46^{a}
.40 to .49 in	10.8^{c}	7.39^{b}	7.29^{ab}	7.21	7.49^{a}
.50 to .59 in	11.7^{bc}	7.16^{bc}	7.38^{a}	7.20	7.46^{a}
$\geq$ .60 in	12.9^{a}	7.08^{c}	7.41^{a}	7.29	7.54^{a}

[a,b,c,d,e] Means in a column with different superscripts differ significantly ($P<.05$).

[1] Score of 7 = slight-, 8 = slight^{o}, 9 = slight^{+}, 10 = small^{-}, 11 = small^{o}, 12 = small^{+}, etc.

[2] Score of 1 = extremely tough, dry or bland flavor: 9 = extremely tender, juicy or intense flavor.

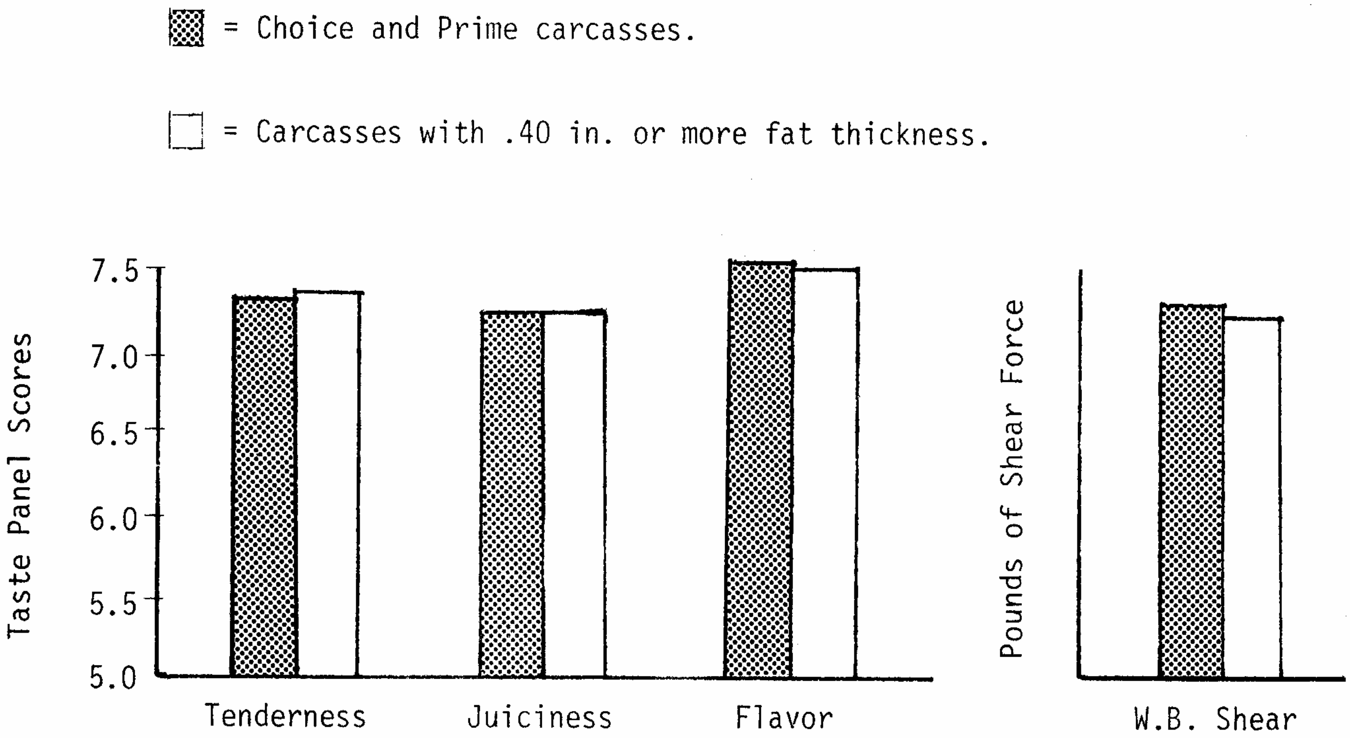

Figure 1. Taste panel scores and Warner-Bratzler shear value comparisons for carcasses grading Choice and Prime versus those with .40 in. or more fat thickness regardless of marbling score.

Is it Time for a New Beef Grade?

Economic pressure on cattle feeders and the consumer's apparent desire for leaner beef may mean it's time to change the way we grade beef. Average cost of gain is about 57¢ per pound for the entire feeding period. The early gains are economical. But since the cost of gain late in the feeding period is much higher, it costs too much to get cattle into the choice grade. If the beef is palatable before the cattle grade choice (and research shows it is,) then we may need a new grade that has enough quality to insure palatability, but has a minimum of outside fat. Choice-lean might be a good name. Grain feeding produces quality beef, but cutting 20 to 30 days off the feeding period through changing the grading standards should benefit the whole industry.

Nutritional Effects of Beef Connective Tissue Characteristics and Eating Qualities

J. J. Wu, C. L. Kastner, M. C. Hunt,
D. H. Kropf, and D. M. Allen

Summary

We compared taste panel and connective tissue characteristics of beef fed a high energy diet with beef fed grass. The high energy diet produced higher USDA quality and yield grades, more rapid weight gain, and increased connective tissue collagen synthesis and breakdown. But, it did not consistently improve taste panel and shear characteristics over grass-feeding.

Introduction

Muscles and muscle cells are surrounded by layers of connective tissue, which are comprised mainly of the protein collagen. The connective tissue network shrinks when meat is cooked, and the shrinkage either toughens or tenderizes the cooked meat, depending on the strength of collagen fibers. In tender muscle from young animals, collagen fibers contain very few heat-stable bonds, so they fall apart and gel upon cooking. As animals age, collagen fibers are held together more strongly by heat-stable bonds, then they remain as "chewy", tough fibers rather than falling apart on cooking. Hydroxyproline, a specific amino acid, occurs only in collagen, so measures of hydroxyproline also are measures of collagen. As the connective tissue collagen matures, it becomes more difficult to solubilize. Salt-soluble collagen represents young, newly synthesized collagen, while acid-soluble collagen is more mature. Additionally, the amount of hydroxyproline in the blood indicates how fast collagen is broken down and replaced. We studied the effects of high energy and grass diets on beef eating quality, collagen chemical characteristics, and blood hydroxyproline levels.

Experimental Procedure

We assigned 18 Hereford steers of similar age and nutritional background to three treatment groups: group I was slaughtered in October directly off bluestem pasture at 19 to 20 months of age; group II was slaughtered at the same age, but after 120 days on a 90% concentrate diet; and group III was pastured until October, then fed 90% concentrate for 126 days and slaughtered at 23 to 24 months of age. The *Longissimus* (loin eye) and *Biceps femoris* (outside round) muscles were removed 24 hr postmortem, vacuum packaged, and stored for 5 days before being cut into steaks.

Blood hydroxyproline was measured during the feeding period and total salt-and acid-soluble collagen was measured on *Longissimus* and *Biceps femoris* muscles.

Cooked loin eye and outside round steaks were evaluated by a trained taste panel and Warner-Bratzler shear.

Results

Cattle on high energy diets had higher quality and yield grades and weighed more than cattle fed grass only (Table 7.1).

Figure 7.1 shows changes in free (non-protein) hydroxyproline in the blood of steers with increasing time on a high energy diet. The first six weeks, muscle growth was rapid and collagen turnover rapid. Later, fat deposition predominated and collagen replacement slowed, as indicated by declining hydroxyproline.

As shown in Table 7.2, collagen in loin eye steaks from cattle fed the high energy diets was more readily soluble than collagen from grass-fed cattle (group I). Collagen synthesis was accelerated by a high energy diet. Loin eye steaks from the three groups did not differ in total collagen, Warner-Bratzler shear force (Table 7.3), or taste panel ratings for shear tenderness, juiciness, and flavor intensity. Outside round steaks from grass-fed steers were juicier than those from steers fed a high energy diet (groups II and III). As we expected, collagen was much higher in outside round muscles than in loin eye. High-energy feeding did not consistently improve taste panel tenderness, shear force, or collagen solubility of outside round steaks.

In this study grass finished cattle yielded acceptable taste panel scores. Feeding did not consistently improve taste or shear tenderness.

Table 7.1. Means for carcass traits of cattle from three nutritional regimens.

Carcass traits	Nutritional regimens Group I Grass	 Group II Fed	 Group III Grass and Fed
Quality grade^{a}	Standard$^{17 b}$	Good$^{60 c}$	Choice$^{07 d}$
Hot carcass wt., lb	377.3 ^{b}	598.2 ^{c}	591.2 ^{c}
Yield grade^{a}	1.60^{b}	2.85^{c}	2.91^{c}

[a] Based on descriptions included in USDA (1975) beef grading standards.

[b,c,d] Means for the same trait bearing a common superscript letter do not differ (P>.05).

Table 7.2. Means for collagen characteristics of *longissimus* (loin eye) and *biceps femoris* (outside round) muscles from cattle fed three nutritional regimens.

Intramuscular collagen	Nutritional regimens Group I Grass	 Group II Fed	 Group III Grass and fed
	Longissimus		
Collagen content (mg/g)			
Fresh tissue	3.88^{a}	4.26^{a}	4.28^{a}
Moisture and fat free	17.62^{a}	18.22^{a}	18.41^{a}
Percent solubility^{c}			
Salt soluble	1.99^{a}	2.48^{b}	2.22^{a,b}
Acid soluble	3.00^{a}	2.80^{a}	3.86^{b}
Salt + Acid soluble	4.99^{a}	5.28^{a}	6.08^{b}
	Biceps femoris		
Collagen content (mg/g)			
Fresh tissue	8.53^{a,b}	9.12^{a}	7.74^{b}
Moisture and fat free	45.70^{a}	44.71^{a}	36.46^{b}
Percent solubility^{c}			
Salt soluble	1.20^{a,b}	1.29^{a}	1.05^{b}
Acid soluble	2.30^{a}	2.42^{a}	2.98^{a}
Salt + Acid soluble	3.50^{a}	3.71^{a}	4.03^{a}

[a,b] Means in the same row bearing a common superscript letter do not differ (P>.05).

[c] Amount of salt-soluble collagen and acid-soluble collagen in meat samples are used as an indication of collagen maturity; salt-soluble collagen contains newly synthesized collagen, while acid-soluble collagen is slightly older than salt-soluble collagen.

Table 7.3. Means for taste panel ratings and Warner-Bratzler shear force values of longissimus (loin eye) and biceps femoris (outside round) steaks from cattle fed three nutritional regimens.

Trait	Nutritional regimens Group I Grass	 Group II Fed	 Group III Grass and fed
	Longissimus		
Overall tenderness	5.9^{b}	6.1^{b}	6.6^{b}
Connective tissue amount	6.3^{b}	6.6^{bc}	7.2^{c}
Flavor intensity	6.1^{b}	6.3^{b}	6.4^{b}
Juiciness	6.5^{b}	6.0^{b}	6.3^{b}
Shear force, lb	7.0^{b}	7.0^{b}	5.9^{b}
	Biceps femoris		
Overall tenderness	5.6^{b}	5.1^{c}	5.7^{b}
Connective tissue amount	5.0^{bc}	4.5^{c}	5.3^{b}
Flavor intensity	6.3^{b}	6.3^{b}	6.3^{b}
Juiciness	6.7^{b}	5.8^{c}	5.6^{c}
Shear force, lb	10.1^{b}	12.3^{c}	10.8^{bc}

[a] Means based on 8-point rating scale 8 = extremely tender, intense flavor, juicy or no connective tissue; 1 = extremely tough, bland flavor, dry or abundant connective tissue.

[b,c] Means in the same row bearing a common superscript letter do not differ (P>.05).

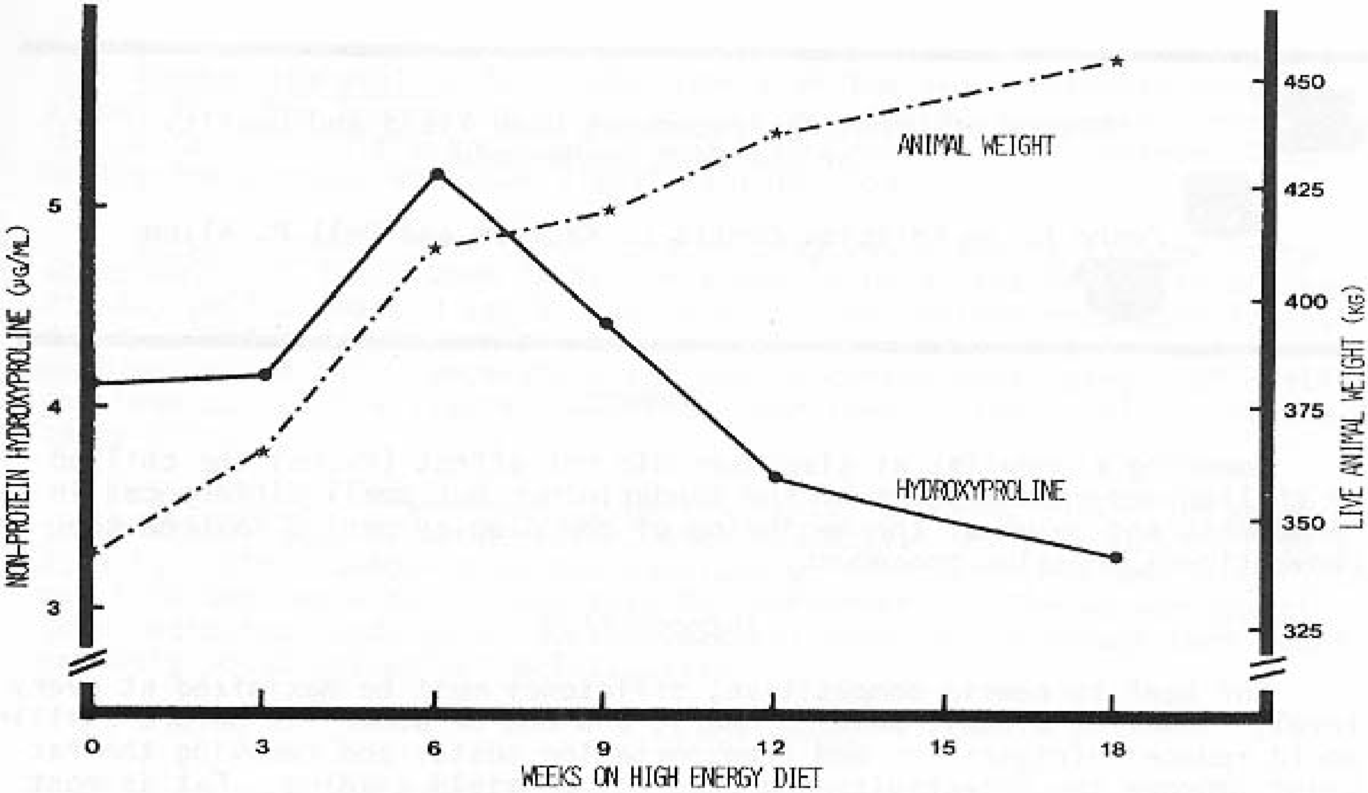

Figure 7.1. Effect of high energy diet on the blood plasma non-protein hydroxyproline and live animal weight of group III cattle.

Beef Tenderness and Collagen

Muscles and muscle cells are surrounded by layers of connective tissue, comprised mainly of the protein, collagen. When meat is cooked, this connective tissue network shrinks. This shrinkage has either a toughening or tenderizing effect on the cooked meat. In tender muscle from young animals, collagen fibers contain very few heat stable bonds, so fibers fall apart and gel upon cooking. In older animals, the collagen fibers are held together by heat stable bonds. The cooked collagen fibers remain intact as "chewy", tough fibers.

Effects of Dressing Procedures Upon Yield and Quality of the Beef Tenderloin

Pedro E. de Felicio, Curtis L. Kastner and Dell M. Allen

Summary

Removing kidney fat at slaughter did not affect (P>.05) the chilled or chilled-and-aged weights of the tenderloin. But small differences in tenderness and color at the beginning of the display period favored the conventional dressing procedure.

Introduction

For beef to remain competitive, efficiency must be maximized at every level. Removing kidney, pelvic, heart, and cod or udder fat before chilling would reduce refrigeration and transportation costs, and removing the fat might improve the objectivity and accuracy of yield grading. Fat is most easily removed while hot and it is easily rendered into edible tallow before chilling.

Our experiment was designed to determine if fast chilling after the kidney fat was removed affected the yield and quality of the unprotected tenderloin.

Experimental Procedure

Sixteen beef carcass sides were subjected to one of the following treatments:

1. Conventional dressing (C). Kidney, pelvic, and cod fat left intact on the carcass.
2. Experimental dressing procedure (UP). Kidney fat removed on the slaughter floor, so tenderloin was chilled unprotected.

After 3 days in the cooler at 32 to 40 F, tenderloins were removed, trimmed of external fat, vacuum packaged, and aged for 3 days at 32 to 36 F. Fresh and aged weights of the major tenderloin muscle were recorded. Steaks were tested for color changes during display, for thaw plus cooking losses, and for tenderness. Temperature declines in the tenderloins were also recorded.

Results and Discussion

Temperature decline: The chilling rates soon after dressing (1 through 6 hours after slaughter) and during the subsequent period differed widely between the two treatments. By six hours after slaughter the tenderloin temperature in C carcasses was 88 F compared with 70 F in the UP tenderloins. And the difference tended to increase to 11 hours postmortem.

Tenderloin yields: As tenderloins from the two treatments weighed almost the same before and after aging, removing kidney fat did not increase shrinkage. The differences of 50 and 40 g, respectively, between C and UP treatment means were not significant ($P>.05$).

Color scores: Meat color upon display was slightly lighter (more acceptable) in the C than in the UP tenderloins at the beginning of the display period (days 0 and 1 of display). Then colors equalized through day 4. During display, color changed less in UP than in C tenderloins. A combination of high temperature and low pH during early stages of chilling may have caused the lighter appearance and lower color stability of the C tenderloins.

Tenderness: C tenderloins were slightly tenderer (lower Warner-Bratzler shear value) than UP tenderloins, with respective shear values of 2.26 and 2.49 kg. Since tenderloins had remained at a high temperature longer, they may have been more fully aged than UP counterparts. The Warner-Bratzler shear only indicates tenderness, so the small differences, although consistent, probably would not affect palatability.

Conclusions

Removing kidney fat on the slaughter floor will reduce refrigeration and transportation costs, and it may be desirable to remove pelvic and inguinal fat. Because the removal lowers both carcass dressing percentage and wholesale loin yields, a price adjustment would be necessary.

This report suggests that changes in cooling rate caused by removing fat do not greatly increase shrinkage or decrease the tenderloin's quality.

A Steer's Not All Steaks

A 1,000 lb. live animal yields a carcass of about 612 lbs. Of that 612 lbs., only about 402 lbs. is "edible product". There are about 73 lbs. of bone and about 137 lbs. of fat, which includes fat trim, kidney and pelvic fat, and cod fat. The more of these low-value byproducts we can process at central slaughter plants, the less product we must refrigerate and ship.

Continuous Versus Intermittent Electrical Stimulation of Beef Carcasses and Their Effect on Hot-boned Muscle-pH Decline

J. E. Bowles, C. L. Kastner, M. E. Dikeman,
M. C. Hunt, J. L. A. Kendall, and M. Lyon

Summary

Short bursts of electricity (intermittent electrical stimulation) to beef carcasses accelerated pH decline and the onset of rigor mortis more than continuous stimulation did.

Introduction

Boning beef carcasses while they are still warm leads to large savings in power and cooler space. "Hot boning" processes and its advantages were discussed in the 1980 Cattlemen's Day publication. However, when a muscle undergoes rigor after being hot boned, it can become less tender. Rigor occurs because the muscle's chemical energy supply (glycogen) is converted to lactic acid, which causes the pH to drop, and rigor to occur. Using electrical stimulation to contract carcass muscles speeds up glycogen conversion to lactic acid, the subsequent pH drop, and rigor. Then, the carcass can be hot boned without decreasing tenderness.

The optimum combination of electrical stimulation (continuous or intermittent shock, voltage, postmortem stimulation time, duration of stimulation, amperage and frequencies) required for the fastest rigor onset has not been determined, so that is what we hoped to determine.

Experimental Procedure

Two groups of crossbred steers were slaughtered, electrically stimulated and hot boned. In group I, 46 sides were stimulated 1 hour postmortem with 400 volts of continuous, 60 cycle, alternating current for 2 minutes. Approximately .6 amp was delivered through the carcass. Two hours after slaughter the strip loin was hot boned. PH was monitored on the strip loin *longissimus* muscle.

In group II, 24 sides were electrically stimulated for 2 minutes at 45 minutes postmortem, using the same current characteristics except the current was pulsed, 1.6 second "on" and 0.8 second "off."

Results and Discussion

Both continuous and intermittent ES accelerated postmortem pH decline, but intermittent stimulation decreased the muscle pH slightly faster. Intermittent stimulation at 45 minutes postmortem may be more effective in accelerating postmortem pH decline than continuous stimulation at 1 hour postmortem. Allowing muscles to relax between contractions may allow the chemical energy from glycogen to be used up faster than when the muscle remains contracted.

Factors Affecting Conception After Synchronization With Lutalyse® and Timed Insemination

Mike King, G. H. Kiracofe, and R. M. McKee

Summary

With heifers given two injections of Lutalyse 11 days apart, and inseminated 80 hours after the second injection, only 20% in heat before 48 hours conceived compared with 65% that were in heat 48 to 80 hours after injection. Those showing heat early may have been inseminated too late. Heifers receiving their second injection on day 7, 8, or 9 of the cycle came into heat earlier than those injected on days 10 through 15.

Introduction

Two injections of Lutalyse 11 days apart, and insemination 80 hours after the second injection has become popular in synchronizing and breeding beef heifers but conception rates have varied.

We wanted to determine if inseminating at 80 hours after injection was optimum for conception.

Procedure

Heat was checked twice daily for 35 days in 87 yearling beef heifers. Then all were injected with Lutalyse and heat checks were continued another 11 days. All heifers observed in heat during the 46 day heat check were given a second Lutalyse injection. Day of the estrous cycle at second injection was determined from the last observed estrus.

After the second injection, heifers were checked for heat every 4 hours for 6 days, and time to heat was recorded.

All heifers were inseminated 80 hours after the second injection. Pregnancy was determined by rectal palpation 58 days after insemination.

Results and Discussion

Thirty-eight heifers were in heat during the twice daily heat checks and received the second Lutalyse injection. Thirty-two were detected in heat from 34 to 118 hours after the second injection; six failed to show estrus within 6 days.

® Lutalyse is a registered name of the hormone prostaglandin marketed by The Upjohn Co., Kalamazoo, MI for synchronization of heat in beef cattle.

Effect of interval to heat on conception rate is shown in Table .1. Ten heifers in heat by 48 hours after the second injection had a conception rate of 20 percent, compared with 65% for 20 heifers that showed heat between 48 and 80 hours. Neither of two heifers in heat after the 80 hour insemination conceived.

Our data suggest that conception rate would be improved in heifers that show heat before 48 hours by inseminating them earlier than the recommended 80 hours. Heifers coming in heat between 48 and 80 hours can be inseminated at 80 hours.

The day of the cycle at the second injection influenced the interval to heat. Heifers in days 7, 8, and 9 of their estrous cycle had an average interval to heat of 50 hours; those in days 10 to 15 of their cycle, 59 hours.

Table 10.1. Conception related to interval from second injection to estrus.

Interval to heat	No. of heifers (% of group)	Conceiving at 80 hours number (%)
Before 48 hours	10(26)	2(20)
48-80 hours	20(53)	13(65)
After 80 hours	2(5)	0(0)
No estrus	6(16)	0(0)
Total	38(100)	15(39)

What's Prostaglandin?

Prostaglandin, a complex chemical derived from fatty acids, is in every cell in the body, and performs a variety of functions. Prostaglandin produced in the non-pregnant uterus passes to the ovary, and signals the ovary to start a new cycle. Lutalase is a specific prostaglandin, (PGF_2) and can be used for heat synchronization.

In the 1960's, prostaglandin was rare. Its only source was the seminal vessels (accessory sex glands) of slaughtered male sheep. Then the "sea whip", a living coral was found to be rich in the compound. In the late 1960's, there was enough prostaglandin to do limited large animal research. Finally, the UpJohn Company found how to synthesize the compound, and discovered that PGF_2 could induce heat in cattle.

Various Prostaglandins are used to treat human diseases. Others are produced in injured tissue and cause pain and inflamation. Aspirin is a mild prostaglandin inhibitor.

Effect of Limited Suckling on Reproductive Performance and Milk Production of Cows and Weight Gains and Suckling Behavior of Calves

Ken Odde, G. H. Kiracofe and R. R. Schalles

Summary

We used 109 Polled Hereford and percentage Simmental cows to evaluate limited suckling as an aid to induce cows to cycle after calving. Cows were allotted to: 1. once daily suckle; 2. twice daily suckle; 3. 48 hr calf removal (just before breeding season); and 4. controls (suckle _ad libitum_). Half of each group was implanted with Norgestomet 9 days before the breeding season.

Limited suckling increased the number of cows showing estrus and conceiving early in the breeding season, and Norgestomet increased the percentage pregnant the first 21 days of the breeding season.

Introduction

Cows conceiving early in the breeding season have heavier calves at weaning and more time to rebreed the next year. Suckling supresses onset of estrous cycles in beef cows. Weaning calves before the breeding season increases cycling activity and improves reproductive performance. Researchers in Texas have shown that allowing calves to nurse only once daily significantly shortened the interval from calving to first post-partum heat and conception in two-year-old Brahman x Hereford heifers. Recent research also has shown that progesterone given before the breeding season may increase reproductive efficiency.

Our trial was designed to determine the effects of limited suckling on cow reproductive performance and milk production and calf weight gains and suckling behavior, and to determine the effect of a synthetic progestin implant (Norgestomet[a]) on cow reproduction performance.

Materials and Methods

We began checking heat twice daily April 15, 1980, and weighed all cows April 29 and monthly thereafter. May 9, 83 Polled Hereford and 29 percentage Simmental cows were allotted by breed, calving date, and winter nutrition treatment to one of four groups:

Group 1. Once daily suckle. Calves were separated from cows May 9 and penned. From then until June 2 (24 days), cows were brought to the calf pen daily at approximately 6 pm and the calves were allowed to nurse. After all cows had been nursed, they were returned to pasture.

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[a] Norgestomet implants, which are not commercially available, were provided by G. D. Searle & Co.

Group 2. Twice daily suckle. This group was handled the same as group 1 except that cows were nursed twice daily at approximately 7 am and 6 pm.

Group 3. Forty-eight hour calf removal. Calves were separated from cows May 18 and returned May 20.

Group 4. Controls (no calf separation). Suckling was allowed *ad libitum*.

We implanted half of the cows in each treatment group with 6 mg Norgestomet, a synthetic progestin, May 9 and removed the implants May 18. The breeding season started May 20 and continued through July 17 (59 days). From May 20 until June 2 all cows were bred artificially approximately 12 hr after they were detected in heat. From June 2 to July 1, half the cows in each treatment were bred artificially and the other half were exposed to bulls. Then all cows were exposed to bulls from July 3 to July 17.

Calves were 2 to 70 days old at the beginning of the limited suckle treatment. Calves separated from their dams had access to water and were fed grain and prairie hay while separated. After June 2, all calves had access to creep feed until weaned.

We recorded the total time each calf suckled in both limited suckle groups May 26, and observed the control group for 24 hours on pasture May 27-28 recording incidence and duration of suckling. All groups were observed for 24 hours on pasture between June 12 and 16, and incidence and duration of suckling were recorded. Milk production was measured in mid-June by the difference in weights before and after calves suckled.

Pregnancy rates were determined by rectal palpation after the breeding season.

Results

One calf from each of groups 2, 3, and 4 died either shortly before or during the breeding season; data from their dams were not included.

Limiting nursing to either once or twice daily or removing the calves for 48 hr before the breeding season increased the percentage of cows showing estrus the first 21 days of the breeding season. A higher percentage of cows were pregnant at all stages of the breeding season in the limited suckle groups than in the controls (Table 11.1).

The Norgestomet implant had little effect on percentage of cows showing estrus the first 21 days of the breeding season, but increased the percentage pregnant the first 21 days of the breeding season (Table 11.2).

Milk production did not differ among the treatment groups (Table .1).

Control cows were nursed 5.6 times per day when groups 1 and 2 cows were being limited to 1 and 2 nursings daily, which likely accounts for a higher percentage of cows in the limited suckle groups than controls showing estrus the first 21 days of the breeding season.

Limiting nursing to once or twice daily did not affect the incidence or duration of suckling observed two weeks later (Table 11.1).

Calf weight gains during the limited suckle period were greatest in the twice-daily suckle group and least in the 48 hr calf-removal group, but 205-day adjusted weaning weights were similar for all groups (Table 11.1).

Discussion

Stimulating cycling by suckling management is labor intensive. After the first 3 or 4 days of limited suckling, we spent about one hour in the morning and one hour in the evening putting the cows in the calf pen, insuring that cows found their calves, sorting cows from the calf pen and feeding and watering calves. After 3 or 4 days of limited suckling, most cows were at the calf pens at the regular nursing time and would return to grazing after nursing.

For limited suckling to be practical, the improved reproductive performance must pay for the added labor.

Two-year-old and late calving cows are less likely to be cycling early in the breeding season and should benefit most from limited suckling.

Table 11.1. Effects of limited suckling of beef cows on reproductive performance, milk production, calf weight gains, and suckling behavior.

	Treatment Group			
	Group 1 once daily suckle	Group 2 twice daily suckle	Group 3 48 hr calf removal	Group 4 controls
Number in group[a]	29	27	26	27
Reproductive performance				
Percent in estrus first 21 days of breeding season	89.7	85.2	88.5	66.7
Percent pregnant:				
first 21 days	44.8	40.7	38.4	37.0
first 42 days	82.8	74.1	76.9	66.7
breeding season (59 days)	89.7	88.9	92.3	85.2
Milk production[b], lb/24 hr	15.7	18.0	15.8	15.5
Suckling behavior				
During treatment[c], suckles/24 hr	1	2	0	5.6
During treatment[c], total suckling minutes/24 hr	18.7	31.3		48.0
After treatment[d] suckles/24 hr	4.8	4.9	4.9	4.9
After treatment[d], total suckling minutes/24 hr	42.2	41.2	45.2	46.3
Calf performance				
Initial wt, lb (Apr 29)	130.0	131.9	131.5	133.1
Final wt, lb (June 2)	197.6	212.5	189.0	200.7
Gain during trial, lb	67.6	80.6	57.5	67.6
Adjusted weaning wt, lb	476.5	486.7	468.5	481.8

[a] Groups 2, 3 and 4 had 28, 27, and 28 cow-calf pairs initially but one calf from each group died during the trial; data on their dams were excluded.

[b] Milk production was measured June 18-26.

[c] Incidence and duration of suckling during treatment were recorded May 26-28.

[d] Incidence and duration of suckling after treatment were recorded June 12-16.

Table 11.2. Effect of norgestomet on estrus and fertility in beef cows.

	Norgestomet implant	No implant
Percent showing estrus first 21 days of breeding season	84.9	78.6
Percent pregnant first 21 days of breeding season	49.0	32.1

[a] G. D. Searle & Co. Half of the cows in groups 1-4 were implanted May 9-18.

Determining Milk Production in Beef Cows

We measure milk production in beef cows by the "weigh-suckle-weigh" technique. Calves are separated from cows for about 8 hours. Ideally, this results in hungry calves. Then, calves are weighed accurately, allowed to nurse, and reweighed. Weight difference estimates the milk consumed. This is done three times at eight hour intervals to estimate milk produced in 24 hours.

Errors can result if the calf does not empty the udder at each nursing, the cow is too nervous during separation to secrete her normal amount of milk, or calves urinate or defecate between weighings.

Although weigh-suckle-weigh should be considered only an estimate of milk production, it's more accurate and safer than hand milking a wild cow!

Effects of Weaning Weight on Reproductive Performance in Beef Heifers

L. R. Sprott, L. R. Corah, and G. H. Kiracofe

Summary

Fertility during the first two breeding seasons was not affected by the dam's weaning weight, but lightest heifers at weaning reached puberty later, had smaller pelvic areas at calving, more difficult deliveries, had more calves die, and weaned a smaller percentage of their calves.

Introduction

Light-weight heifers appear to have lower pregnancy rates and wean fewer calves. In this experiment, we determined the effects of dams' weaning weights on their reproductive performance through the second breeding season.

Procedure

To determine the effects of dam weaning weight on reproductive performance, we held Angus and Angus x Hereford heifers (163 head) in a drylot from weaning through breeding, calving, and rebreeding. Heifers were classified at weaning as light (less than 367 lbs) or heavy (367 lbs or more). Heifers were grown at 1.5 pounds per head per day. NRC requirements were met during gestation and lactation. Puberty was defined as the first standing estrus.

Both breeding seasons lasted 60 days, and heifers were artificially inseminated by one technician using semen from a bull of known fertility. Calving ease was scored: 1=no assistance; 2=easy pull; 3=difficult pull; 4=caesarean section. Twenty-four hour milk production was measured by the weigh-suckle-weigh technique. After heifers not pregnant from the first 60-day breeding period were eliminated, 134 heifers remained.

Results and Discussion

Light heifers (less than 367 lbs) at weaning reached puberty later ($P<.01$) than those that were heavier at weaning (Table 12.1), but conception and pregnancy rates and weight gains during the growing phase were similar for both groups. Pelvic areas were similar when heifers reached 15 months of age.

Pelvic areas at calving were smallest ($P<.05$) in dams lightest at weaning (Table 12.3), and they had more ($P<.09$) difficult deliveries. Calves born to the lightest weaning dams were smaller at birth ($P<.05$). Daily gain and adjusted weaning weight of the calves were similar but more ($P<.05$) calves born to light weaning dams died the first 24 hours after birth, probably from stress during difficult deliveries. Dams in the light weight group weaned fewer ($P<.05$) calves. Milk production, post-calving interval to estrus, and conception were similar in both groups (Tables 12.2 and 12.3).

Table 12.1. Effects of weaning weight on reproductive performance during first breeding period.

	Weaning weight	
	Light (<367 lbs)	Heavy (367 lbs or more)
No. of animals	90	73
Average weight at puberty (lbs)	630.1	614.2
Average age at puberty (days)	388.4^a	333.8^b
Percent first service conception	71.7	67.6
Percent pregnant	87.0	80.0
Average daily gain (lbs)	1.4	1.4
Pelvic area at 15 months of age (cm^2)	199.0	203.3

^{a,b}Values in the same row with different superscripts differ significantly ($P<.01$).

Table 12.2. Effects of dams' weaning weight on their reproductive performance after calving.

	Dams' weaning weight	
	Light (<367 lbs)	Heavy (367 lbs or more)
No. of cows	51	50
Postcalving interval to estrus (days)	58.2	57.2
Percent first service conception	64.0	64.0
Percent pregnant	80	82

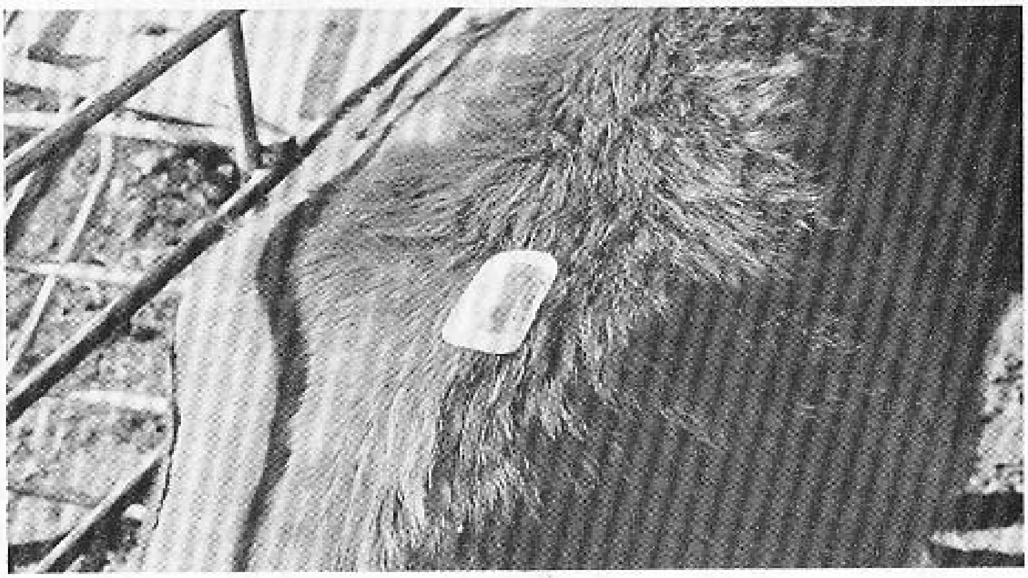
Table 12.3. Effects of dams' weaning weight on milk production, calving difficulty, and offspring performance.

	Dams' weaning weight	
	Light (<367 lbs)	Heavy (367 lbs or more)
No. of cows	78	56
24-hr milk production (lbs)*	12.3	10.3
Pelvic area at calving (cm^2)	249.8^a	261.2^b
Calving difficulty	1.78^c	1.39^d
Calf birth weight	60.1^a	64.2^b
Calf average daily gain up to 120 days of age (lbs)*	1.14	1.17
Adjusted weaning weight of calf (lbs)	384.8	383.9
Percent calves dying within 24 hrs of birth	13^a	2^b
Percent calves weaned	64.1^a	82.1^b

^{a,b}Values in the same row with different superscripts differ significantly ($P<.05$)

^{c,d}($P<.09$)

*n=44, 42 respectively



Kamar heatmount detectors are put on the rump with adhesive. When pressure is applied for a few seconds the detector turns red. A red detector indicates the cow was ridden, thus was in heat.

Use of Kamar® Heatmount Detectors in Beef Cattle Synchronized With Lutalyse®

G. H. Kiracofe, Margaret Heekin, Ken Odde, and Mike King

Summary

The ability of the Kamar Heatmount Detector to identify cows ready for insemination 80 hours after two Lutalyse injections was tested with 439 beef cows and heifers. The detector was placed on the rump at the second injection and was "read" at insemination. Conception rate from the 80-hour timed insemination for cows with red (activated) and lost detectors was 56.5% compared with 7.6% of the cows with white detectors.

Introduction

The Food and Drug Administration approved Lutalyse for synchronizing heat in beef cattle in 1979. Recommended procedure is to inject all cows in the herd with Lutalyse twice (11 days apart), then inseminate all cows 80 hours after the second injection. The procedure is popular as it can be used to artificially inseminate cows without heat detection. However, as many as 40 percent of a given herd may not be cycling when Lutalyse is injected, so they have no chance to conceive.

We tested the ability of the Kamar Heatmount Detector to identify cows ready for insemination 80 hours after Lutalyse injection.

Experimental Procedure

In five trials, two Lutalyse injections were given 11 days apart to 439 beef cows and heifers, all of which were inseminated 80 hours after the second injection. A Kamar Heatmount Detector was placed on the rump of each animal at the second injection. At insemination the detector was read as (1) red (activated, indicating heat), (2) white (not activated, indicating the cow was not ridden, thus, not in heat) or (3) lost (assumed from riding, thus, indicating heat). Partially red detectors were considered white unless there were other indications of heat. Conception rates from the 80-hour insemination were determined by rectal palpation about 60 days after insemination.

®Kamar is a registered name for heatmount detectors sold by Kamar, Inc., Steamboat Springs, CO.

Lutalyse is a registered name for the hormone prostaglandin sold by The Upjohn Co., Kalamazoo, MI, for synchronization of heat in beef cattle.

Results and Discussion

Kamar heat detectors appear to effectively identify cows in heat after synchronization with Lutalyse. Only 11 of 145 cows with white detectors at the 80-hour insemination (Table 1) conceived to that insemination. If semen and insemination costs $8 per cow, $1160 was spent to settle 11 cows. The detectors for 439 cows cost about $285. Not breeding cows with white detectors would have resulted in 11 fewer conceptions at first service, and their conception would have been delayed at least 21 days--a loss of $370, assuming it costs $1.60 for each day a cow is open. Subtracting potential losses from savings gives a net savings of $505 for the herd, or about $1.15 per cow. In this study, the breakeven cost of inseminating all cows or using detectors and not inseminating those with white detectors would have been $4.50 per insemination, including semen.

The value of heat detectors will increase in herds with fewer cows cycling and decrease in herds with more cows cycling. In our trials, about 75% were cycling.

With many cows in heat at once, excessive riding will cause many detectors to be lost (17.1% in our experiment). Lost detectors must be considered activated and the cow assumed in heat. However, if cows are exposed to brush, loose wire fences, back-rubs, etc., detectors could be lost for reasons other than riding and, thus, cause heat detection errors.

Decisions regarding heat in cows with only partially activated detectors should be based on other indications. We counted partially red detectors unactivated unless there were other signs of heat like cervical mucus, enlarged vulva, etc. Of 15 cows with partially red detectors, only 2 conceived.

Conception rates for cows with red and lost detectors combined was 56.5%. Only 7.6% of cows with white detectors conceived from the 80-hour timed insemination, so not inseminating those cows would have resulted in a substantial saving.

Table 1. Conception related to condition of Kamar detector at insemination.

	Condition of Kamar								
	Red			Lost			White		
	# Cows	# Preg.	% Concep.	# Cows	# Preg.	% Concep.	# Cows	# Preg.	% Concep.
Trial 1	39	27	69.2	5	4	80.0	47	3	6.0
Trial 2	39	23	59.0	39	23	59.0	35	3	8.6
Trial 3	12	9	75.0	18	9	50.0	9	2	22.2
Trial 4	28	15	53.6	2	0	0	8	0	0
Trial 5	101	51	50.5	11	5	45.5	46	3	6.5
Total	219	125	57.1	75	41	54.7	145	11	7.6

The Effects of Stocking Rate and Level of Winter Supplementation on Pregnancy Rates in Spring Calving Cows in the Kansas Flint Hills

L. R. Sprott, C. E. Owensby, L. R. Corah, and G. H. Kiracofe

Summary

Pregnancy rates the first 40 days of breeding were lower in cows stocked at less than 6 acres/AU than in those allowed more grazing acres. Supplementation rate during the last 100 days of gestation had little effect on pregnancy rates. Thin cows that had weaned their first calf had lowest pregnancy rates.

Introduction

Low stocking rate increases weight gain in grazing steers and suckled beef cows. Adequate winter energy supplementation improves body condition and can improve reproductive performance in calving cows. Our study was designed to measure the effects of stocking rate and level of winter supplementation on body condition and pregnancy rates in spring calving cows grazing native Flint Hills range.

Procedure

Spring calving cows from eight locations within a 35 mile radius were pregnancy tested to determine time of conception and total pregnancy rates. Cows were classed by age; those 3 years old and those older than 3. Only cows that had previously weaned a calf were included. Body condition was scored from 1 to 9 for thinnest to fattest cows. Stocking rate and supplementation level were determined for each set of cows. Supplemental feeding began 100 days before calving, but no supplement was fed during the breeding season.

Results and Discussion

Stocking rates ranged from 4.6 acres to 9.3 acres per animal unit (AU). Cows on range stocked at less than 6 acres/AU had lower pregnancy rates after 20, 40, and 60 days of breeding, but only the difference at 40 days was statistically significant (Table 14.1). Cows from heavily stocked range also were thinner when pregnancy tested. Winter supplement levels had no effect on conception rates.

Cows that had weaned their first calf were thinner and had lower pregnancy rates than older cows after 40 and 60 days of breeding (Table 14.2). Cows with body condition 4 had lower pregnancy rates after 20 days of breeding than those with a body condition of 6 (Table 14.3), and the 4s had lower pregnancy rates after 40 and 60 days of breeding than those in body condition of 5 or 6. The younger cows with a body condition of 4 were particularly affected. Clearly, thin body condition is not conducive to good reproductive performance.

Estimates of pregnancy rates after 20, 40, and 60 days of breeding as affected by actual stocking rates are shown in Figure 14.1; it does not predict pregnancy as affected by stocking rate, but shows that more acres per AU tended to increase pregnancy rates after 20, 40, and 60 days of breeding. Higher pregnancy rates during the early period (first 40 days) is desirable, because the early conceiving cows are the first to give birth, and the earliest born calves usually wean heavier. However, we emphasize that factors such as body condition of the dam at calving, weight gain of the dam after calving, time of calving with the relation to start of breeding, and bull fertility were not considered in this experiment. These factors should not be overlooked in a herd management program.

Table 14.1. Effect of stocking rate on pregnancy rates and body condition.

	Stocking Rate	
	<6 acres/AU	6 or more acres/AU
No. of cows	447	290
Percent Pregnant after:		
20 days	23	36
40 days	36[a]	67[b]
60 days (end of breeding)	79	84
Body condition at time of pregnancy exam.	4.4[a]	5.3[b]

[a,b] Values in the same row with different superscripts differ significantly (P<0.01).

Table 14.2. Effect of dam age on pregnancy rates and body condition.

	Age of Dam	
	3 years	More than 3 years
No. of cows	158	579
Percent pregnant after:		
20 days	28	31
40 days	43[a]	60[b]
60 days (end of breeding)	74[a]	88[b]
Body condition at time of pregnancy exam	4.7[a]	5.1[a]

[a,b] Values in the same row with different superscripts differ significantly (P<.01).

Table 14.3. Effect of body condition on pregnancy rates.

	Body condition		
	4	5	6
No. of cows	168	274	197
Percent pregnant after:			
20 days	14^{a}	15^{a}	24^{b}
40 days	32^{a}	43^{b}	60^{c}
60 days (end of breeding)	70^{a}	90^{b}	92^{b}

^{a,b,c}Values in the same row with different superscripts differ significantly ($P<.05$).

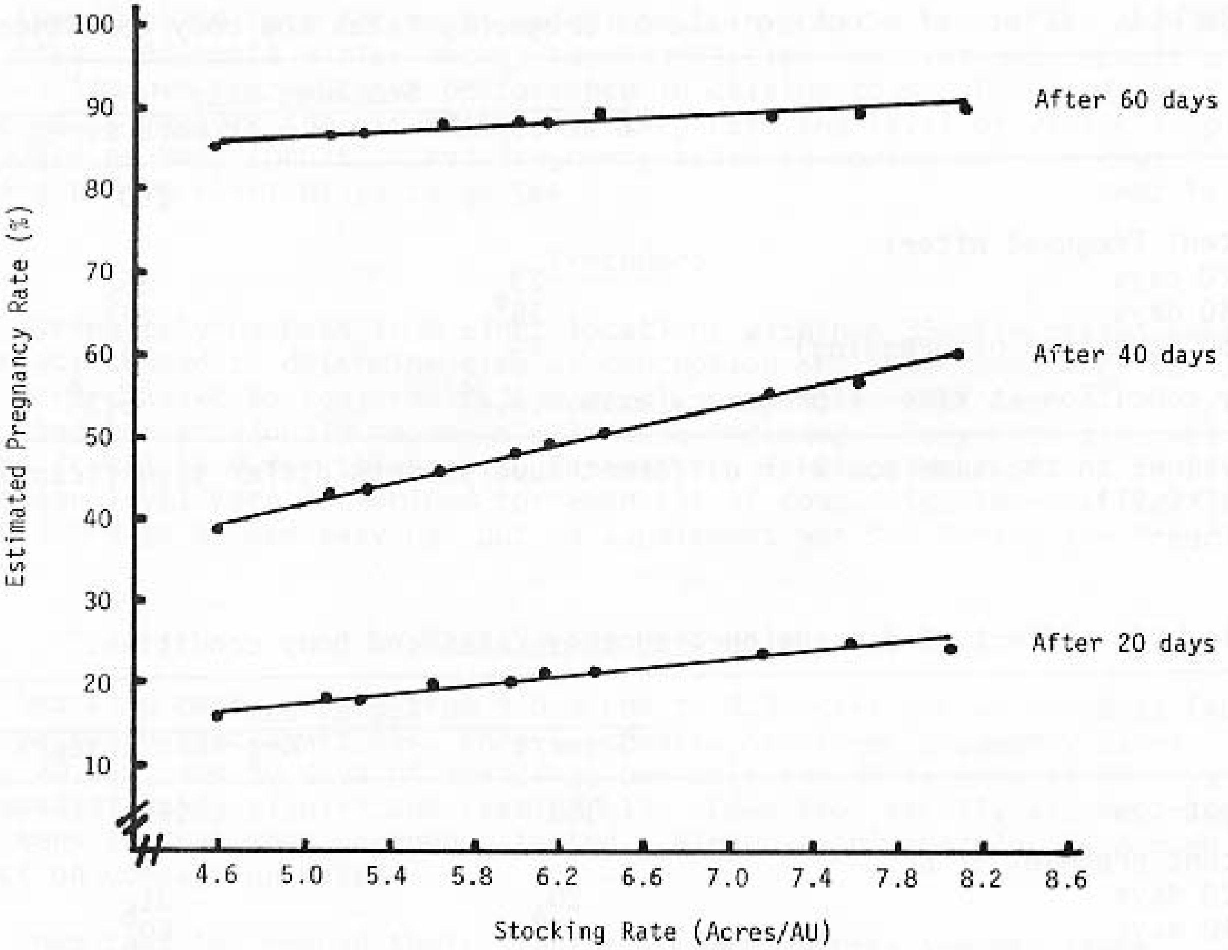


Figure 14.1. Estimates of pregnancy rates after 20, 40, and 60 days of breeding as affected by stocking rate.

Four Ear Tags Evaluated

L. R. Sprott and L. R. Corah

Summary

Four types of ear tags were evaluated for retention over 2 years. Retention was low for one type, and high for the other three types.

Introduction

Individual identification in beef herds is essential for efficient record keeping. Hot iron brands, freeze brands and ear tattoos are the only permanent identification, but they are hard to read. Most producers prefer large, easy-to-read tags that remain in the animals' ears at least 2 years.

We studied retention of four types of tags for a 2 year period.

Procedure

Beef replacement heifers from several trials at Kansas State University were held in a drylot over a 2 year period. Upon arrival, 100 head were identified with a Taylored[1] tag in the right ear and a Temple[2] tag in the left. Eighty-five head were identified with an Allflex[3] tag in the right ear and a Ritchey[4] tag in the left. All tags were the "jumbo" or "maxi" size.

Results and Discussion

Table .1 shows that only 65% ($P<.05$) of the Taylored tags were still in place after one month. Taylored tags were lost throughout the trial, but losses in the other three were minimal. Temple and Allflex tags tended to remain in the ear longer than Ritchey tags. Taylored tags, those with highest losses, were the easiest to read, especially in winter, because they hung below the base of the ear, out of the hair. Losses may have stemmed from that design. Their design has since been changed.

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[1] Taylored Tags Inc.; Taylor, Nebraska

[2] Temple Tag. Co.; Temple, Texas

[3] Allflex Tag Co.; Santa Monica, California

[4] Ritchey Mfg. Co.; Brighton, Colorado

Table 15.1. Percent tags retained over time.

	Tags			
	Taylored	Allflex	Ritchey	Temple
No. of Animals	100	85	85	100
Percent tags retained after:				
Months indicated				
1	65[a]	100[b]	100[b]	100[b]
3	46[a]	100[b]	100[b]	99[b]
5	43[a]	98[b]	98[b]	98[b]
14	11[a]	98[b]	93[b]	98[b]
23*	3[a]	96[bc]	90[c]	98[b]

*No. of animals = 76, 59, 59, 76, respectively.

[a,b,c] Values in same row followed by different superscripts differ significantly (P<.05).

What to Look for in Ear Tags

Lost ear tags are worthless, so durability and retainability are the chief criteria. How are the tags held in place and how durable they are, especially at their attachment point? How well does the tag fit your record-keeping system? Can you get different colors to identify different groups? Can you specify numbers, or can you apply your own? Will the tag be easy to read? Some tags curl or get covered with hair especially in the winter. No matter how economical or how easy a tag is to apply, if it's lost, or you have to run cattle through a chute to read it, it's a poor investment.

Effect of Rumensin on the Growth and Sexual Development of Beef Bulls

L. R. Corah, W. D. Busby, R. M. McKee, and G. H. Kiracofe

Summary

Fifty percentage Simmental bull calves were fed either with or without Rumensin. Although Rumensin improved gain by 9.2%, it had no effect on sexual development.

Introduction

Feeding Rumensin to stocker and feedlot cattle has improved gains and feed utilization, but information is scant on feeding Rumensin to bulls. We carried out this experiment to see if Rumensin would affect sexual development.

Experimental Procedure

Thirty-seven percentage Simmental bull calves were early weaned (average age, 52 days) and allotted by weight, age, and Simmental percentage to two groups. They were all fed a high-grain ration *ad lib*. for 11 days, then 18 head were fed an average of 96.5 mg Rumensin per day for 126 days. Nineteen head, fed similarly, did not receive Rumensin. Then 13 bulls, first calves from heifers, weaned at an average of 190 days, were added. After the bulls had been on an adjustment high-grain, growing diet 32 days, Rumensin was added to one group (now containing 25 head) at 236.8 mg/day for 126 days.

Sexual development was estimated from scrotal circumference (taken every 28 days), LH and testosterone concentrations (blood collected at an average age of 231 and 339 days), sexual aggressiveness (libido tests for 10 minutes at an average age of 231, 258, 287, 318, and 362 days) and sperm production (semen collected by electro-ejaculation at an average age of 263 and 351 days).

Results

Rumensin improved gain 9.2% but had no effect on any of the characteristics measured, except Rumensin-fed bulls had higher testosterone levels than controls at day 339. Results are shown in table 16.1.

Table 16.1. Effects of Rumensin on gain, sperm production, hormone concentration, and libido score.

	Treatment	
	Control	Rumensin
Early Weaned Period		
No. bulls	19	18
Average birth date	March 26	March 26
Initial weight	227.2	226.3
Daily gain	2.6	2.66
Growing Period		
No. bulls	25	25
Final Weight	902.9	935.9
Daily gain	2.58^a	2.79^b
Feed/gain ratio	6.89	6.31
Semen Measures		
% motility		
- day 263	8.3	5.0
- day 351	12.6	12.0
Sperm concentration		
- day 263	1.1×10^7	2.1×10^7
- day 351	7.5×10^7	7.9×10^7
% live sperm cells		
- day 263	37.4	43.2
- day 351	47.0	54.6
Hormone concentration		
Testosterone (ng/ml)		
- day 231	3.25	3.19
- day 339	6.71^a	10.04^b
LH (ng/ml)		
- day 231	1.49	2.58
- day 339	1.30	1.22
Libido Score		
- day 231	4.68	3.96
- day 258	5.12	5.64
- day 287	7.16	6.36
- day 318	6.36	5.72
- day 352	6.26	6.20

[a,b] Means on the same line with different superscripts differ significantly ($P<.05$).

The Effects of Rumensin® and Two Levels of Energy Prior to Calving on Reproductive Performance in First Calf Heifers

L. R. Sprott, L. R. Corah, J. G. Riley and G. H. Kiracofe

Summary

Heifers fed low energy diets gained less before calving, took longer from calving to first estrus, and dropped lighter calves. Their conception rates were lower and fewer showed estrus the first 20 days of breeding.

Rumensin lengthened the time from calving to estrus with no effect on calf birth weight, milk production, or percentage of calves weaned. However, calves from heifers fed Rumensin gained faster. Long-term Rumensin feeding to heifers (from weaning through second breeding) increased weight gain and hastened puberty with no effect on reproductive performance. Rumensin-fed dams tended to wean heavier calves.

Introduction

Low energy levels prior to calving reduce subsequent reproductive performance in beef heifers. Rumensin improves performance of growing and feedlot cattle, but little data exists on its effects on heifers or cows. Our trial determined the effect of Rumensin and two levels of energy prior to calving on subsequent reproductive and calf performance.

Procedure

Two groups of pregnant Angus and Angus x Hereford heifers were confined to drylot. One group (70 head) received no Rumensin; the other (65 head) received 200 mg Rumensin per head per day from weaning through calving and subsequent breeding. Half of each group received either 7.53 Mcal ME (low energy) or 11.41 Mcal ME (high energy) per head per day for 100 days prior to the start of calving. At calving, all heifers received 23 Mcal ME per head per day. We estimated calving difficulty (1=no assistance, 2=easy pull, 3=hard pull, 4=caesarean section), weighed all calves at birth, and observed cows for estrus twice daily beginning 20 days after the calving season started. Cows were artificially inseminated during the 60-day breeding season by one technician using semen from a highly fertile bull. Milk production was measured by the weigh-suckle-weigh technique. Only heifers that weaned a calf (101 head) were included in the reproductive data.

®Rumensin, product of Elanco Products Co., Indianapolis, IN 46706

Results and Discussion

Cows on low precalving energy gained less weight during the 100 day precalving period, lost more condition, weighed less at calving, and dropped lighter calves (Table 17.1). Furthermore, they tended to wean fewer calves, had longer postcalving intervals to estrus, lower pregnancy rates, and fewer showed estrus the first 20 days of the breeding season (Table 17.2).

Rumensin had no effect on precalving weight gain and body condition change (Table 17.3), but lengthened postcalving interval to estrus (Table 17.4), which contradicts other research work. Fewer cows fed Rumensin showed estrus in the first 20 days of breeding (Table 17.4). No other Rumensin effect on reproduction was noted. Calves born to dams fed Rumensin outgained calves from control dams (Table 17.3) and Rumensin-fed heifers produced slightly more milk.

Heifers in this study received Rumensin 630 days, with the effects during various periods shown in Table 17.5. Rumensin improved average daily gain and tended to shorten the time to puberty. For the 130 days following the first breeding, Rumensin significantly improved weight gain but this trend declined the last 100 days before calving. Following calving, Rumensin did not improve gain. We concluded that prolonged Rumensin feeding had no effect on reproductive performance in heifers.

Table 17.1. Effects of precalving energy level on weight gain and body condition.

	Energy Level	
	Low (7.53 Mcal ME/hd/day)	High (11.41 Mcal ME/hd/day)
No. of cows	67	68
Precalving average daily gain (lbs)	-0.35^a	0.81^b
Body condition at start	6.5	6.6
Body condition at calving	4.4^a	5.3^b
Postcalving weight (lb)	776.2^a	869.6^b
Degree of calving difficulty	1.51	1.66
Milk production in 24 hours (lbs)	12.1	10.7
Calf birth weight (lbs)	60.1^a	64.2^b
Calf average daily gain to 120 days of age (lbs)	1.12	1.19
Percent calves weaned	69.7	73.5

[a,b] Values in the same row with different superscripts differ signigicantly ($P<.05$).

Table 17.2. Effects of precalving energy level on reproductive performance.

	Energy Level	
	(7.53 Mcal ME/hd/day)	(11.41 Mcal ME/hd/day)
Number of cows	51	50
Postcalving interval to estrus (days)	63[a]	51[b]
Percent first service conception	64.7	62.0
Services/conception	1.51	1.71
Percent pregnant	74.5[c]	88.0[d]
Average time of conception from calving (days)	92.1	90.7
Percent in estrus by days after start of breeding: 20	66.6[a]	86.0[b]
40	86.2	98.0
60	98.0	98.0

[a,b] Values in the same row with different superscripts differ significantly ($P<.05$)
[c,d] ($P<.08$).

Table 17.3. Effects of Rumensin on weight gain and body condition.

	Treatment	
	Control	Rumensin
Number of animals	70	65
Precalving average daily gain (lbs)	0.20	0.29
Precalving body condition change	-1.59	-1.83
Postcalving body condition change	0.47	0.45
Postcalving average daily gain (lbs)	0.62	0.51
Degree of calving difficulty	1.58	1.60
Milk production in 24 hrs. (lbs)	11.22	12.32
Calf birth weight (lbs)	62.0	62.2
Calf average daily gain to 120 days of age (lbs)	1.14[a]	1.30[b]
Adjusted weaning weight (lbs)	375.1	393.6
Percent calves weaned	71.0	72.3

[a,b] Values in the same row with different superscripts differ significantly ($P<.05$).

Table 17.4. Effects of Rumensin on reproductive performance.

	Treatment	
	Control	Rumensin
Number of cows	53	48
Postcalving interval (days) to estrus	50^a	65^b
Percent first service conception	60.3	66.6
Services/conception	1.67	1.56
Percent pregnant	81.1	81.3
Average time of conception from calving (days)	88.1	94.7
Percent in estrus by days after start of breeding: 20	83.3^a	64.5^b
40	92.5	91.6
60	98.1	98.0

[a,b] Values in the same row with different superscripts differ significantly ($P<.05$)

Table 17.5. Long-term effects of Rumensin on heifer weight gains and performance.

	Treatment	
	Control	Rumensin
Daily weight gain, lbs		
Weaning through breeding	1.38^a	1.48^b
Breeding to 100 days precalving	$.68^a$	$.81^b$
100 days precalving	.20	.29
Postcalving	.62	.51
Age at puberty (days)	367.5	356.7

[a,b] Values in the same row with different superscripts differ significantly ($P<.05$)

Feeding MGA to Grazing Heifers

Larry Corah, Frank Brazle[1], Jeff Davidson[2]

Summary

Feeding MGA to grazing heifers suppressed estrus but did not improve gain.

Introduction

MGA is widely used to promote growth and feed efficiency in feedlot heifers. But this trial was designed to study the efficacy of MGA on grazing heifers--an area that has received little attention.

Experimental Procedure

The trial was conducted at the Harold Engle Jr. ranch near Madison, Kans. April 28, 1980, 70 head of predominantly crossbred heifers were individually weighed, tagged, and allotted randomly in equal numbers to treatment or control groups. The two groups were pastured separately in 160-acre native grass pastures, and rotated every 20-30 days to eliminate pasture effects.

The heifers fed MGA received 1.4 pounds of a 14% range pellet formulated to supply .5 mg MGA/heifer/day. The control heifers received the same supplement without the MGA. Eighty days after the trial started, the heifers received an additional 3 pounds of a 17% range cube/heifer/day. Because of the extremely dry summer conditions, they were weighed off pasture August 2, 1980, much earlier than planned.

Results

Results are shown in Table .1. In spite of dry grazing conditions, the average daily gain of the heifers was excellent. The 3% gain improvement by heifers fed MGA was not statistically significant.

Table 18.1. Effect of MGA on the performance of grazing heifers.

Treatment	No.	Starting weight, lbs	Final weight, lbs	Pounds gained	A.D.G.
Control	32	500.6	664.5	163.9	2.48
MGA-fed	34	506.9	675.7	168.8	2.56

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[1] Southeast Area Livestock Extension Specialist, Chanute, Kans.

[2] Greenwood County Extension Agricultural Agent, Eureka, Kans.

Growing Rations of Forage Sorghum Silage and Alfalfa Haylage

Harvey Ilg, Keith Bolsen, and Michael Dikeman

Summary

Growing rations containing forage sorghum silage (FSS) or equal amounts of FSS and alfalfa haylage were fed to crossbred steer calves for 112 days. Steers consumed more of the FSS + haylage but rate and efficiency of gain were best for steers fed the FSS. We calculated the value of alfalfa haylage at various prices for FSS and soybean meal.

Introduction

Alfalfa is an important crop to Kansas livestock men and farmers. In 1979, Kansas produced 1.03 million acres of alfalfa yielding 3.50 tons of hay equivalent/acre. Although most alfalfa is harvested as hay, haylage or silage use is increasing.

This trial evaluated alfalfa haylage as a source of both energy and protein in a growing ration for steer calves.

Experimental Procedure

The forage sorghum was Dekalb FS 25a+ grown under dryland conditions and harvested October 21 to 23, 1979. It was direct-cut in the firm-dough stage (66 to 68% moisture) and ensiled in a 20 ft. x 60 ft. A. O. Smith Harvestore. The alfalfa haylage (ensiled at 42 to 48% moisture in a 14 ft. x 40 ft. A. O. Smith Harvestore) was made from 3rd and 4th cutting, 1/10 to 1/4 bloom, Kanza alfalfa harvested in August and September, 1979. Ration, forage, and supplement compositions are in Table 19.1. Ration 1 (forage sorghum silage) was formulated to provide 12% crude protein, and soybean meal supplied 43% of the total crude protein. For ration 2, alfalfa haylage replaced half of the forage sorghum silage (dry matter basis). Ration 2 contained 12% CP and the same amounts of rolled milo and supplement as ration 1, but its supplement contained no soybean meal and alfalfa haylage supplied 58% of the total crude protein. Both rations were mixed twice daily and full-fed to crossbred steer calves sired by 3/4 Simmental bulls. Two pens of five steers and one pen of six steers received each ration during the 112-day trial (November 28, 1979 to March 19, 1980).

All steers were weighed individually after 16 hrs without feed or water at the start and end of the feeding trial. Intermediate weights were taken before the a.m. feeding on days 28, 56, and 84.

Results

Steer performances are shown in Table 19.2. Steers fed forage sorghum gained faster and more efficiently (approaching significance, $P<.10$) than those fed FSS + alfalfa haylage. Feeding FSS and haylage together increased forage intake 16.8% (1.82 lbs. dry matter/steer/day) over FSS alone.

As indicated by chemical analyses and steer performance, the alfalfa haylage had less net energy than expected; the forage sorghum silage, more. If we assume the FSS and rolled milo had similar net energy values in both rations, then the alfalfa haylage contained approximately 53 to 55 megacalories of $NE_{maintenance}$ and 22 to 24 megacalories of NE_{gain}/lb. (DM basis).

The value of the alfalfa haylage fed in this trial depends primarily on the price of the forage sorghum silage and soybean meal---both being replaced with haylage. Shown in Table .3 are values of alfalfa haylage calculated from selected prices of FSS and soybean meal. Each price combination for haylage, FSS, and soybean meal gives the same feed cost/ lb. of gain for rations 1 and 2.

Table 19.1. Composition of the two growing rations.

Ingredient	Ration 1 FSS	Ration 2 FSS + haylage
	lbs/steer/day	
Forage sorghum silage[1]	full fed	full fed[3]
Alfalfa haylage[2]	----	full fed[3]
Rolled milo	2.30	2.30
Supplement A[*]	2.00	----
Supplement B[**]	----	2.00

[1] Preliminary chemical analyses: 31.2% DM; 7.71% crude protein and 24.32% crude fiber (DM basis).

[2] Preliminary chemical analyses: 54.4% DM; 19.68% crude protein and 28.62% crude fiber (DM basis).

[3] Silage and haylage were fed in equal amounts on a DM basis.

[*] Contained 42.8% CP, 1.9% calcium, and 1.4% phosphorus, and supplied 200 mg of Rumensin per steer daily.

[**] Contained 8.9% CP, 1.9% calcium, and 1.4% phosphorus, and supplied 200 mg of Rumensin per steer daily.

Table 19.2. Performance by calves fed the forage sorghum silage and alfalfa haylage rations.[1]

Item	Ration 1 FSS	Ration 2 FSS + alfalfa haylage
No. of steers	16	16
Initial wt., lbs.	578	584
Final wt., lbs.	794	773
Avg. total gain, lbs.	216	189
Avg. daily gain, lbs	1.93	1.69
Avg. daily feed, lbs.[2]		
forage sorghum silage	10.82	6.35
alfalfa haylage	---	6.29
milo	2.07	2.07
supplement	1.80	1.80
Total	14.69	16.51
Feed/lb. of gain, lbs.[2]	7.63	9.77

[1] 112-day feeding period (November 28, 1979 to March 29, 1980).

[2] 100% dry matter basis.

Table 19. 3. Relative values of alfalfa haylage based on steer performance results from Table 3 and indicated prices for forage sorghum silage and soybean meal.*

Forage sorghum silage price ($/ton)	Soybean meal price ($/ton) 200	250	300	350
16	34.67	44.33	59.67	72.33
19	39.00	51.66	64.00	77.00
22	43.00	55.67	68.00	80.67

*Value of haylage expressed as $/ton of alfalfa hay equivalent.

Commercial Silage Additive Trials[1]

Keith Bolsen

Introduction

Most Kansas grown crops can be harvested, stored, and fed as silage. A good silage fermentation should produce a well-preserved, palatable feed with minimum nutrient loss, but making a good silage requires good management. The crop must be harvested at the proper maturity and moisture, be finely chopped, and be tightly packed in the silo.

Numerous commercial silage additives, whose manufacturers make various claims for improving silage quality, are available. Last year, we reported on 5 trials involving six commercial additives (Report of Progress 377). Each additive improved the silage in at least one of the four criteria we evaluate.

1) Ensiling temperature: Silage heats initially because oxygen is present and, later, as carbohydrates are converted to acids, carbon dioxide, and water. Protein may be heat-damaged. Low temperatures indicate air was removed and fermentation was sufficient to minimize nutrient loss.
2) Silage dry matter recovery: Some dry matter is always lost during fermentation. But good management limits this loss. "Runoff" and silage discarded due to spoilage may lead to poor dry matter recovery.
3) Silage feeding value: This is measured by feeding and metabolism trials, and takes into account palatability and digestibility as well as rate of gain and feed efficiency.
4) Aerobic stability: As silage is removed from the silo, it is exposed to air, and an "aerobic" deterioration can start, causing heating and nutrient losses. Most silages have an adequate "bunk life", but a few may begin to heat and lose nutritive value almost as soon as they are taken from the silo.

We believe our results are useful to farmers who are trying to answer two important questions about any particular silage additive: (1) Will it improve the silage? and (2) Will its benefits offset its costs?

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[1] Mention of products and companies is made with the understanding that no discrimination or endorsement is intended. Also, no criticism is implied of products and companies not mentioned.

Silage additives were evaluated in four of the five silage trials reported here. We used the four most common silage crops in Kansas: corn, sorghum, alfalfa, and wheat. All of the commercial additives (Cold-flo^R, Ensila Plus^R, Sila-bac^R, and Silo Guard^R) were used in previous trials at the Beef Research Unit.

Summary

In general, we obtained less improvement from silage additives this year than last.

Cold-flo increased ensiling temperature in corn silage, but lowered it in sorghum silage. DM recovery averaged 5.4% lower for Cold-flo silages than controls and 68% of the nitrogen applied to the fresh crop was recovered in the treated silages. Feeding value of Cold-flo silages was similar to control silages, and Cold-flo extended bunk life.

Ensila Plus lowered ensiling temperatures and improved DM recoveries slightly (0.81% in corn silage and 1.8% in wheat silage), but it did not affect feeding values or extend bunk life.

Sila-bac lowered the ensiling temperatures of forage sorghum silage but not alfalfa silage. Feeding values of both silages were improved by Sila-bac but DM recoveries from the concrete stave silos were not improved by Sila-bac. Control and Sila-bac silages had relatively long bunk lives.

Silo Guard lowered ensiling temperature, increased DM recovery (86.1 vs. 82.0%), and slightly improved feeding value of alfalfa silage.

Summarized in Table 1 are dry matter recovery for 16 additive silages and their nine controls in trials conducted from 1975 to 1980. Recovery of feedable dry matter averaged 85.5% for controls and 89.0% for additives. Twelve additive silages had higher DM recoveries and only four silages, the same or lower recoveries than controls.

Table 20.1. Dry matter recovery for control and additive silages in 9 trials conducted from 1975 to 1980.*

Silage and dry matter	Additive treatment	Recovery of feedable DM**	Silage and dry matter	Additive treatment	Recovery of feedable DM**
		%			%
Corn (38%)	control	80.9	Sorghum (29%)	control	84.1
	Silo Best^R	87.5		Silo Guard	92.0
Corn (35%)	control	87.4	Sorghum (33%)	control	91.0
	Silo Guard^R	93.7		Cold-flo	84.9
				Sila-bac	90.7
Corn (44%)	control	88.7	Alfalfa (36%)	control	84.6
	Cold-flo^R	91.5		Ensila Plus	90.0
	Sila-bac^R	91.7		Silo Guard	89.7
	Silo Best^R	91.3		Sila-lator^R	90.4
Corn (37%)	control	93.3	Alfalfa (33%)	control	82.0
	Cold-flo	88.5		Sila-bac	82.0
	Ensila Plus^R	94.1		Silo Guard	86.2
Wheat (42%)	control	77.6	9-Trial average	control	85.5
	Ensila Plus	79.4		additive	89.0

*All silages were made in 10 ft. x 50 ft. concrete stave silos.

**Percent of the dry matter ensiled.

NaOH and Ensila Plus Additives for Wheat Silage and Alfalfa Haylage for Growing Steers[1]

Keith Bolsen, Harvey Ilg, and Mopoi Nuwanyakpa

Summary

Enzyme (Ensila Plus) and alkali (NaOH) silage additives were evaluated with whole-plant wheat silages which were fed with or without alfalfa haylage (45% moisture). Steers fed NaOH silage consumed the most feed but were the least efficient. Although adding haylage increased feed intake, daily gain was not improved. Ensila Plus wheat silage was used 5.2% more efficiently than control wheat silage. NaOH increased ensiling temperatures by 5 to 8°C during the 4-week ensiling period. The amount of silage dry matter removed from the silos and fed was unusually low for all three wheat silages (77.6, 79.4, and 77.1% for control, Ensila Plus, and NaOH silages, respectively).

Experimental Procedure

Three whole-plant wheat silages (42 to 48% DM) were made June 19 to 21, 1979. Silage treatments were: 1) control (no additive); 2) dry NaOH applied at 3.8% of the crop DM; and 3) Ensila Plus applied at 0.19 lb. of product + 0.19 lb. of finely rolled sorghum grain/ton of fresh crop.

At harvest, the wheat was in the hard-dough stage and the whole plant contained about 50% dry matter. Water was added at the silo to increase moisture content to approximately 58% moisture.

Silos were opened after 70 days. Each silage was full-fed to 20 yearling Hereford steers (four pens of five steers) during a 78-day growing trial (August 29 to November 15, 1979). In two pens, cattle were fed 88.75% wheat silage and 11.25% supplement. In the other two, alfalfa haylage replaced half of the wheat silage. Rations and supplements are presented in Table 21.1. All rations were formulated to contain 12% crude protein and equal amounts of phosphorus and aureomycin. The two NaOH wheat silage rations also contained supplemental potassium. Alfalfa haylage provided about 67% of the total CP in rations B, D, and F; soybean meal + urea provided about 50% of the total CP in rations A, C, and E. The alfalfa haylage (ensiled at 52 to 58% DM in a 14 ft. x 40 ft. A. O. Smith Harvestore) was from 3rd and 4th cut alfalfa harvested in August and September, 1979.

All steers were weighed individually after 16 hrs without feed or water at the start and end of the trial. Intermediate weights were taken before the a.m. feeding on days 28 and 56.

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[1] Ensila Plus^{R} is an enzyme product of Agrimerica, Inc., 1829 Stanley Street Northbrook, IL 60062.

Dry matter losses during fermentation, storage, and feedout were measured for the three wheat silages by weighing and sampling all loads of fresh crop put into the silos and later weighing and sampling all wheat silage removed. Ensiling temperatures during the first 4 weeks were monitored with five thermocouples evenly spaced in each silo.

Aerobic stability (bunk life) of each silage was also determined. Approximately 40 lbs. of fresh silage was obtained from each silo October 29, 1979, and divided into 9 equal lots of 4.0 lbs. and each lot placed in an expanded polystyrene container lined with plastic. A thermocouple was placed in the center of the silage and cheesecloth stretched across the top of the container. After 6, 13, and 28 days of air exposure, triplicate containers of each silage were weighed, mixed, and sampled, and dry matter loss was determined.

Table 21.1. Composition of the six rations and supplements fed with the three wheat silages.

	Control wheat silage		NaOH wheat silage		Ensila Plus wheat silage	
	alone	+ haylage	alone	+ haylage	alone	+ haylage
	A	B	C	D	E	F
Ration composition	% of the DM					
Wheat silage:						
control	88.75	44.375	---	---	---	---
NaOH	---	---	88.75	44.375	---	---
Ensila Plus	---	---	---	---	88.75	44.375
Alfalfa haylage	---	44.375	---	44.375	---	44.375
Supplement	11.25	11.25	11.25	11.25	11.25	11.25
Supplement composition (calculated):						
crude protein	50.0	9.0	50.0	9.0	50.0	9.0
calcium	1.75	---	1.75	---	1.75	---
phosphorus	1.75	---	1.75	---	1.75	---
potassium	---	---	7.1	3.5	---	---

Results

Chemical analyses of the three wheat silages and alfalfa haylage are not completed, however, % dry matter at feeding averaged 43.0 for control, 43.7 for NaOH, 41.1 for Ensila Plus, and 55.7 for haylage.

Ensiling temperatures are shown in Figure 21.1. NaOH silage averaged 5 to 8° C warmer and Ensila Plus silage 0.5 to 2.0° C cooler than the control during the 4-week ensiling period.

Steer performances are shown in Tables 21.2 and 21.3. Steers fed NaOH wheat silage consumed the most feed ($P<.01$), but they were 7.8 and 13.8% less efficient ($P<.05$), respectively, than steers fed control or Ensila Plus silages. Although NaOH wheat silage produced slightly faster daily gains than the other two wheat silages, the differences were not significant. The high sodium content of the two NaOH silage rations caused excessively high water intake and urine excretion. The effects of these increased metabolic functions and wet pen conditions on steer performances are not known.

Adding alfalfa haylage did not affect daily gain but did increase ($P<.05$) feed intake by 14.9% overall--much more for the control (19.1%) and Ensila Plus (22.6%) silages than for NaOH silage (5.4%). This indicates that alfalfa haylage had less net energy for maintenance and gain than any of the three wheat silages.

Ensila Plus wheat silage rations were used 5.2% more efficiently than control rations (7.54 vs. 7.96 lbs. of dry matter/lb. of gain).

Wheat silage DM losses during fermentation, storage, and feedout were unusually high (18.0, 16.9, and 15.8% for control, Ensila Plus, and NaOH silages, respectively, Table 21.4). Silage chemical composition results (when available) may help to explain these losses. Also air penetration into the silage surface on feedout could have increased the aerobic losses (particularly for the control and Ensila Plus silages as mentioned in the footnote to Table 21.5).

Aerobic stability (Table 21.5) was greater for Ensila Plus and NaOH wheat silages than either control wheat silage or alfalfa haylage.

Table 21.2. Performance by steers fed the six wheat silage and haylage rations[1]

	Control wheat silage		NaOH wheat silage		Ensila Plus wheat silage	
	alone	+ haylage	alone	+ haylage	alone	+ haylage
No. of steers	10	10	10	10	10	10
Initial wt., lbs.	590	590	590	590	590	590
Final wt., lbs.	758	755	769	770	756	762
Avg. daily gain, lbs.	2.16	2.11	2.29	2.31	2.12	2.20
Avg. daily feed intake, lbs.[2]						
Wheat silage	13.65	8.31	17.30	9.18	12.83	8.05
Haylage	---	8.33	---	9.20	---	8.12
Supplement	1.82	1.79	1.84	1.80	1.82	1.79
Total	15.47	18.43	19.14	20.18	14.65	17.96
Feed/lb. of gain, lbs.[2]	7.19	8.73	8.37	8.78	6.91	8.17

[1] 78-day trial; August 29 to November 15, 1979

[2] 100% dry matter basis.

Table 21.3. Performance by steers fed the three wheat silages and two alfalfa haylage treatments.

	Control	NaOH	Ensila Plus	Wheat silage alone	Wheat silage + haylage
No. of steers	20	20	20	30	30
Avg. daily gain, lbs.[1]	2.14	2.30	2.16	2.19	2.21
Avg. daily feed, lbs.[1]	16.95^{b}	19.66^{a}	16.31^{b}	16.42^{d}	18.86^{c}
Feed/lb. of gain, lbs.[1]	7.96^{f}	8.58^{e}	7.54^{f}	7.49^{d}	8.56^{c}

[1] 100% dry matter basis.

[a,b] Values with different superscripts differ significantly (P<.01).

[c,d] Values with different superscripts differ significantly (P<.01).

[e,f] Values with different superscripts differ significantly (P<.05).

Table 21.4. Wheat silage fermentation, storage, spoilage, and feedout losses.

Wheat silage	DM put into the silo	DM recovered Feedable	DM recovered Non-feedable (spoilage)*	DM lost during fermentation, storage and feedout
	lbs.	% of the DM put into the silo		
Control	29,854	77.6	4.4	18.0
NaOH	28,368	77.1	7.1	15.8
Ensila Plus	33,232	79.4	3.7	16.9

* Removed from the silage surface: (1) when the silos were opened August 28, 1979, and (2) September 5, 1979, when excessive spoilage had accumulated in the silos.

Table 21.5. Changes in temperature and losses of dry matter by the three wheat silages and alfalfa haylage during air exposure.[1,2]

Silage	Day of initial rise above ambient temp.*	Maximum temp.	Accumulated temp. above ambient, °C day 6	day 13	day 28	Loss of DM (% of DM exposed to air) day 6	day 13	day 28
		°C						
Control	8	43.3	**	24.8	24.8	<1.0	4.5	13.4
NaOH	**	**	**	**	**	<1.0	2.1	2.5
Ensila Plus	24	21.7	**	**	8.8	<1.0	1.5	3.7
Alfalfa haylage	4	43.9	17.0	73.2	94.5	2.5	11.2	16.1

* 1.5°C rise above ambient temperature (18.3°C).

** No rise in temperature.

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[1] Silage removed from the silos October 29.

[2] During September, ambient temperatures reached 30 to 35°C on several days. Control and Ensila Plus silage were highly unstable and both silages heated and spoiled after only 2 to 4 days of air exposure.

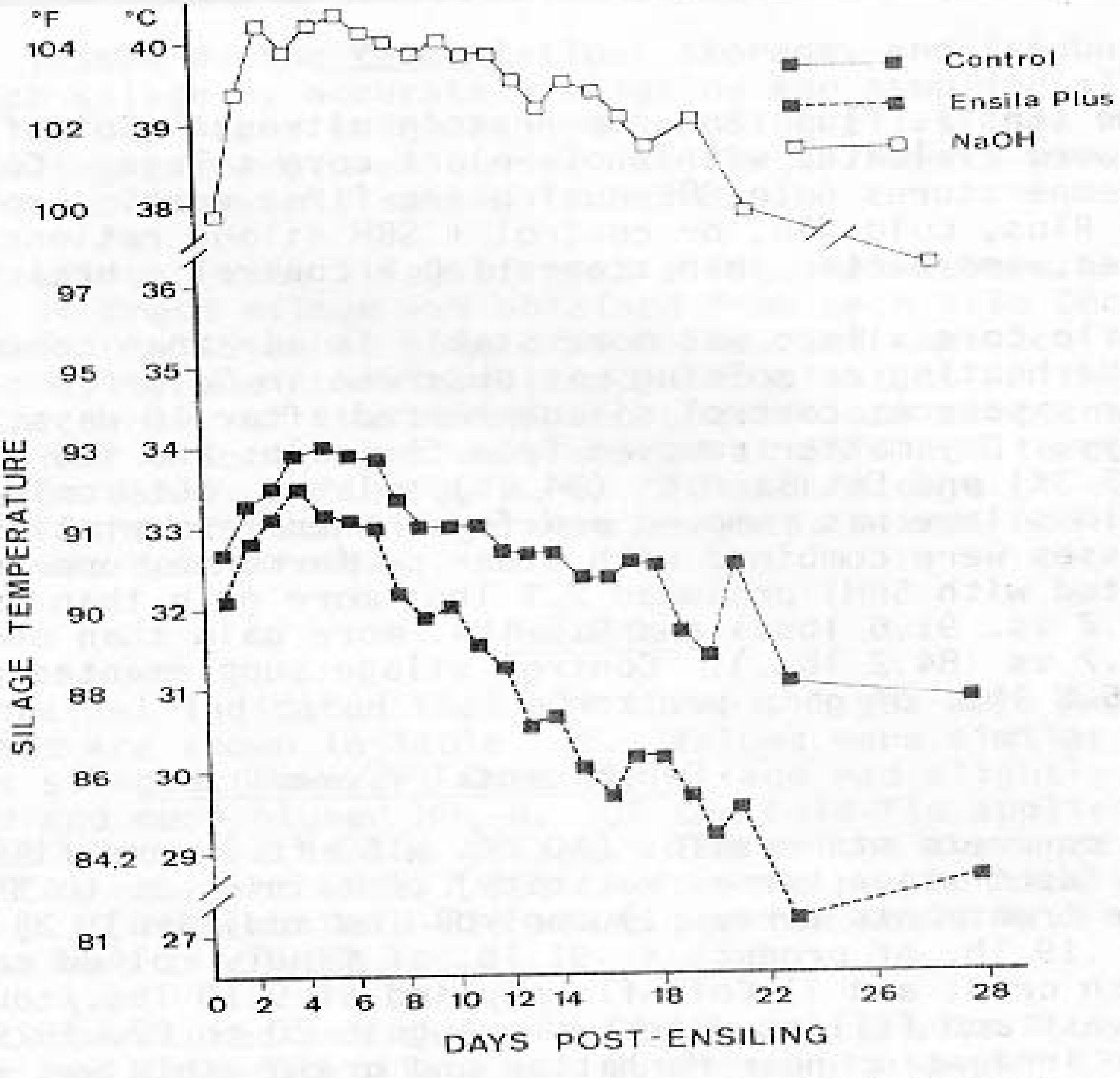

Figure 1. Ensiling temperatures for control, Ensila Plus, and NaOH wheat silages (June 18-20 to July 16-18, 1979).

Ensila Plus and Cold-flo Additives for Corn Silage[1,2]

Keith Bolsen and Harvey Ilg

Summary

Enzyme (Ensila Plus) and non-protein nitrogen (Cold-flo) silage additives were evaluated with whole-plant corn silage. Cold-flo increased ensiling temperatures 6 to 8°F during the first week. Growing steers fed Ensila Plus, Cold-flo, or control + SBM silage rations had similar performances, and better than steers fed a control + urea ration.

Cold-flo corn silage was more stable in air than control or Ensila Plus silages. No heating or molding was observed in Cold-flo silage after 28 days of air exposure; control silage heated after 10 days; Ensila Plus after 8 days. Dry matter removed from the silos and fed was similar for control (93.3%) and Ensila Plus (94.1%) silages, but only 88.55% of the Cold-flo silage was removed and fed. When fermentation, storage, and feedout losses were combined with steer performance, one ton of control silage (supplemented with SBM) produced 2.1 lbs. more gain than one ton of Ensila Plus silage (93.7 vs. 91.6 lbs.) and 9.5 lbs. more gain than one ton of Cold-flo silage (93.7 vs. 84.2 lbs.). Control silage supplemented with urea produced 85.8 lbs. of gain per ton.

Experimental Procedure

Three concrete stave silos (10 ft. x 50 ft.) were filled with whole-plant corn (dent stage kernel maturity) containing 36 to 39% dry matter. Corn silage treatments were: 1) control (no additive); 2) Ensila Plus applied at .19 lb. of product + .91 lb. of finely rolled sorghum grain/ ton of fresh crop; and 3) Cold-flo applied at 9.10 lbs./ton of fresh crop. Harvest and filling dates were August 20 to 22, 1979. Corn was grown under irrigation near Manhattan and grain yield was approximately 120 bushels/acre.

Silos were opened after 51 days. Each ration was full-fed to 20 yearling Hereford steers (four pens of five steers) during a 78-day growing trial (October 12 to December 29, 1979). Control silage was supplemented with soybean meal (SBM) for one group of 20 steers and urea for another group of 20 (urea provided 26% of the total ration crude protein); Ensila Plus silage was supplemented with SBM; and Cold-flo silage was supplemented with sorghum grain and no additional protein (Table 22.1). Supplements were fed at 2 lbs. per steer per day. All four rations were formulated to contain about 11.5% crude protein and equal amounts of calcium, phosphorus, vitamin A, and aureomycin.

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[1] Ensila Plus^R is an enzyme product of Agrimerica, Inc., 1829 Stanley Street, Northbrook, IL 60062.

[2] Cold-flo^R is a non-protein nitrogen product of USS Agri-Chemicals Division of United States Steel, P.O. Box 1605, Atlanta, GA 30301.

All steers were weighed individually after 16 hrs without feed or water at the start and end of the feeding trial. Intermediate weights were taken before the a.m. feeding on days 28 and 56.

Silage samples were collected weekly from the silos. Feed consumed was recorded daily for each of the 16 pens. The quantity of corn silage fed was regulated by the amount the steers would consume, and corn silage was always in the bunks. Silage not consumed was removed, weighed and discarded every 7 days.

Dry matter losses during fermentation, storage, and feedout were measured for each silage by accurately weighing and sampling all loads of fresh crop ensiled and later weighing and sampling all silage removed from the silos. Ensiling temperatures during the first 7 weeks were monitored with five thermocouples evenly spaced in each silo.

Aerobic stability (bunk life) of each silage was determined. Approximately 60 lbs. of fresh silage was obtained from each silo December 18, 1979, and divided into 15 equal lots of 4.0 lbs. and each lot was placed in an expanded polystyrene container lined with plastic. A thermocouple was placed in the center of the silage and cheesecloth stretched across the top of the container. Containers were stored at 65°F and temperature was recorded twice daily. After 3, 6, 9, 12, and 28 days of air exposure triplicate containers of each silage were weighed, mixed, and sampled, and dry matter loss was determined.

Results

Visual appraisal indicated that all three silages were well preserved. Chemical analyses are shown in Table .2. Values were similar for control and Ensila Plus silages, however, Cold-flo silage had slightly higher pH and lactic acid and much higher NH_3-N. Of the Cold-flo applied to the fresh crop, 57.85% was recovered in the silage. The silage averaged 11.34% crude protein (CP) compared with 7.73% CP for the pre-ensiled crop. Assuming no losses, the 9.10 lbs. of Cold-flo added per ton would have raised the silage CP equivalent to 14.15%.

Ensiling temperatures are shown in Figure 1. Ensila Plus silage was slightly cooler and Cold-flo silage was considerably warmer (3 to 10°F) than control silage throughout the 7-week ensiling period.

Steer performances are shown in Table 22.3. Rates and efficiencies of gain were excellent, reflecting the high grain content of the silage and the mild weather during the trial. The only significant differences were the faster ($P<.05$) gain of steers fed Ensila Plus silage than those fed control silage + urea, and the lower ($P<.05$) feed required per lb. of gain for steers fed control silage + SBM than those fed control silage + urea. Cold-flo silage produced nearly 4% faster and more efficient gains than control silage + urea.

Presented in Table22.4 are silage fermentation, storage, and feedout losses. Control and Ensila Plus had similar losses (6.70 and 5.89%, respectively) and both had an advantage over Cold-flo in percentages of silage dry matter removed and fed (93.30 and 94.11% vs. 88.55%).

Aerobic stabilities of the three corn silages are presented in Table 22.5. The Cold-flo silage was highly stable and showed no signs of deteriorating throughout the 28 days. The control and Ensila Plus silages were moderately stable in air, with initial temperature rise on day 10 for control and day 8 for Ensila Plus. Aerobic deterioration was characterized by simultaneous rises in temperature and pH, loss of dry matter, and loss of fermentation acids.

Table 22.1. Composition of the supplements fed with the corn silages.

Ingredient	Control		Ensila Plus	Cold-flo
	SBM	Urea		
	lbs./ton			
Soybean meal	1630	--	1630	--
Grain sorghum	180	1545	180	1775
Urea	--	230	--	--
Dicalcium phosphate	100	135	100	135
Salt	50	50	50	50
Trace minerals	10	10	10	10
Tallow	20	20	20	20
Aurofac-10*	7	7	7	7
Vitamin A**	3	3	3	3
	% dry matter basis			
Calculated crude protein	42.0	44.0	42.0	10.0

*Added to supply 70 mg of chlortetracycline/steer daily.

**Added to supply 30,000 IU of vitamin A/steer daily.

Table 22.2. Chemical analyses of control, Ensila Plus, and Cold-flo corn silages.[1]

Silage	Dry matter	pH	starch	NFE[2]	Crude protein	Crude fiber	Lactic acid	Acetic acid	Propionic acid	Butyric acid	NH_3-N*
	%		% of the DM								
Control	36.4	3.60	30.00	66.2	8.6	17.0	3.13	1.46	.27	.01	4.97
Ensila Plus	37.8	3.73	32.7	67.8	8.1	16.2	2.94	1.06	.22	.02	4.14
Cold-flo	36.4	4.00	31.0	63.7	11.2**	17.6	4.38	1.65	.24	.09	37.26

[1] Each value is the mean of 10 samples.

[2] NFE means nitrogen-free extract.

*NH_3-N means ammonia-nitrogen expressed as a percent of total nitrogen.

**Crude protein for the Cold-flo silage was also determined weekly for the fresh, wet sample. The average CP was 11.34% on a DM basis.

Table 22.3. Performances by steers fed the four corn silage rations.[1]

Item	Corn silage			
	Control			
	SBM	Urea	Ensila Plus	Cold-flo
No. of steers	20	20	20	20
Initial wt., lbs.	645	645	645	647
Final wt., lbs.	837	824	840	833
Avg. daily gain, lbs.	2.46[a,b]	2.29[b]	2.50[a]	2.38[a,b]
Avg. daily feed intake, lbs.[2]				
corn silage	17.14	17.42	17.98	17.52
supplement	1.75	1.75	1.75	1.75
total	18.89	19.17	19.73	19.27
Feed/lb. of gain, lbs.[2]	7.72[a]	8.40[b]	7.95[a,b]	8.10[a,b]

[1] 78-day trial; October 12 to December 29, 1979.

[2] 100% dry matter basis.

[a,b] Values with different superscripts differ significantly (P<.05).

Table 22.4. Corn silage fermentation, storage, and feedout losses.[1]

Corn silage	DM put into the silo	DM recovered		DM lost during fermentation storage, and feedout
		Feedable	Non-feedable (spoilage)	
	lbs.	% of the DM put into the silo		
Control	50,790	93.30	1.58	5.12
Ensila Plus	50,570	94.11	1.99	3.90
Cold-flo	55,688	88.55	1.29	10.16

[1] Dry matter percentages of the forages when ensiled were: control, 37.0; Ensila Plus, 38.0; and Cold-flo, 36.4.

Table 22.5. Changes in temperature and losses of dry matter and nutrients during air exposure by the three corn silages.

Corn silage	Day of initial rise above ambient temp.*	Maximum temp.	days exposed to air					
			0	3	6	9	12	28
		°F	Accumulated temp. above ambient, °F					
Control	10	121	--	**	**	**	13.5	305.6
Ensila Plus	8	125	--	**	**	40.7	146.8	435.5
Cold-flo	**	**	--	**	**	**	**	**
			Loss of DM (% of DM exposed to air)					
Control			--	1.2	1.1	4.9	3.5	29.5
Ensila Plus			--	3.4	3.5	7.2	11.0	31.6
Cold-flo			--	<1.0	<1.0	<1.0	<1.0	2.3
			pH					
Control			3.60	3.73	3.77	3.80	3.83	6.54
Ensila Plus			3.70	3.80	3.83	4.53	6.57	6.60
Cold-flo			3.80	3.80	3.83	3.80	3.87	3.94
			Lactic acid (% of the DM)					
Control			3.12	4.08	3.08	2.98	3.17	.61
Ensila Plus			2.31	2.59	2.86	1.02	.77	.40
Cold-flo			4.52	4.52	4.05	4.45	4.54	4.01
			Acetic acid (% of the DM)					
Control			1.19	1.14	1.19	.84	.69	.22
Ensila Plus			1.14	.96	.83	.39	.28	.18
Cold-flo			2.88	2.70	3.17	2.65	3.31	1.34

*3.0°F rise above ambient temperature (65°F).

**No rise in temperature.

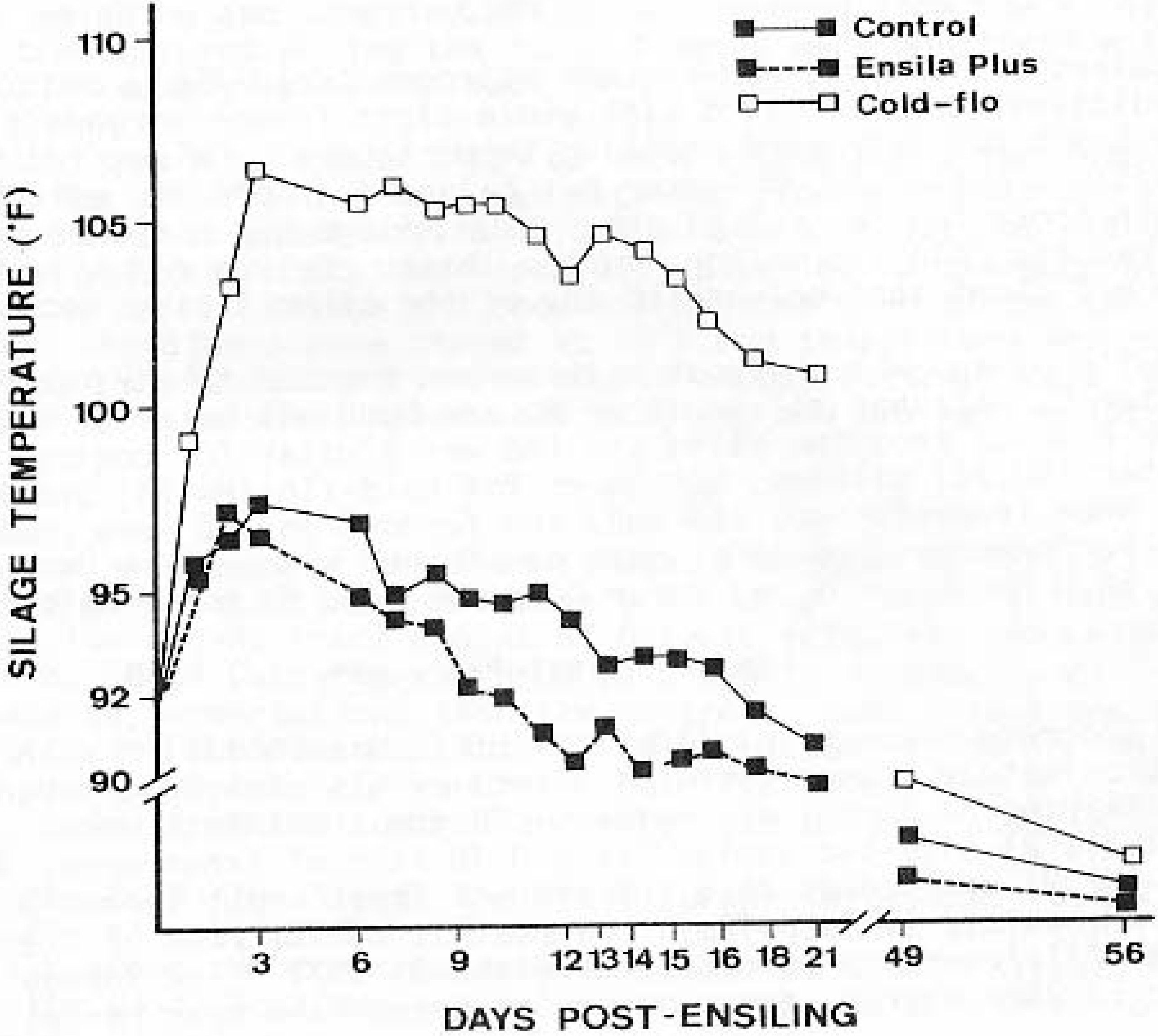

Figure 1. Ensiling temperatures for control, Ensila Plus, and Cold-flo corn silages (August 22-24 to October 17-19, 1979).

Sila-bac, Cold-flo, and Sodium Hydroxide for Forage Sorghum Silage[1,2]

Keith Bolsen and Harvey Ilg

Summary

Inoculant (Sila-bac), non-protein nitrogen (Cold-flo), and alkali (NaOH) silage additives were evaluated with whole-plant forage sorghum silage. All three additives decreased ensiling temperatures. Calves fed Sila-bac or NaOH silages gained 12.0% faster but calves fed Cold-flo silage gained 7.7% slower than those fed control silage. NaOH silage was consumed in the greatest amount; Cold-flo silage, in the least. Calves fed Sila-bac silage were more efficient than calves fed any of the other silages.

Cold-flo silage was the most stable when exposed to air; control silage heated after 5, Sila-bac silage after 6, and NaOH silage after 9 days. Dry matter removed from the silos and fed was similar for control (91.0%) and Sila-bac (90.7%) silages, but lower for Cold-flo (84.6%) and NaOH (78.9%) silages. When fermentation, storage, and feedout losses were combined with calf performance, pounds of gain per ton of silage were 74.0 for Sila-bac, 64.0 for control, 62.2 for Cold-flo, and 57.8 for NaOH silages.

Experimental Procedure

Four concrete stave silos (10 ft. x 50 ft.) were filled with 5 to 7 loads (approximately 6 tons each) of direct-cut, whole-plant sorghum (dough stage) containing 32 to 35% dry matter. Silage treatments were: 1) control (no additive); 2) Sila-bac applied at 1.0 lb./ton of fresh crop; 3) sodium hydroxide (NaOH) applied at 24.5 lbs./ton of fresh crop; (about 3.8% of the crop on a DM basis); 4) Cold-flo applied at 11.05 lbs./ton of fresh crop. Harvest and filling dates were October 8 and 9, 1979. The forage sorghum was DeKalb FS 25a+ hybrid, grown on nonirrigated land near Manhattan.

Silos were opened November 15, 1979, and silages fed to 72 heifer calves allotted by breed and weight to 12 pens (3 per silage) of six heifers each. Calves were Hereford and Hereford x Simmental with an average weight of 414 lbs. at the start of the 84-day trial. Rations were a full-feed of sorghum silage plus 2.0 lbs. of supplement (Table 23.1) mixed and fed twice daily. All rations contained about 12% crude protein and supplied equal amounts of calcium, phosphorus, vitamin A, and aureomycin. The NaOH silage supplement also contained 8.35% potassium chloride. Sorghum grain replaced SBM in the Cold-flo silage supplement. All calves were fed a full-feed of prairie hay plus 2.0 lbs. of supplement for 4 weeks before the trial started.

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[1] Sila-bac^R is a lactobacillus inoculant product of Pioneer Hi-Bred International, Inc., Microbial Products Division, 3930 SW Macadams, Portland, OR 97201.

[2] Cold-flo^R is a non-protein nitrogen product of USS Agri-Chemicals, Division of United States Steel, P. O. Box 1605, Atlanta, GA 30301.

All heifers were weighed individually after 16 hrs without feed or water at the start and end of the feeding trial. Intermediate weights were taken before the a.m. feeding on days 28 and 56.

Silage samples were collected weekly from the silos. Feed consumed was recorded daily. Silage fed to each pen daily was regulated by the amount the heifers would consume with silage always available in the feed bunks. Silage not consumed was removed, weighed and discarded every 7 days.

Dry matter losses during fermentation, storage, and feedout were measured by accurately weighing and sampling all loads of fresh crop put in the silos and later weighing and sampling all silage removed from the silos. Ensiling temperatures during the first 4 weeks were monitored with five thermocouples evenly spaced in each silo.

Aerobic stability (bunk life) of each silage was determined. Approximately 60 lbs. of fresh silage was obtained from each silo January 21, 1980, and divided into 12 equal lots of 4.0 lbs. and each lot was placed in an expanded polystyrene container lined with plastic. A thermocouple was placed in the center of the silage and cheesecloth stretched across the top of the container. Containers were stored at 65°F and temperature was recorded twice daily. After 2, 4, 7, and 14 days of air exposure, triplicate containers of each silage were weighed, mixed, and sampled, and dry matter loss was determined.

Results

Chemical analyses of the four silages are shown in Table 23.2. Both control and Sila-bac silages had undergone normal fermentations as evidenced by low pH, low NH_3-N, trace amount of butyric acid, and predominance of lactic acid. Both Cold-flo and NaOH resulted in distinctly different and more extensive fermentations than the control. NaOH silage contained more lactic (5.22 vs. 2.85%) and acetic (2.24 vs. 1.46%) acids and had a higher pH (4.24 vs. 3.98) than the control. Cold-flo silage had a higher pH (4.62 vs. 3.98) than the control and excessive butyric acid (3.99 vs. .03%).

For the Cold-flo silage, the fresh forage sorghum was 6.42% crude protein; the silage, 12.99% (DM basis). Calculations show the 11.05 lbs. of Cold-flo added per ton should have yielded 15.03% CP silage. Thus, 76.3% of the Cold-flo added was recovered. Ammonia accounted for 39.3% of the total nitrogen.

Ensiling temperatures are shown in Figure 1. All three silage additives lowered ensiling temperatures. Cold-flo and NaOH had the greatest effect: 7 to 19°F cooler than the control during the first 2 weeks. Sila-bac silage averaged 4 to 6°F cooler than control.

Heifer performances are shown in Table 23.3. Sila-bac and NaOH silages supported 12.0% faster daily gains than control silage and 21.3% faster daily gains than Cold-flo silage ($P<.05$). Feed intake was highest ($P<.05$) for NaOH silage and lowest ($P<.05$) for the Cold-flo silage. Feed required per lb. of gain was 12 to 13% lower for heifers fed Sila-bac silage than for heifers fed any of the other three silages ($P<.05$). Cold-flo silage was used 3% more efficiently than control silage.

Presented in Table23.4 are silage fermentation, storage, and feedout losses. Control and Sila-bac silages had large advantage over Cold-flo and NaOH silages.

Aerobic stabilities of the four sorghum silages are shown in Table 23.5. Cold-flo silage showed no signs of spoilage during the 14 days. The control and Sila-bac silages were moderately stable in air, with initial temperature rise on day 5 for control and day 6 for Sila-bac. NaOH silage heated on day 9. Dry matter losses were not excessive, ranging from 4.3 to 9.5% after 7 days and 6.6 to 12.4% after 14 days. When the three silages (control, Sila-bac, and NaOH) deteriorated in air; temperature, pH, and dry matter loss increased sharply, followed by decreases in lactic and acetic acids.

Table 23.1. Composition of the supplements fed with the sorghum silages.

Ingredient	Silage Control and Sila-bac	 NaOH	 Cold-flo
		lbs./ton	
Rolled milo	---	---	1787
Soybean meal	1815	1642	---
Tallow	20	20	20
Salt	42	42	42
Dicalcium phosphate	80	86	120
Limestone	28	28	16
Potassium chloride	---	167	---
Trace minerals	5	5	5
Vitamin A*	2.6	2.6	2.6
Aurofac-10**	7.4	7.4	7.4
		%, dry matter basis	
Calculated crude protein	45.0	41.0	9.0

*Added to supply 30,000 IU of vitamin A/heifer daily.

**Added to supply 70 mg of chlortetracycline/heifer daily.

Table 23.2. Chemical analyses of control, Sila-bac, Cold-flo, and NaOH sorghum silages.[1]

Silage	Dry matter	pH	Starch	NFE[2]	Crude protein	Crude fiber	Lactic acid	Acetic acid	Propionic acid	Butytic acid	NH_3-N*
	%		% of the DM								
Control	34.04	3.98	19.34	57.6	7.5	24.5	2.85	1.46	.26	.03	4.21
Sila-bac	34.91	3.96	20.56	59.1	7.7	23.5	2.75	1.20	.22	.05	3.53
Cold-flo	31.13	4.62	20.59	54.3	13.0	23.5	3.21	1.31	.32	3.99	39.25
NaOH	30.64	4.24	22.43	59.4	6.4	22.2	5.22	2.24	.26	.13	3.63

[1] Each value is the mean of 8 samples.

[2] NFE means nitrogen-free-extract.

*NH_3-N means ammonia-nitrogen expressed as a percent of total nitrogen.

Table 23.3. Performances by heifer calves fed control, Sila-bac, Cold-flo, and NaOH sorghum silage rations.[1]

Item	Sorghum silage			
	Control	Sila-bac	Cold-flo	NaOH
No. of heifers	18	18	18	18
Initial wt., lbs	415	415	413	415
Final wt., lbs.	513	524	504	525
Avg. total gain, lbs.	98	110	91	110
Avg. daily gain, lbs.	1.17^{ab}	1.31^{a}	1.08^{b}	1.31^{a}
Avg. daily feed, lbs.[2]				
sorghum silage	10.65	10.27	9.40	11.43
supplement	1.82	1.82	1.77	1.84
total	12.47^{b}	12.09^{b}	11.17^{c}	13.24^{a}
Feed/lb. of gain, lbs.[2]	10.66^{b}	9.23^{a}	10.34^{b}	10.19^{b}

[1] 84-day trial; November 11, 1979 to February 7, 1980.

[2] 100% dry matter basis.

[abc] Values with different superscripts differ significantly ($P<.05$).

Table 23.4. Sorghum silage fermentation, storage, and feedout losses.[1]

	DM put into the silo	DM taken out of the silo and fed	DM lost during fermentation, storage, and feedout
	lbs.	% of the DM put into the silo	
Control	20,979	90.98	9.02
Sila-bac	21,792	90.65	9.35
Cold-flo	23,829	84.86	15.14
NaOH	29.244	78.89	21.11

[1] Dry matter percentages of the forages when ensiled were: control, 34.97; Sila-bac, 35.69; Cold-flo, 32.20; and NaOH, 31.94.

Table 23.5. Changes in temperature and losses of dry matter and nutrients during air exposure by the four sorghum silages.

Sorghum silage	Day of initial rise above ambient temp.*	Maximum temp.	days exposed to air 0	2	4	7	14
		°F	Accumulated temp. above ambient °F				
Control	5.2	119	--	**	7.7	81.4	102.2
Sila-bac	6.2	116	--	**	1.2	50.9	135.3
Cold-flo	**	**	--	**	**	**	**
NaOH	9.6	89	--	**	**	**	84.3
			Loss of DM (% of DM exposed to air)				
Control			--	<1.0	3.5	9.5	12.4
Sila-bac			--	<1.0	<1.0	4.6	10.9
Cold-flo			--	<1.0	<1.0	4.3	6.6
NaOH			--	<1.0	1.0	7.2	9.2
			pH				
Control			3.75	3.85	3.95	7.42	8.25
Sila-bac			3.88	3.95	3.94	5.36	7.89
Cold-flo			4.36	4.50	4.48	4.45	4.44
NaOH			4.22	4.32	4.34	4.33	7.40
			Lactic acid (% of the DM)				
Control			4.18	3.92	2.85	.34	.27
Sila-bac			3.34	3.49	3.18	1.41	.36
Cold-flo			4.82	4.67	4.29	4.26	4.84
NaOH			6.28	6.40	6.36	6.12	6.09
			Acetic acid (% of the DM)				
Control			1.49	1.37	.76	.28	.20
Sila-bac			1.20	1.24	1.10	.33	.33
Cold-flo			1.71	2.06	2.00	2.27	1.93
NaOH			2.77	2.66	2.82	3.19	.45

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*3.0°F rise above ambient temperature (65°F).

**No rise in temperature.

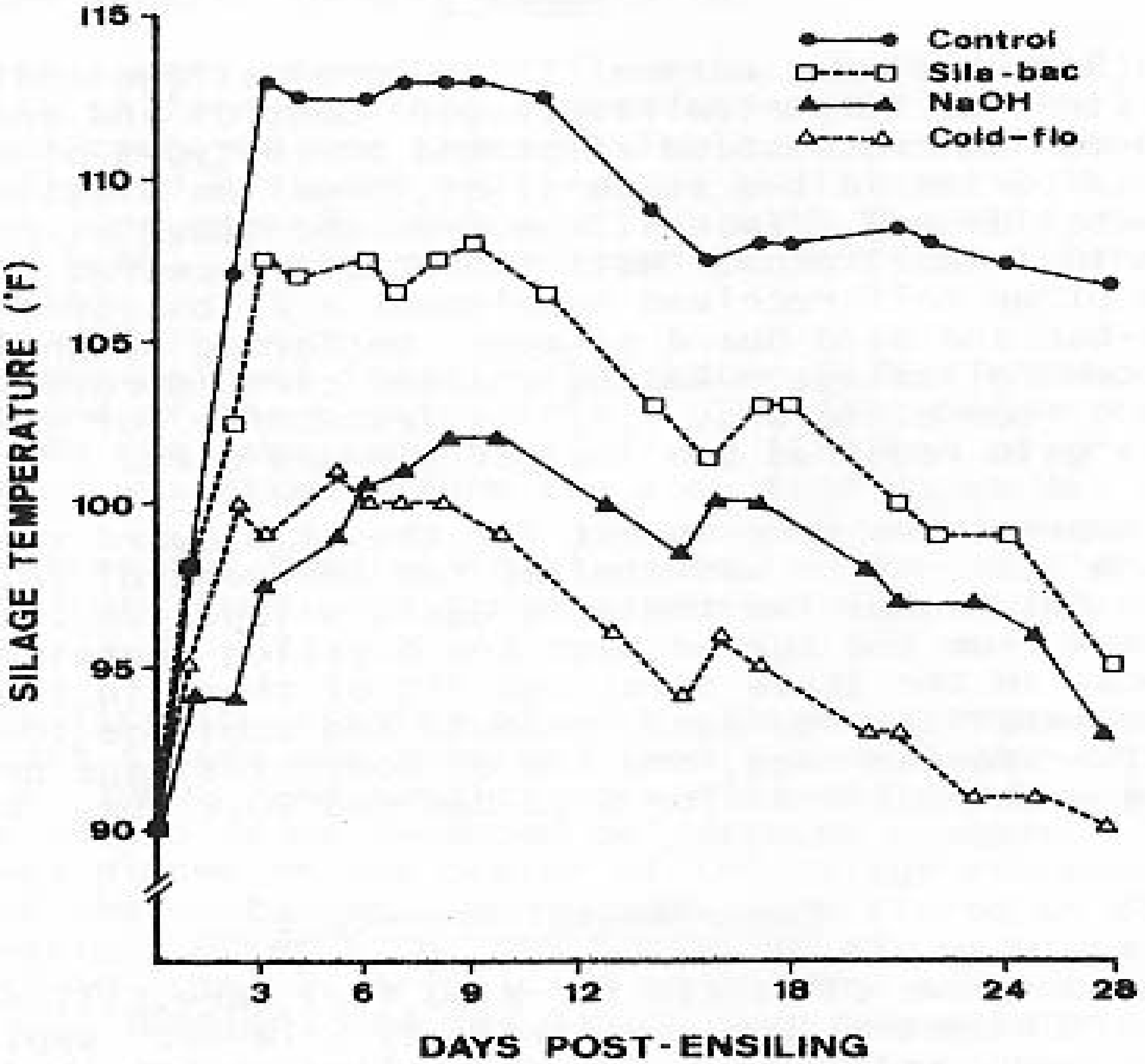

Figure 1. Ensiling temperatures for control, Sila-bac, Cold-flo, and NaOH sorghum silages (October 8-9 to November 5, 1979).

Effects of Sila-bac and Silo Guard on Alfalfa Silage Quality and Corn Supplementation on Steer Performance[1,2]

Keith Bolsen, Harvey Ilg, and Mark Hinds

Summary

Inoculant (Sila-bac) and enzyme (Silo Guard) silage additives were evaluated with first-cutting alfalfa silage. Control and treated silages were made in 50-ton concrete stave silos and three types of experimental silos (nylon bags buried in the stave silos, 5-gallon plastic containers, and 55-gallon metal drums). Each silage from the stave silos was full-fed to 16 steers in individual pens. Half the steers received 2 lbs. of supplement; the other half received supplement + 2 lbs. of cracked corn. Steers fed Sila-bac and Silo Guard silages performed slightly better than those fed control silage. Adding cracked corn improved rate of gain (.37 lb./day) and feed efficiency (.71 lb. less DM/lb. of gain). Each 1.0 lb. of extra gain required 5.5 lbs. of air-dry corn.

Ensiling temperatures were lowest for the Silo Guard silage. Dry matter recovery from the stave silos was similar for the control (81.98%) and Sila-bac (82.04%) silages but higher for the Silo Guard silage (86.14%). Fermentation and storage losses from the buried bags and 5-gallon containers were about 50% of those in the stave silos and 75% of those in the 55-gallon drums. When fermentation, storage, feedout, and spoilage losses were combined with steer performance, one ton of control silage produced 80.4 lbs. of gain compared with 83.7 lbs. for Sila-bac and 90.2 lbs. for Silo Guard silages.

Experimental Procedure

Three concrete stave silos (10 ft. x 50 ft.) were filled with three alfalfa silages: 1) control (no additive), 2) Sila-bac^{R} applied at 1.0 lb./ton of fresh crop, and 3) Silo Guard^{R} applied at 1.0 lb./ton of fresh crop. Additives (dry products) were applied by hand at the silage blower.

Silages were made May 20 and 21, 1980, and all silos received three loads (approximately 4.5 tons each) of wilted alfalfa on both filling days. The alfalfa was Kanza variety and taken from one field after windrowing with a mower-conditioner and field-wilting for 24 hours. Dry matter contents of the 18 loads of alfalfa are shown in Table 24.1. Chop length was 1/4 to 3/8 inch theoretical cut.

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[1] Sila-bac is a lactobacillus inoculant product of Pioneer Hi-Bred International, Inc., Microbial Products Division, 3930 SW Macadams, Portland, OR 97201.

[2] Silo Guard is an enzyme (and its co-factors) product of International Stock Foods, Inc., P.O. Box 29, Waverly, NY 14892.

Thermocouples were placed in the center of each silo after loads 1, 3, 4, and 6 and the wire ends were soldered to a 12-inch x 1/4 inch copper tube. Ensiling temperatures were monitored for the first 7 weeks.

About 700 lbs. of fresh crop was taken from each silo after loads 3 and 6 and used to fill 48 experimental silos. For each silage treatment each day; we filled 2 metal drums (55 gallon) lined with polyethylene; 3 plastic containers (5 gallon); and 3 nylon bags (25 lbs.) with tightly packed alfalfa. The plastic buckets were made air-tight with lids that were fitted with rubber O ring seals and Bunson valves. The nylon bags were buried in the alfalfa in each stave silo.

The stave silos were opened after 7 weeks. Each of the three silages was full-fed to 16 uniform Hereford steers averaging 609 lbs. Compositions of the six rations compared are shown in Table 24.2. All steers received 2 lbs. of supplement daily and 8 steers received an additional 2 lbs. of cracked shelled corn. Rations were fed twice daily, with the silage and concentrates mixed at the feed bunk. Steers were housed in individual feeding pens throughout the 52-day trial.

All steers were weighed individually after 16 hrs without feed or water at the start and end of the growing trial. Two days before the final weighing, all steers were fed the same amount of silage (11 lbs. of dry matter). An intermediate weight was taken before the a.m. feeding on day 28.

On the day after the feeding trial ended, a rumen fluid sample was taken via stomach tube from each steer approximately 4 hours after the a.m. feeding.

Aerobic stability (bunk life) of each silage was measured twice. Sixty lbs. of fresh silage was obtained from each silo August 8 and 60 lbs. again September 6, 1980. The samples were divided into 12 equal lots of 4.0 lbs. and each lot was placed in an expanded polystyrene container lined with plastic. A thermocouple was placed in the center of the silage and cheesecloth stretched across the top of the container. Containers were stored at 65°F and temperature recorded twice daily. After 3, 6, and 9 days of air exposure in Trial 1 and 3, 6, 9, and 14 days in Trial 2, triplicate containers of each silage were weighed, mixed, and sampled, and dry matter loss was determined.

Results

Chemical analyses of the three alfalfa silages are not completed but preliminary results are shown in Table .3. All three silages appeared to be well preserved.

Ensiling temperatures are shown in Figure 24.1. None of the silages showed excessive heating during the 7 weeks. Silo Guard silage averaged 3.5°F cooler the first week and remained 4 to 6° cooler than the control silage. Sila-bac silage averaged 2.0°F warmer than control first 7 days but 1.0 to 3.5° cooler during weeks 2 to 7.

Steer performances for the six rations are shown in Table 24.4 and for the three silage treatments and two corn treatments, in Table 24.5. There were no interactions between the alfalfa silages and cracked corn addition.

Sila-bac and Silo Guard silages produced slightly faster daily gains (5.2 and 9.6%, respectively) and more efficient gains (4.6 and 7.3%, respectively) than the control silage. However, the differences were not statistically significant.

Adding cracked corn to the alfalfa silage rations resulted in .37 lb. faster daily gain, 1.36 lbs. more DM intake, and .71 lb. less DM/lb. of gain. The extra gain from each 2 lbs. of air-dry cracked corn was .41 lb. for control, .27 lb. for Sila-bac, and .47 lb. for Silo Guard silages. Stated another way, each 1.0 lb. extra gain required 4.88, 7.41, and 4.25 lbs. of air-dry cracked corn for control, Sila-bac, and Silo Guard silages, respectively.

Presented in Table .6 are data for rumen fluid analyses. There were no interactions between silage and corn treatments and only a few of the differences were significant. Adding cracked corn resulted in slightly lower values for pH and acetic:propionic acid ratio but slightly higher values for total volatile fatty acids and lactic acids.

Presented in Table 24.7 are silage DM recoveries from the concrete stave and experimental silos. The dry matter lost during fermentation, storage, and feedout from the concrete staves was similar for the control and Sila-bac silages (12.78 and 12.18%, respectively) compared with 8.09% for Silo Guard silage. For each of the three silages, losses from the buried bags were only 48% of losses from the concrete stave silos. We think there are at least two reasons for these lower losses. First, the bags were buried in the center of the silage where density and compaction were greatest while in the stave silos, a large amount of silage was in contact with the silo walls, doors, and upper surface. Second, the surface of the stave silos was continuously exposed to air for the 8 weeks of silage feeding but buried bags were protected until removed.

Losses from the 5-gallon containers were similar to those in the buried bags, indicating favorable anaerobic conditions in both types of experimental silos. The 55-gallon drums yielded fermentation and storage losses intermediate between concrete stave silos and buried bags or 5-gallon containers for all three silages.

In both the stave silos and 55-gallon drums, 5 to 7% of the dry matter ensiled was removed from the surface and discarded as non-feedable spoilage when the silos were opened. We think those spoilage losses are not related to the alfalfa silage treatments but rather to poor compaction and air penetrating the silage surface.

Stabilities of three alfalfa silages when exposed to air on feedout are presented in Table 24.8. In both aerobic stability trials, initial temperature rise was on day 9 for the control silages and dry matter loss was 4.2 percent. Sila-bac and Silo Guard silages showed no signs of spoilage during the first 9 days in Trial 1 or 14 days in Trial 2.

Table 24.1. Dry matter contents of the alfalfa at ensiling.

Date and load number	Silage treatment Control	 Sila-bac	 Silo Guard
	Dry matter, %		
May 20			
1	36.5	36.6	38.8
2	36.5	34.1	40.8
3	38.0	32.0	37.3
May 21			
4	28.9	31.3	29.0
5	30.6	32.3	29.5
6	32.2	34.9	34.5
Avg. dry matter[1]	33.8	34.0	34.7

[1] Weighted averages that are adjusted for differences in load weights.

Table 24.2. Compositions of the six alfalfa silage rations.

	Ration number 1	 2	 3	 4	 5	 6
	lbs./steer/day					
Silage:						
Control	full fed	full fed	--	--	--	--
Sila-bac	--	--	full fed	full fed	--	--
Silo Guard	--	--	--	--	full fed	full fed
Supplement[1,2]	2.0	2.0	2.0	2.0	2.0	2.0
Corn, cracked	--	2.0	--	2.0	--	2.0

[1] lbs./ton: rolled milo, 1789.7; salt, 90; trace minerals, 10; monosodium phosphate, 107; and Rumensin-60, 3.3.

[2] Formulated to contain 9% protein and 1.5% phosphorus and to supply 200 mg of monensin/steer daily.

Table 24.3. Dry matter, pH, and NH_3-N for control, Sila-bac, and Silo Guard silages.[1]

Silage	dry matter	pH	NH_3-N*
	%		
Control	32.21	4.85	9.2
Sila-bac	32.30	4.91	9.7
Silo Guard	33.14	4.93	11.3

[1] Each value is the mean of 8 samples.

* NH_3-N means ammonia-nitrogen expressed as a percent of total nitrogen.

Table 24.4. Performances by steers fed the six alfalfa silage rations.[1]

Item	Control		Sila-bac		Silo Guard	
	- corn	+ corn	- corn	+ corn	- corn	+ corn
No. of steers	8	8	8	8	8	8
Initial wt., lbs.	610	611	606	607	610	609
Final wt., lbs.	719	740	725	740	728	752
Avg. total gain, lbs.	109	130	119	133	119	143
Avg. daily gain, lbs.	2.09	2.50	2.28	2.55	2.28	2.75
Avg. daily feed, lbs.[2]						
alfalfa silage	15.84	14.65	15.50	15.33	15.54	15.75
supplement	1.80	1.80	1.80	1.80	1.80	1.80
corn	--	1.75	--	1.75	--	1.75
total	17.64	18.20	17.30	18.88	17.34	19.30
Feed/lb. of gain, lbs.[2]	8.58	7.34	7.71	7.47	7.69	7.07

[1] 52-day trial; July 22 to September 12, 1980.

[2] 100% dry matter basis.

Table 24.5. Performance by steers fed each of the three alfalfa silages and two corn treatments.

Item	Control	Sila-bac	Silo Guard	Without corn	With corn
No. of steers	16	16	16	24	24
Avg. daily gain, lbs.	2.30	2.42	2.52	2.22^{a}	2.59^{b}
Avg. daily feed, lbs.[1]					
silage	15.24	15.41	15.64	15.63	15.24
supplement	1.80	1.80	1.80	1.80	1.80
corn	.88	.88	.88	--	1.75
total	17.92	18.09	18.32	17.43^{a}	18.79^{b}
Feed/lb. of gain, lbs.[1]	7.96	7.59	7.38	8.00^{c}	7.29^{d}

[1] 100% dry matter basis.

[a,b] Values with different superscripts differ significantly ($P<.01$).

[c,d] Values with different superscripts differ significantly ($P<.05$).

Table 24.6. Rumen fluid analyses for steers fed each of the three alfalfa silages and two corn treatments.

Item	pH	Ammonia-nitrogen	Total volatile fatty acids	Acetic acid	Propionic acid	Lactic acid
		ppm	u moles/ml	—— molar % ——		ug/ml
Silage:						
Control	6.91	234.8^{b}	87.4	58.3	27.2	175.3
Sila-bac	6.99	185.4^{a}	83.2	61.3	24.5	156.9
Silo Guard	6.89	219.9^{b}	85.3	58.6	25.8	208.9
Corn:						
without	6.96	212.4	83.0	59.5	25.8	165.4
with	6.89	214.2	85.3	59.3	25.9	180.3

[a,b] Values with different superscripts differ significantly ($P<.01$).

Table 24.7. Alfalfa silage fermentation, storage, spoilage, and feedout losses from the concrete stave and experimental silos.

Silo and silage treatment	DM put in the silo	DM recovered		DM lost during fermentation, storage and feedout
		Feedable	Non-feedable (spoilage)	
	lbs.	% of the DM put into the silo		
Concrete staves				
Control	17,813	81.98	5.24	12.78
Sila-bac	18,634	82.04	5.78	12.18
Silo Guard	18,664	86.14	5.77	8.09
Buried bags[1]				
control	8.51	93.82	--	6.18
Sila-bac	8.30	94.10	--	5.90
Silo Guard	7.94	96.10	--	3.90
5-gallon containers[2]				
control	7.33	93.86	--	6.14
Sila-bac	7.97	92.77	--	7.23
Silo Guard	7.34	94.77	--	5.23
55-gallon drums[3]				
control	90.18	84.00	6.40	9.60
Sila-bac	87.74	86.38	6.72	6.90
Silo Guard	83.92	85.49	7.09	7.42

[1] Each value is the mean of six buried bags.

[2] Each value is the mean of six containers.

[3] Each value is the mean of four drums.

Table 24.8. Alfalfa silage temperature changes and losses of dry matter during air exposure.[1,2]

	Day of initial rise above ambient temp.*	Maximum temp.	Loss of DM, %			
			day 3	day 6	day 9	day 14
	^{o}F					
Trail 1						
Control	9.0	118	<1.0	<1.0	4.24	--
Sila-bac	11.0	117	<1.0	1.84	1.20	--
Silo Guard	14.0	113	<1.0	<1.0	1.93	--
Trial 2						
Control	9.0	99	<1.0	<1.0	4.18	8.04
Sila-bac	**	**	<1.0	<1.0	1.20	1.78
Silo Guard	**	**	<1.0	<1.0	1.45	2.21

[1] Alfalfa silage used in Trial 1 was ensiled on the second filling day (May 21) and removed from the silos August 8.

[2] Alfalfa silage used in Trial 2 was ensiled on the first filling day (May 20) and removed from the silos September 6.

*A 3^{o}F rise or higher.

**No rise in temperature.

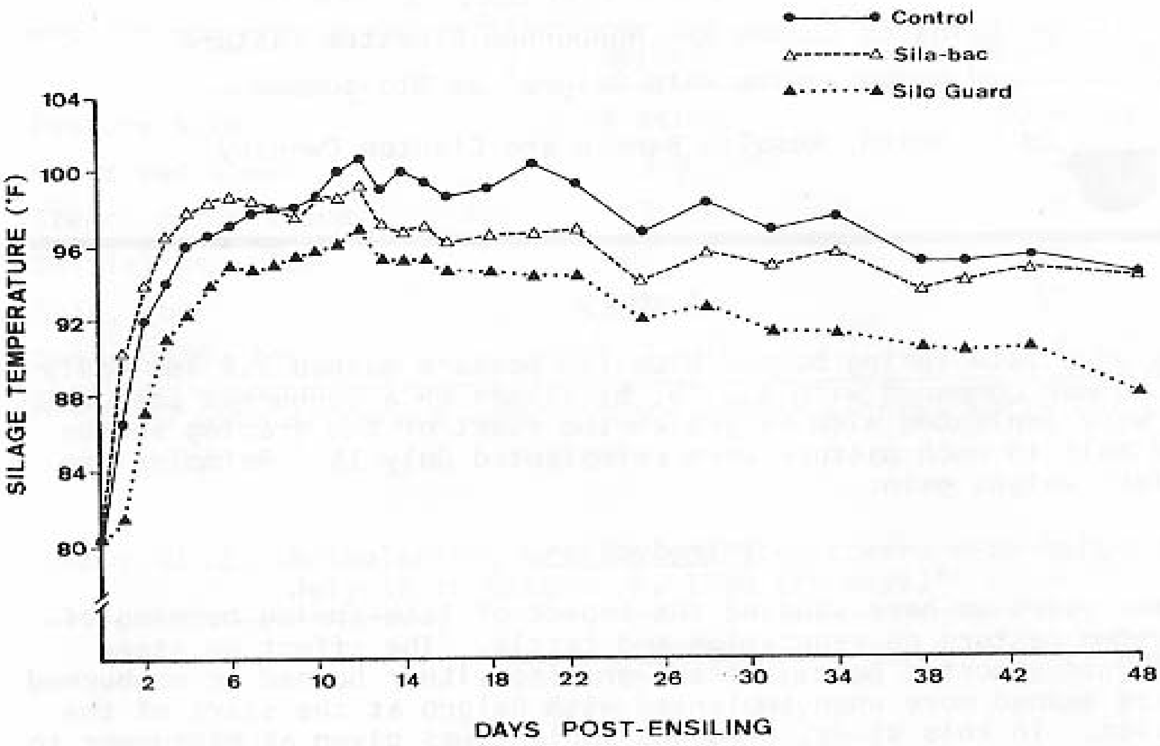

Figure 1. Ensiling temperatures for control, Sila-bac and Silo Guard alfalfa silages (May 20-21 to July 9-10, ,980).

Silage Essentials

Any crop can be ensiled if it has enough available carbohydrate to produce fermentation acids and is stored in the absence of oxygen. Absence of oxygen depends on (a) the right water content, (b) fineness of chop, and (c) packing. Most crops contain enough carbohydrate to ferment, but some low-quality crop residues may need to have carbohydrate in the form of grain or molasses added. No matter how well the silage is prepared, remember that the feeding value of the finished silage is no better than the material ensiled.

Steer Gains on Burned and Nonburned Bluestem Pasture and Reimplanting with Ralgro[1] at Mid-summer

Ed F. Smith, Rosalie Behnke and Clenton Ownesby

Summary

Steers on a late spring burned bluestem pasture gained 1.4 lbs daily during the summer compared with 1.0 lb. by steers on a nonburned pasture. All steers were implanted with Ralgro at the start of the grazing season (May 1) and half in each pasture were reimplanted July 15. Reimplanting did not affect weight gain.

Introduction

For many years we have studied the impact of late-spring burning of native bluestem pasture on vegetation and cattle. The effect on steer gains in 1980 is reported here. Steers grazing either burned or nonburned pastures have gained more when implanted with Ralgro at the start of the grazing season. In this study, a second implant was given at midsummer to determine if a further increase in gain could be obtained.

Experimental Procedure

The 44-acre pasture burned annually was burned about May 1. The nonburned pasture is 60 acres. They were grazed by yearling Angus steers with an initial weight of about 475 lbs. Weights were taken in the morning after steers were penned without feed or water overnight. Both pastures were stocked at 3.3 acres per steer from May 1 to October 2 (154 days). All steers were implanted with Ralgro May 1 and half in each pasture were reimplanted July 15.

Results and Discussion

Annual burning increased steer gains ($P<.01$) by .4 pound per head daily. Nearly all the increase occurred between May 1 and July 15. In the past, steers on burned pastures usually gained more but not so much as in 1980. The 1980 gains may have resulted from a combination of improved digestibility and increased forage intake. Burning maintains the grass longer in a more immature, palatable stage.

Ralgro usually has increased summer steer gains on grass. In the 1980 trial, and one conducted in 1977, (Kansas Rpt. of Progress 320) steers implanted at the start of grazing and reimplanted at mid-summer gained no more than those implanted only once.

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[1] Ralgro (Zeranol) is a product of International Minerals and Chemical Corporation.

Table 25.1. Steer gains on burned and nonburned bluestem pasture May 1 to October 2, 1980 (154 days).

	Burned	Non-burned
Pasture size	44 acres	60 acres
Acres per steer	3.3	3.3
Steers per pasture	13	18
Initial wt., lbs.	485	465
Gain, lbs.	215	155
Daily gain, lbs.	1.40[a]	1.00[b]

[a,b] Means with different superscripts differ significantly ($P<.01$).

Table 25.2. Reimplanting grazing yearling steers with Ralgro at mid-summer July 15 to October 2, 1980 (79 days)[a]

	Burned		Not burned	
	Implanted May 1	Implanted May 1 and July 15	Implanted May 1	Implanted May 1 and July 15
No. of steers	7	6	9	9
Initial wt., lbs.	630	619	543	549
Final wt., lbs.	714	689	614	618
Gain, lbs.	84	70	71	69
Daily gain, lbs	1.06	0.88	0.90	0.88

[a] There were no significant differences in daily gains.

Selenium Content of Native Bluestem Pastures

L.H. Harbers, D.A. Sapienza, L. Schwanke,
S.M. Kazemi, and E.F. Smith

Summary

We used steers with esophageal cannulas to measure selenium in burned and unburned bluestem pastures between May and September. Individual variation among steers sampled varied as much as two fold in selenium content. All values were considered adequate for cattle.

Introduction

The micronutrient, selenium, is required by animals at about 0.10 ppm of their ration. Levels above 8.5 ppm can produce chronic toxicity. Eastern Kansas grains and forages are thought to have adequate selenium, while western Kansas has toxic levels in local areas.

Materials and Methods

Samples were collected from burned and unburned pastures monthly during the growing season (May-September) from steers with esophageal cannulas. Collected samples were dried at 50 C, ground, digested in perchloric acid, and analyzed for selenium by a fluorimetric procedure.

Results and Discussion

Selenium contents, summarized in table 26.1, ranged from 0.6 to 2.25 ppm in control pastures and from 1.05 to 1.95 ppm in burned pastures. Variation was wide among steers grazing the same pasture. Differences between sampling dates were small. We found less than 0.1 ppm in only one case, but a sample from a second steer grazing the same pasture contained 1.2 ppm.

The average selenium content from nonburned pastures was 1.34 ppm and that from burned pastures, 1.54 ppm. So selenium content is probably adequate during the growing period. We are now measuring selenium and vitamin E on the same pastures during fall and winter.

Table 26.1. Selenium content (ppm) of esophageally collected samples of nonburned and burned Flint Hills pastures.

	May	June	July	Early Aug	Late Aug	Early Sept	Late Sept	Average
Nonburned	0.95	1.10	0.60	1.55	2.25	2.25	1.55	1.34
Burned	1.45	0.65	1.55	1.05	1.25	1.90	1.95	1.54
Average	1.20	1.38	1.08	1.30	1.30	2.08	1.75	1.44

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Don L. Good, Head
Department of Animal Sciences
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3-81—5.2M