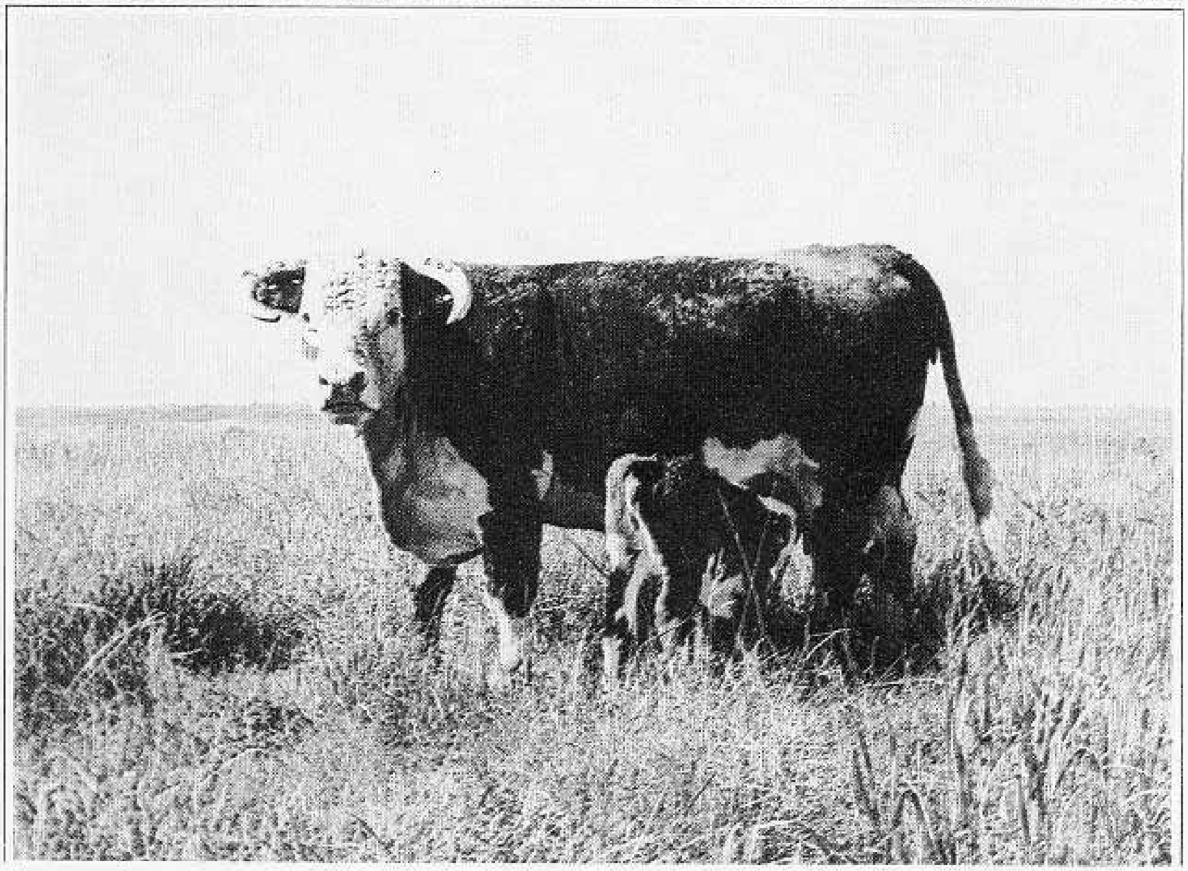
Kansas State University

Cattlemen's Day 1979



Report of Progress 350 • March 1979 • Department of Animal Sciences & Industry • Weber Hall
Agricultural Experiment Station • Floyd W. Smith, director

CONTENTS

Cowherds and Reproduction

Forages and Pastures

Feedlot Studies

Meats

Rumen Physiology

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 difference resulting from chance is less than 5%. If two averages are said to be "significantly different," the probability is less than a 5% that the difference is from chance--the probability exceeds 95% that the difference results from the treatment.

In other cases you may see a mean given as 2.50 + 0.10. The 2.50 is the mean; 0.10 is the "standard error." Two-thirds of the Individual values will fall within one standard error from the mean. In this case between 2.40 and 2.60 (2.50 - 0.10 and 2.50 + 0.10).

Many animals per treatment, replicating treatments several times, and using uniform animals increases the probability that observed differences result from treatments, not chance.

In nearly all the research reported here, statistical analyses are included to Increase the confidence you can place in the results.

Survey of Kansas Cow-Calf Producers

Jack Riley and Will Thompson

Summary

The average producer we surveyed was 46 years old with 1 year of college. He had 125 cows and 5 bulls, usually Hereford or Angus, breeding naturally on pasture for 4½ months. Most replacement heifers calved at the same time as cows. Few semen tested and only 50% pregnancy tested. Eleven percent of the cows were culled annually and 75% of the producers raised their own replacements. The average cow-calf pairs used 10 acres of pasture, 2 acres of crop residues and 1 acre of hay. Vaccinations for Blackleg (79%) and Leptospirosis (61%) were popular but less than 30% routinely vaccinated for Vibriosis or IBR. Only twenty-five percent implanted their calves, 35% used some form of preconditioning, and 40% used a wormer. Calves averaged 12 months old and 675 pounds when sold. The local auction market was the most popular (52%). In 1976-1977, when the survey was made, most producers (58%) planned to maintain their present herd size and 73% considered $50-$60/cwt. ($47 average) a realistic price for feeder calves at weaning.

Introduction

We gathered information on management practices and opinions of 350 Kansas cow-calf producers. Results indicate tremendous variation in size of operation and management procedures. Information from the survey is presented.

Procedure

The survey was conducted in cooperation with the Beef Science class at Kansas State University. Each student the fall semester of 1976 and spring semester of 1977 completed a survey form by interviewing a Kansas cow-calf producer. The survey was not conducted according to standardized statistical survey methods, but we think the results from 350 producers indicate a cross-section of management practices and attitudes in the Kansas cattle industry.

Results

Questions asked are tabulated at the end of this report. The results indicate that students interviewed producers younger, better educated, and with larger operations than the average for Kansas. The results indicate that further education is needed so more Kansas producers use management practices proved beneficial. For example, only 24.6% of the 350 producers used implants.

Results from surveying 350 Kansas cow-calf producers, 1977-78.

	Total[a]	Commercial[b]	Registered[c]
Avg. age, years	45.8	45.5	46.3
Avg. education	1 yr. college	1 yr. college	1 yr. college
No. of Cows			
Avg.	126	110	141
50 or fewer	103[d] (29.5)[e]	89[d] (31.0)[e]	17[d] (18.7)[e]
51-100	111 (31.8)	88 (30.7)	28 (30.8)
101-200	78 (22.4)	66 (23.0)	20 (21.9)
201-1000	57 (16.3)	44 (15.3)	26 (28.6)
Cow Breed			
Angus	59 (16.9)	47 (16.4)	15 (16.3)
Hereford	117 (33.5)	92 (32.1)	43 (46.74)
Angus-Hereford cross	21 (6.0)	21 (7.3)	
Angus and Hereford	29 (8.3)	27 (9.4)	5 (5.4)
Charolais	9 (2.6)	6 (2.1)	6 (6.5)
Simmental	9 (2.6)	1 (0.4)	8 (8.7)
Simmental-Hereford cross	7 (2.0)	6 (2.0)	2 (2.2)
Cross breeds	37 (10.6)	36 (12.5)	1 (1.1)
Other	61 (17.5)	51 (17.8)	12 (13.0)
Cow Weight			
Avg., lbs.	1018	990	1082
950 or less	117 (17.0)	109 (38.1)	12 (13.3)
951-1050	152 (50.7)	132 (46.2)	37 (41.1)
1050 or more	77 (22.3)	45 (15.7)	41 (45.6)
No. of Bulls			
Avg.	5.5	4.5	8.3
10 or fewer	301 (89.1)	255 (90.1)	68 (18.0)
11-20	27 (7.9)	21 (7.4)	11 (13.1)
21 or more	10 (3.0)	7 (2.5)	5 (5.9)
Bull Breed			
Angus	65 (19.1)	53 (18.6)	15 (17.4)
Hereford	120 (35.2)	98 (34.4)	36 (41.9)
Angus and Hereford	37 (10.9)	35 (12.3)	5 (5.8)
Angus, Hereford & Simmental	10 (2.9)	10 (3.5)	2 (2.3)
Angus and Simmental	10 (2.9)	10 (3.5)	5 (5.8)
Charolais	11 (3.2)	8 (2.8)	5 (5.8)
Simmental	22 (6.5)	16 (5.6)	7 (8.1)
Hereford and Simmental	8 (2.3)	7 (2.5)	3 (3.5)
Other	58 (17.0)	48 (16.8)	13 (15.1)

a refers to all producers surveyed.
b refers to producers whose operations produce primarily commercial cattle.
c refers to producers whose operations produce primarily registered cattle.
d number of producers.
e percentage of the producers.

No. of Cows per Bull			
Avg.	24.5	24.8	23
20 or fewer	89 (26.3)	67 (23.7)	32 (38.5)
21 to 30	156 (46.2)	144 (50.9)	26 (31.3)
31 or more	93 (27.5)	72 (25.4)	25 (30.1)
Breeding Program Used			
Artificial Insemination	11 (3.2)	3 (1.1)	8 (8.8)
Pasture	284 (81.4)	259 (89.9)	49 (53.8)
Both A.I. and pasture	54 (15.5)	26 (9.0)	34 (37.4)
Length of Breeding Season			
Avg. days	134	144	103
45 or less	10 (3.8)	10 (3.6)	4 (4.4)
46-60	53 (19.6)	52 (18.5)	26 (28.6)
61-90	141 (36.3	96 (34.1)	38 (41.7)
91-120	51 (14.9)	44 (15.7)	10 (11.0)
121-365	86 (25.4)	79 (28.1)	13 (14.3)
Heifers compared with cows calving			
Earlier	101 (31.1)	82 (30.7)	30 (34.5)
Same time	185 (56.9)	154 (57.7)	46 (52.9)
Later	39 (12.0)	31 (11.6)	11 (12.6)
Do you flush			
Yes	124 (35.5)	91 (31.7)	48 (52.2)
No	225 (64.5)	196 (68.3)	44 (47.8)
Do you semen test			
Yes	151 (43.4)	117 (40.6)	48 (53.3)
No	197 (56.6)	171 (59.4)	42 (46.7)
Do you pregnancy test			
Yes	175 (50.0)	138 (47.9)	56 (60.9)
No	175 (50.0)	150 (52.1)	36 (39.1)
Culling rate			
Avg. %	11.0	10.4	12.8
10% or less	186 (66)	157 (68.0)	45 (59.2)
More than 10%	94 (34)	74 (32.0)	31 (40.8)
Are replacement heifers			
Raised	257 (74.5)	208 (73.2)	76 (83.5)
Bought	35 (10.1)	33 (11.6)	3 (3.3)
Both bought & Raised	53 (15.4)	43 (15.1)	12 (13.2)
Acres of grass			
Avg. acres	1217	1105	1266
0-250	75 (21.5)	64 (22.3)	13 (14.3)
251-500	80 (22.9)	67 (23.4)	17 (18.7)
501-1000	86 (24.7)	68 (23.6)	29 (31.8)
1001-2000	54 (15.4)	42 (14.7)	14 (15.4)
2001-4000	32 (9.2)	29 (10.1)	8 (8.8)
4001 or more	22 (6.3)	17 (5.9)	10 (11.0)

Acres of crop residue			
Avg.	284	274	312
0-250	170 (60.1)	139 (60.2)	43 (58.1)
251-500	69 (24.4)	58 (25.1)	17 (23.0)
501 or more	44 (15.5)	34 (14.7)	14 (18.9)
Acres of hay			
Avg.	112	111	137
0-100	217 (66.6)	183 (68.3)	48 (56.5)
101-200	74 (22.7)	57 (21.3)	26 (30.6)
201 or more	35 (10.7)	28 (10.4)	11 (12.9)
Have you ever used a liquid supplement			
Yes	146 (43.5)	120 (43.3)	37 (42.5)
No	189 (56.4)	157 (56.7)	50 (57.5)
If you used a liquid supplement, were you satisfied			
Yes	74 (52.5)	58 (50.0)	19 (54.3)
No	67 (47.5)	58 (50.0)	16 (45.7)
Vaccination used			
Blackleg	257 (78.8)	214 (81.1)	68 (74.7)
Leptospirosis	198 (60.7)	156 (59.1)	65 (71.4)
Brucellosis	97 (29.8)	67 (25.4)	40 (44.0)
Vibrio	96 (29.5)	74 (28.0)	36 (39.6)
BVD	4 (1.2)	11 (4.2)	8 (8.8)
IBR	77 (23.6)	55 (20.8)	28 (30.8)
Do you worm			
Yes	133 (39.9)	110 (40.1)	36 (41.4)
No	200 (60.1)	163 (59.9)	51 (58.6)
If you worm, which wormer do you use			
Tramisol	52 (61.2)	43 (62.3)	15 (60)
TBZ	18 (21.2)	15 (21.7)	6 (24)
Other	15 (17.6)	11 (16.0)	4 (16)
Method used to treat lice, flies, grubs			
Spray	59 (17.1)	52 (18.3)	11 (12.1)
Backrub	8 (2.3)	7 (2.5)	1 (1.1)
Feed	3 (0.9)	3 (1.1)	0 (0)
Dust/Powder	23 (6.7)	22 (7.7)	1 (1.1)
Pour on	20 (5.8)	17 (6.0)	6 (6.6)
Combination	227 (65.8)	178 (62.7)	71 (78)
Nothing	5 (1.4)	5 (1.8)	1 (1.1)
Do you implant			
Yes	86 (24.6)	77 (26.7)	
No	263 (75.4)	288 (73.3)	
If you implant, which implant do you use			
Ralgro	45 (55.6)	41 (55.4)	
DES	26 (32.1)	24 (32.4)	
Ralgro and DES	7 (8.6)	7 (9.5)	
Synovex	1 (1.2)	1 (1.4)	
Synovex and Ralgro	1 (1.2)	1 (1.4)	
Varies	1 (1.2)	0 (0)	

Do you precondition			
Yes	122 (35.3)	92 (32.4)	42 (45.7)
No	224 (64.7)	192 (67.6)	50 (54.3)
Age of calf when sold			
Avg. age	12.27	12.14	13.08
8 months or less	82 (25.3)	72 (26.4)	17 (21.8)
9-12 months	138 (42.6)	117 (42.8)	33 (42.3)
13 months or more	104 (32.1)	84 (30.8)	28 (35.9)
Weight of calf when sold			
Avg. weight, lbs	677	660	754
500 or less	102 (31.3)	94 (34.2)	17 (21.8)
501-750	142 (43.5)	120 (43.6)	33 (42.3)
751 or more	82 (25.2)	61 (22.2)	28 (35.9)
Where do you sell calves			
Terminal auction	34 (9.9)	32 (11.3)	6 (6.7)
Direct off farm	43 (12.6)	32 (11.3)	19 (21.3)
Order buyer	16 (4.7)	14 (5.0)	2 (2.2)
Local sale barn	176 (51.5)	160 (56.7)	26 (29.2)
Combination of above	53 (15.5)	36 (12.8)	22 (24.7)
Other	20 (5.9)	8 (2.8)	14 (15.7)
Have you ever maintained ownership of your calves			
Yes	124 (35.6)	97 (33.8)	41 (45.1)
No	224 (64.6)	190 (66.2)	50 (54.9)
Have you ever hedged			
Yes	19 (5.5)	13 (4.5)	10 (11)
No	329 (94.5)	271 (66.2)	81 (89)
If you have hedged, will you do it again			
Yes	8 (44.4)	7 (53.8)	2 (22.2)
No	10 (55.6)	6 (46.2)	7 (77.8)
Will your cow numbers			
Increase	78 (22.7)	62 (22.0)	21 (23.3)
Decrease	65 (19.0)	52 (18.4)	18 (20.0)
Stay the same	200 (58.3)	168 (59.6)	51 (56.7)
Price considered desirable for calves (Oct. 76 - May 77)			
Avg.	47.29	46.75	47.12
0-40¢/lb.	76 (23.6)	63 (23.0)	16 (20.0)
41-60¢/lb.	235 (73.0)	197 (73.3)	59 (73.8)
61¢/lb. or more	11 (3.4)	10 (3.7)	5 (6.2)
Should imports be restricted			
Yes	329 (96.8)	271 (96.8)	86 (96.6)
No	11 (3.2)	9 (3.2)	3 (3.4)
Should the government support prices			
Yes	45 (13.2)	38 (13.5)	10 (11.2)
No	295 (86.8)	243 (86.5)	79 (88.8)

Incidence of Short Estrous Cycles After Weaning in Beef Cows

Steve Ward, Ken Odde, Guy Kiracofe,
and Miles McKee

Summary

Weaning calves from cows that had not cycled after calving caused a higher percentage of cows to show estrus in the next 25 days than cows suckling calves. However, 78.3% of the nonsuckling cows had short cycles (7-10 days) compared with 16.6% of the cows suckling calves. A short cycle does not appear to be clinically abnormal when estrus occurs with the first ovulation after calving. The percentage of cows having an estrus with the first ovulation, and thus a short cycle, increases drastically when calves are weaned.

Although anestrous cows can be induced to cycle by weaning their calves, the first estrus after weaning is relatively infertile.

Introduction

Increased use of artificial insemination has increased attention to estrous cycles. Cycles of 18 to 24 days are considered "normal." Cycles of 7 to 12 days (short cycles) have been observed in both heifers and cows, but most have been in postpartum cows. Whether that is clinically abnormal has not been determined. It is not known if an ovulation occurs at the first, second, or both estrus periods or if cows conceive at the expected rate after a short cycle.

Other researchers have reported that weaning calves within 24 hrs. after birth increased the proportion of cows with abnormal estrous cycles. They reported 7 of 14 weaned cows had short cycles while only 2 of 14 lactating cows had short cycles. Last year we noted that weaning postpartum anestrus cows increased the number with short cycles; 77.8% of the cows in estrus within 10 days after early weaning had short cycles (average 8 days); however, we did not study details of the short cycles.

Lack of understanding and interest in short cycles prompted us to see if we could determine if short cycles are increased by weaning calves from early postpartum anertrus cows.

Materials and Methods

Eighty-eight crossbred Simmental cows were checked for estrus three times daily from calving until the end of the experiment. Thirty-three (19 to 68 days postpartum) that had not been detected in estrus and did not have a palpatable corpus luteum by May 10, 1978, were selected for the experiment. Twenty-five had their calves weaned May 10; the remaining 8 continued suckling their calves. All cows were artificially inseminated about 12 to 18 hrs. after estrus was detected.

Results and Discussion

Early weaning (average of 44 days after calving) increased the percentage of anestrous cows exhibiting estrus the first 10 days or the first 25 days after weaning (Table 2.1).

Weaning calves early from postpartum anestrous cows also increased the percentage of cows exhibiting short estrous cycles (78.3% vs. 25% for controls).

Sixteen of nineteen cows (84%) that had calves weaned and showed either standing estrus or signs of estrus (hyperactivity) in the first 10 days after weaning had estrous cycles of 7 to 10 days. During the same period only 1 of 3 lactating cows had a short cycle.

Weaning calves stimulates noncycling cows to begin cycling; however, the high percentage of short cycles may extremely lower fertility at the first estrus. Although we could not confirm conception dates, our percentages of inseminated cows returning to estrus was 91.3 for nonsuckled cows and 50.0 for suckled cows. Short cycles are not clinically abnormal for the first postpartum estrus. Suckling may inhibit estrus at the first postpartum ovulation; if so, removing suckling calves may allow estrus to be exhibited. The corpus luteum from the first ovulation apparently has a short life span, which results in a short cycle. In cows suckling a calf, estrus does not usually accompany the first ovulation; thus a short cycle is not observed. Weaning calves before the first estrus after calving drastically increased short cycles.

Table 2.1. Postpartum intervals and effects of weaning on occurrence of estrus in beef cows.

Treatment group	No.	Average days postpartum[a]	No. (& %)[b] of cows exhibiting estrus 10 days	25 days	No. (& %)[b] of cows with short cycle
Cows with calves weaned	25	43.9	19(76.0)	23(92.0)	18(78.3)[c]
Lactating control cows	8	44.5	3(37.5)	6(75.0)	1(16.6)[c]

[a]Average number of days from calving to May 10 (date of weaning).
[b]Percentage in ( ).
[c]Percentage calculated on basis of cows that exhibited estrus in 25 days.

Effects from Using Ralgro[1,2] Sequentially on Sexual Development of Bulls and on Growth and Carcass Characteristics of Steers and Bulls

Lori Fink, Larry Corah, Guy Kiracofe, and Miles McKee

Summary

Forty-nine Simmental X Hereford and Hereford calves (24 bulls and 25 steers) were used to study the effect of Ralgro on growth, carcass traits, sex drive, sperm production, and development of sex organs. Approximately half of the bulls and half of the steers received a total of four 36-mg. Ralgro implants, one implant each 100 days (approximately 28, 128, 228 and 328 days of age). Implanted bulls and steers had higher average daily gains; however, the effect was greater in steers than bulls. Ralgro impaired all facets of sexual development measured. None of the implanted bulls could have been used for breeding purposes as yearlings.

Introduction

Ralgro increases growth and performance of steers, but little is known about its affects on bulls or effects from implanting steers every 100 days from birth to slaughter. It is not known if bull calves implanted with Ralgro can be used later for breeding. We measured the effect of four sequential 36-mg. Ralgro implants on growth and carcass traits of steers and bulls and on sexual development of yearling bulls.

Experimental Procedure

Eleven of 24 bull calves and 13 of 25 steer calves were implanted with 36 mg. of Ralgro April 19 when calves averaged 28 days of age (range 0 to 71). All implanted animals were reimplanted at approximately 128, 228, and 328 days of age. All calves were weaned October 14, 1977, and placed on a growing ration of 19% corn, 77% corn silage, and 4% supplement. January 16, 1978, they were switched to a finishing ration that was 73% corn, 13% corn silage, and 4% supplement. All calves were weighed at birth, at weaning (October 14, 1977), 120 days after weaning (February 23, 1978), and at slaughter.

Testicle-scrotal circumference was measured October 14, 1977, February 23, 1978, and June 10, 1978. The measurement was taken at the area of maximum circumference and included the scrotum and both testicles. Pelvic area was measured May 15, 1978, with a Rice pelvimeter. Semen was collected by electro-ejaculator.

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[1] Ralgro is a product of International Minerals & Chemical Corporation.

[2] Mention of products and companies is made with the understanding that no discrimination is intended and no endorsement implied.

During May and June, bulls were observed for mounting activity, two hours each day for eight days, and number of mounts by each bull was recorded.

Sex drive was evaluated June 10, 1978. Each bull was exposed to a heifer in heat for 10 minutes and scored on a scale of 1 to 5; one representing no interest and five representing mating.

Steers were slaughtered June 13, 1978, and bulls were slaughtered June 15, 20, or 27. At slaughter, testicle length, circumference, and weight and penis weight and length were measured. Bull and steer carcasses were evaluated for quality and yield grade.

Results and Discussion

Ralgro implants increased average daily gain (ADG) in bulls and steers over nonimplanted animals (2.04 lbs. versus 1.97 lbs. in bulls and 2.12 lbs. versus 1.95 lbs. in steers). Implanted steers weighed 83.7 lbs. more at slaughter than nonimplanted steers (Table 3.2). Implanted bulls had smaller testicle-scrotal circumferences but larger pelvic areas (Table 3.1) indicating that Ralgro increases pelvic bone growth.

Nonimplanted bulls did three times more mounting than implanted bulls, so implanting may have an advantage for bulls that go into feedlots.

Implants depressed sex drive scores (1.45 vs. 2.08) and semen production. Eight of 13 nonimplanted bulls were classified as fertile but none of the 11 implanted bulls was classified fertile. No sperm were found in 2 of 13 nonimplanted bulls or 6 of 11 implanted bulls. Testicle length, circumference, and weight and penis length and weight, measured at slaughter, were depressed in implanted bulls, (Table 3.1) indicating that Ralgro significantly retards sexual development.

With the few animals used, differences in quality and yield grades were inconsistent (Table 3.2).

We concluded that four Ralgro implants will suppress sexual development in bulls to the point that they cannot be used for breeding as yearlings, and that implanting may benefit bulls fed for slaughter by both promoting growth and depressing mounting activity. Additional data are needed to determine if fewer implants would have similar effects.

Table 3.1. Effects of Ralgro on sexual development of bulls.

	Testicle-scrotal circum(cm) 10-14-77	2-23-78	6-10-78	Pelvic[1] area (sq.cm.)	Slaughter data: Testis length (cm.)	Testis circum. (cm.)	Testicle wt. (gm.)	Penis wt. (gm.)	Penis length (cm.)
Not implanted[2]	23.51	29.63	37.42	164.08	27.05	18.64	485:20	337.20	32.55
Implanted[2]	20.10	22.65	30.90	197.54	19.91	14.03	247.93	219.07	30.07

[1]Taken rectally with a pelvimeter on 6-10-78.

[2]All differences (means) of measurements taken differed significantly (P<.05) between implanted and nonimplanted bulls.

Table 3.2. Effects of Ralgro on growth and carcass traits of bulls and steers.

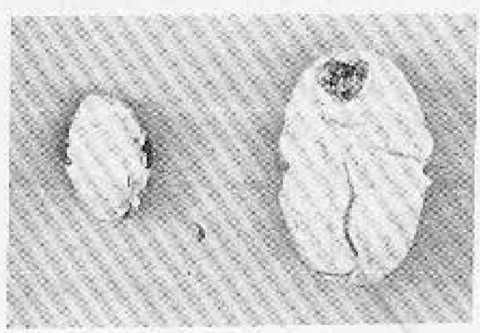
	Number of animals	Wean[1] wt.(lbs.)	Wt. on[2] 2-23(lbs.)	Slaughter wt.(lbs.)	ADG birth to slaughter (lbs.)	Carcass[3] grade	Yield grade	Back fat(in.)
Bulls								
Not implanted	13	441.04[a]	729.32[a]	959.81[a]	1.97[a]	9.04[a]	2.00[a]	0.24[a]
Implanted	11	450.20[a]	714.13[a]	995.93[a]	2.04[a]	7.68[b]	2.19[a]	0.24[a]
Steers								
Not implanted	12	430.41[a]	704.18[a]	951.72[a]	1.95[a]	5.59[a]	3.00[a]	0.48[a]
Implanted	13	477.26[b]	742.74[a]	1035.41[b]	2.12[b]	6.93[a]	2.55[b]	0.37[b]

[1]Taken 10-14-77.

[2]120 day weight on feed.

[3]1 = prime$^+$, 12 = standard$^-$

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



Ralgro-implanted bulls had much smaller testicles than controls.

Effect of Growth Rate from Birth Through Thirty Months on Performance of Heifers

R. R. Schalles, A. T. Fleck, G. H. Kiracofe, and L. R. Corah

Summary

Heifers with faster gain the first and second winter (weaning to yearling and 18 months to 2 years old) had better production and reproduction than heifers with low or moderate gains. Gains during the first winter (weaning to yearling) had more influence on future performance than gains during the second winter as bred heifers.

Introduction

Opinions of cattle producers differ on how replacement heifers should be fed for best development. Feeding too well has shortened life span and impaired milking ability, while low feeding has caused poor reproduction, reduced milk production and low weaning weights.

Experimental Procedure

Data were collected during three years from 156 Polled Hereford heifers born in the spring, within 60-day calving seasons. They ran with their mothers on native Flint Hills range until weaned at 6 to 7 months. The first winter after weaning they were randomly allotted to various high roughage rations and gained from 0.2 to 2.0 lb per day. All sound heifers were bred artifically as yearlings for 45 days followed by 15 days with bulls. Heifers grazed as a group from May 1 to November 1 on native bluestem range. In November, heifers were palpated to confirm conception date, and open heifers were removed from the study. Pregnant heifers were randomly allotted within weight, condition, and expected calving date into winter treatment groups with various energy levels. They remained on the second winter nutrition level until parturition. Then they were put on the same ration balanced to meet NRC requirements for energy, protein, and minerals until May 1. From May 1 to October 1 (weaning) heifers and their calves grazed native bluestem range. Starting May 20, heifers were rebred artifically for 45 days followed by 15 days with bulls. At weaning, heifers were again palpated to confirm conception dates.

Results and Discussion

The effects of weaning and yearling weight, prebreeding condition, and first winter gains on reproduction the first breeding season as yearlings, are shown in Table 4.1. Heifers' adjusted 205-day weight and adjusted 365-day weight did not significantly affect first-service conception, breeding-season conception, or conception date. Low gains the first winter (from weaning to yearling) resulted in lower ($P<.01$) first-service conception rates, but the conception rate for the 60-day breeding season was only slightly lower. Heifers that gained the most the first winter had the highest breeding-season conception rates. Heifers in moderate condition as yearlings (weight-height ratio) had the highest conception rate, indicating that thin and fleshy heifers had more difficulty conceiving.

Birth weight of a heifer's first calf was lower ($P<.05$) if its dam had low first winter gain. However, heifers with high first winter gain had the largest pelvic area and fewest calving problems.

Heifers with high first winter gains (Table 4.2) a year later produced calves 15 lb heavier at 90 days and 35 lb heavier at weaning than heifers with low first winter gains. The difference did not result from milk production, and may reflect fewer calving problems and superior mothering ability. Monthly milk production during the first lactation was not affected by first winter gains (Table 4.3).

Second winter gains (Table 4.2) had no significant effect on the heifers' pelvic area, ease of calving, or calf's birth weight. Calves from heifers that gained slowly the second winter were heavier at both 90 days and at weaning than calves from heifers that gained moderately or fast. However, the high and moderate gaining heifers gave more milk (Table 4.3). There were no significant differences in rebreeding among groups whose gains were low, moderate, or high the second winter.

From our data it appears that the nutrition level the first winter (weaning to yearling) influenced heifer production and reproduction more than nutrition level during the second winter as bred heifers. Considering all factors, fast gain the first winter and moderate to high gain the second winter appear to produce the best performance so long as the heifers do not become too fat.

Table 4.1. The effects of first-year weight, weight change, and condition on reproductive efficiency at first breeding.[a]

	No. of heifers	Conceived 1st service, %	Conceived final, %[b]	Conception date
Weaning weights, lb				
Low (<380)[c]	88	38	94	June 12
High (>380)	68	41	91	June 10
Yearling weights, lb				
Low (<625)	78	41	92	June 10
High (>625)	78	38	94	June 13
First winter gains, lb				
Low (<210)	31	19	90	June 6
Mod (210-290)	92	49	93	June 10
High (>290)	33	33	94	June 18
Yearling weight/height:				
Low (<12.9 lb/in)	35	40	88	June 7
Mod (12.9-14.3 lb/in)	79	38	96	June 13
High (>14.3 lb/in)	42	43	90	June 12

[a]Weaning weight, yearling weight, first winter gain, yearling weight-height ratio, and sire of heifer were included in the model to obtain least squares means.

[b]Final conception for a 60-day breeding season.

[c]< = less than; > = more than.

Table 4.2. Effects of first and second winter gains of dams on calf birth weight, calving ease, pelvic area, calf performance, milk production, and rebreeding performance.

Gains	First winter[a]			Second winter[b]		
	Low (<210 lb)[c]	Moderate (210 to 290 lb)	High (>290 lb)	Low (< -20 lb)[c]	Moderate (-20 to 60 lb)	High (> 60 lb)
Calf birth weight, lb	64	68	70	68	66	68
Calving ease score[d]	3.08	3.39	2.71	3.17	3.10	2.90
Precalving pelvic area, sq cm	250	247	270	263	245	258
Calf 90-day weight, lb	185	189	200	205	183	187
Calf weaning weight, lb	306	330	341	350	319	308
Milk production, lb/24 hr	10.5	9.7	9.9	9.4	10.4	10.4
Heifers re-exposed	27	84	29	25	88	27
Conceived 1st service, %	48	33	48	40	44	22
Conceived final[e], %	81	66	66	80	70	56
Conception date	June 11	June 12	May 28	June 11	June 6	June 5
Calving to conception, days	72	86	73	81	77	73

[a]Sire of heifer, sire of calf, first winter gain, summer gains, first winter by summer gain interaction, and second winter gain were included in the model to obtain least squares means.

[b]Sire of heifer, sire of calf, first winter gain, summer gains, and second winter gain were included in the model to obtain least squares means.

[c]< = less than, > = more than.

[d]Calving ease score: 1 = no assistance, 2 = slight assistance, 3 = difficult delivery, 4 = very difficult delivery, 5 = caesarean delivery.

[e]Final conception for a 60-day breeding season.

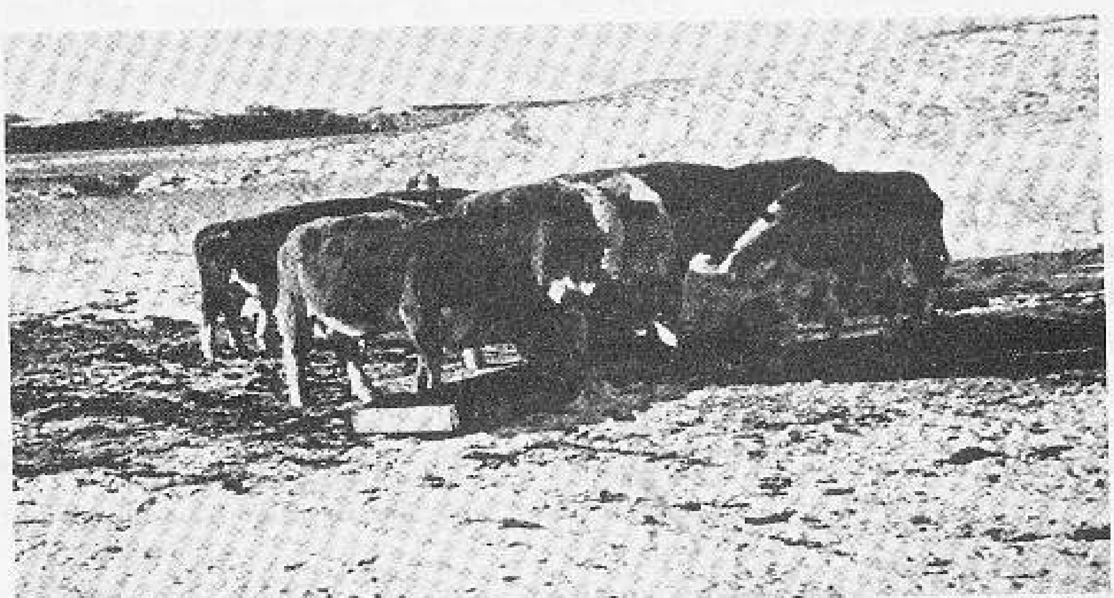
Table 4.3. Effects of first and second winter gains on milk production the first lactation period (lb/24 hr).

Gains	First winter[a]			Second winter[b]		
	Low (< 210 lb)[c]	Moderate (210 to 290 lb)	High (> 290 lb)	Low (< -20 lb)[c]	Moderate (-20 to 60 lb)	High (> 60 lb)
Milk production						
May	14.6	12.1	13.6	13.7	13.6	12.9
June	14.2	12.9	10.7	12.3	12.5	13.1
July	11.7	11.3	12.3	9.9	13.1	12.3
Aug	9.3	9.2	9.3	8.5	9.6	9.7
Sept	7.7	6.9	7.6	7.0	7.2	8.0
Oct	5.8	6.0	6.0	5.2	6.2	6.3
6-month avg.	10.6	9.7	9.9	9.4	10.4	10.4

[a] Sire of heifer, first winter gain, summer gain, second winter gain, and summer and second winter interaction were included in the model to obtain least squares means.

[b] Sire of heifer, first winter gain, first winter by summer gain interaction, and second winter gain were included in model to obtain least squares means.

[c] < = less than; > = more than.



Winter nutrition is important to production and profitability.

Pelvic Area, Calving Ease and Rebreeding in First Calf Heifers

R. R. Schalles, A. T. Fleck, L. R. Corah, and Guy Kiracofe

Summary

Pelvic area had little influence on the number or severity of calving problems after size and condition of two-year-old first-calf heifers, sex and weight of their calf, and genetic background of the heifer and her calf were accounted for. Little difference in rebreeding was attributed to calving difficulty, although heifers that had Caesarean deliveries rebred about two weeks later than those giving natural birth.

Introduction

The recent selection for larger, faster growing cattle has increased birth weights and dystocia. We looked at the relationship between pelvic area, dystocia, and rebreeding after heifers calved.

Procedures

Data were collected on Polled Hereford heifers for three years. All sound heifers were bred as yearlings and rebred as two-year-olds in a 60-day breeding season. Horizontal and vertical pelvic measurements, taken intrarectally with a Rice pelvimeter before the start of calving season, were multiplied to estimate pelvic area. Heifers were observed at least every two hours during calving and assistance was given as the herdsman determined. Caesarean deliveries were by the KSU Veterinary Medicine staff.

Results and Discussion

Pelvic area had little influence on calving difficulty (Table 5.1) when corrections were made for heifer weight and condition, sex and weight of her calf, and sires of the heifer and her calf. Heifers with medium size pelvic areas required more Caesarean deliveries than those with either large or small pelvic areas. Requiring assistance at calving had little relationship to rebreeding (Table 5.2), although heifers that had Caesarean deliveries conceived about two weeks later than heifers giving natural birth.

Table 5.1. Effect of pelvic area on calving ease.[a]

Precalving pelvic area	Small (< 230 sq cm)	Medium (230 - 265 sq cm)	Large (> 265 sq cm)
Number of heifers	20	43	18
No assistance, %	20	16	22
Difficult assistance, %	65	49	56
Caesarian deliveries, %	15	35	22

[a]Sire of heifer, sire of calf, sex of calf, precalving weight, calf birth weight, and precalving weight-height ratio were included in model to obtain least squares means.

[b]< = less than; > = more than.

Table 5.2. Effect of calving difficulty on rebreeding performance.[a]

	No assistance	Difficult assistance	Caesarian delivery
Number of heifers	46	49	30
Conceived 1st service, %	33	55	43
Conceived final[b], %	67	84	73
Conception date	June 10	June 10	June 14
Calving to conception (days)	79	75	92

[a]Means are adjusted for differences in pre-breeding gains.

[b]Final conception for a 60 day breeding season.

Delayed Winter Supplemental Feeding and Year-round Mineral Supplementation of Beef Cows on Native Range

R. J. Pruitt, R. R. Schalles, L. H. Harbers,
C. Owensby, and E. F. Smith

Summary

Polled Hereford cows on native Flint Hills pasture not supplemented until February lost more weight from December to February, lost less from February to May, and were in poorer condition before calving than cows supplemented beginning in November. But calf survival, birth weight, and calf average daily gain were similar for both groups. Feeding cows a calcium, phosphorus, trace mineral mix did not improve any measure of cow or calf performance.

Introduction

This study was to further investigate nutritional needs of spring calving cows on native Flint Hills pasture and to gain information on the need for year-round mineral supplement. Previous research here (Cattlemen's Day, 1978) showed native Flint Hills grass below NRC requirements for brood cows for sodium, potassium, phosphorous, and copper.

Experimental Procedure

During the winter of 1977-78, we maintained 70 Polled Hereford cows (calving in March and April) in 6 native Flint Hills pastures, and fed 3 pounds of alfalfa hay per cow per day in these pastures from November 1 to April 6 and an additional 6 pounds of sorghum grain per cow per day from February 15 to April 6. Cows in the other three pastures got 3 pounds alfalfa hay and 6 pounds sorghum grain per cow daily only from February 1 to April 6.

One pasture of each group received a salt, calcium, phosphorus, trace mineral mix from November 14 until calves were weaned (October 5). Content and intake of the mineral supplement are given in Table 6.1. Cows in the other 4 pastures received only salt. Using mineral analysis from previous research (Cattlemen's Day, 1978) and estimating 16.5 pounds of grass intake (dry matter) per cow daily for the winter and 30 pounds for the summer, we formulated and fed a mineral supplement to meet NRC requirements for sodium, potassium, phosphorus, and copper. During the winter, soybean meal was added to insure adequate mineral supplementation. Mineral consumption was adequate for all periods except August 1 to October 9. Equal amounts of soybean meal per cow were added to all pastures. Cows were weighed in the morning after being held off feed and water overnight. Only cows weaning a calf were included in analysis of weight change and condition.

Results and Discussion

Cow and calf performance are given in Table 6.2. Cows that were not supplemented until February lost more weight from December to February, lost less from February to May, and were in poorer condition before calving, than cows supplemented beginning in November. But calf survival, birth weight, and calf average daily gain were similar for both groups. Information on calving interval as affected by delayed winter feeding is not yet available, but must be considered. Feeding a calcium, phosphorus, trace mineral mix improved neither cow nor calf performance.

Table 6.1. Intake of salt, mineral, and soybean meal (pounds per cow daily).

	November 14-May 7		May 8-July 31		August 1-October 9	
	Salt & mineral	Salt	Salt & mineral	Salt	Salt & mineral	Salt
Salt	.019	.208	.037	.124	.022	.084
Soybean meal	.223	.222	----	----	----	----
Potassium chloride	.188	----	----	----	----	----
Dicalcium phosphate	.169	----	.147	----	.061	----
Trace mineral mix[1]	.008	----	.012	----	.004	----

[1]Trace mineral mix included 10% manganese, 10% iron, 14% calcium, 1% copper, 5% zinc, 0.3% iodine, 0.1% cobalt.

Table 6.2. Cow and calf performance with indicated supplements.

	Supplemental feeding		Mineral treatment	
	Begun Nov. 1	Begun Feb. 1	Salt & mineral	Salt
Cows per treatment	32	38	26	44
Calves alive at weaning	26	32	18	40
Calf birth weight, lb	78	77	77	78
Calf average daily gain, lb[1]	1.70	1.64	1.65	1.67
No. cows open	1	1	2	0
Cow weight, Dec., lb	1085	1062	1095	1062
Dec to Feb weight change, lb	-38[a]	-84[b]	-74	-59
Feb. to May weight change, lb	-183[a]	-135[b]	-162	-154
May to Sept weight change, lb	+200	+207	+204	+204
Sept cow weight, lb	1064	1050	1063	1053
December weight/height ratio[2]	23.3	22.9	23.3	22.9
February weight/height ratio	22.4[a]	21.0[b]	21.7	21.6
May weight/height ratio	18.5	18.1	18.3	18.3
September weight/height ratio	22.8	22.5	22.6	22.7

[ab]Means with different superscripts differ significantly ($P<.05$).

[1]Adjusted to steer basis and for age of dam.

[2]Weight/height ratio is weight in pounds ÷ height in inches at the withers and is used as an indication of condition. A lower weight/height ratio indicates poorer condition.

Effects of Ralgro[1] and DES[2,3] Implants During the Suckling Period on Later Reproductive Performance of Beef Heifers

L. R. Sprott, L. R. Corah, G. H. Kiracofe,
M. McKee, and F. L. Schwartz

Summary

Heifers were given either one or two Ralgro implants or one DES implant during the suckling period with no obvious effect on later reproductive performance when the heifers were bred as yearlings. However, conception rates in control heifers were low in two trials, so more studies are needed for conclusive results.

Introduction

Recent work at Kansas State University indicates that Ralgro given to bull calves markedly effects testicular development. These bulls, after a growth period, have much smaller testicles than those not given Ralgro as calves. However, the effects of Ralgro and DES on the reproductive performance of heifers is not known. Two university and two field trials were initiated to determine these effects.

Procedure

Approximately 300 heifers were used in two trials at Kansas State University and two field trials. Trial I at KSU consisted of 51 heifer calves divided among two groups. Group 1 served as a nonimplanted control and group 2 received one 36 mg Ralgro implant, while calves were still nursing (Table 1). Trial II at KSU used 77 heifer calves in a similar scheme except it included a DES group and a group implanted twice with Ralgro (Table 1). Trials III and IV were field trials with a total of 161 heifers. Both trials had a nonimplanted control, a group receiving one 15 mg DES implant, and a group receiving one 36 mg Ralgro implant (Table 1).

Results and Discussion

In Trial I at KSU, conception rates of heifers bred as yearlings were not affected by a Ralgro implant during the suckling period.

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[1]Ralgro is a product of International Minerals & Chemical Corporation.

[2]The DES is a product of Hess and Clark Company.

[3]Mention of products and companies is made with the understanding that no discrimination is intended and no endorsement implied.

Although all conception rates were low, data from Trial II at KSU (Table 2) showed a slightly lower first service conception by heifers with two implants, but no differences in overall conception rates. The only differences were the apparent increased first service conception rates by heifers given one Ralgro or one DES implant. The differences were not statistically significant, and overall pregnancy did not differ for any treatment group. Percent showing estrus during the AI period in Trial II did not differ.

Field Trials III and IV further showed that heifers implanted while nursing had similar reproductive performance to nonimplanted controls. No effect on conception rate, percent calving early in the calving season or on average calving date was observed.

Table 7.1. Treatments in Trials I & II at KSU and Field Trials III & IV.

Trial	Group	Treatment	No. heifers	Age at implant
I	1	Control	25	---
	2	One 36 mg Ralgro implant	26	40 days
II	1	Control	17	---
	2	One 36 mg Ralgro implant	20	40 days
	3	Two 36 mg Ralgro implants	21	1 at 40 days 1 at 110 days
	4	One 15 mg DES implant	19	40 days
III	1	Control	10	---
	2	One 15 mg DES implant	28	Approx. 2 months
	3	One 36 mg Ralgro implant	27	Approx. 2 months
IV	1	Control	13	---
	2	One 15 mg DES implant	50	72.3 days
	3	One 36 mg Ralgro implant	33	64.3 days

Table 7.2 Results of trials - KSU.

Trial	Group	No. heifers	Estrus during AI period, %	1^{st} service conception, %	Overall conception, %
	Control	25	---	48	76
I-KSU	One Ralgro	26	---	50	81
	Control	17	76	38	59
II-KSU	One Ralgro	20	60	58	55
	Two Ralgro	21	76	31	62
	One DES	19	74	50	63

Table 7.3. Results of field trials.

Trial	Group	No. heifers	% Overall conception	Of those pregnant-% conceiving by 21 day periods			Avg. calving date
				1st 21 days	2nd 21 days	3rd 21 days	
III-field trial	Control	10	100	90	10	0	2-19
	One DES	28	82	83	17	0	2-17
	One Ralgro	27	100	92	8	0	2-17
IV field trial	Control	13	85	78	22	0	4-4
	One DES	50	83	68	20	12	4-8
	One Ralgro	33	81	66	17	17	4-11

Evaluating the Breeding Potential of Yearling Bulls

Larry Corah, Guy Kiracofe, Miles McKee, and R. R. Schalles

Summary

Two years of research with nine herds indicated one of two yearling bulls with a herd usually will sire most of the calves. In six of the nine cases, the bull we pre-evaluated as most sexually active was the sire of most of the calves, so a brief pre-breeding libido evaluation may help estimate breeding potential. In data from one herd the bull dominant as a yearling continued to be dominant as a two-year-old.

Our data also indicated active breeding yearling bulls easily breed more than 20 to 25 cows during their first breeding season.

Introduction

In a typical cow-calf operation, bulls are often not used until they are at least two years old or younger bulls are paired with older bulls. Recently, cattle breeders have attempted to make greater use of yearling bulls.

A year ago (Report of Progress 320) we reported results from using yearling bulls with four herds. In all four herds, one yearling bull sired more than 90% of the calves, with the number of calves sired by the dominant bull ranging from 21 to 36.

Recent research abroad and in the United States has indicated the breeding capabilities of a bull can be determined before he is used. To test that concept, we evaluated the libidos of bulls in 1977, then paired a high- with a low-libido bull. The pre-determined high libido bull sired most (more than 90%) of the calves in three of the four herds.

To further evaluate the potential of yearling bulls and accuracy in predicting libido, we continued the study.

Appreciation is expressed to the following cooperating Kansas ranchers: Ed Keller, Zurich; Don Stephens, Severy; Melvin Hopp, Marquette; and Ken Flagler, Maple Hill, and to Wes Ibbetson of the Southeastern Kansas Branch Experiment Station for their cooperation and assistance.

Experimental Procedure

Purebred Hereford, Polled Hereford, Angus, and crossbred Simmental yearling bulls raised at the KSU Purebred Beef Unit were studied to determine if we could predict their breeding potential.

The procedure was as follows:

1. Semen quality of each bull was determined by electro-ejaculation, then, bulls with questionable semen quality were eliminated.

2. Bulls were held in a teasing pen in view of a heifer in heat for 10 to 15 minutes.

3. After teasing, one bull was turned into a pen with a cycling heifer and the time required for mounting and copulation was recorded.

4. When a bull did not breed a heifer in 20 minutes, he was removed and held in an adjoining teasing pen another 20 to 40 minutes, then placed in another pen with a different heifer in heat and his breeding activities again observed and recorded.

Within a month after evaluation, a high libido bull of one breed was paired with a low libido bull of another breed to simplify determining the sire of resulting calves. Both bulls were turned out with a herd of 35 to 40 mature cows. Four commercial ranches and the Southeastern Kansas Branch Experiment Station cooperated in the evaluation.

Two bulls paired as yearlings in 1977, were again paired as two-year-olds in 1978, and run with 40 cows on a commercial ranch in Central Kansas.

Results and Discussion

Where the same pair of bulls ran together two breeding seasons, the bull dominant as a yearling was again dominant as a 2-year-old. As a yearling he sired 94.1% of calves (32); as a 2-year-old, 88.2% (30) of calves, refuting the idea that heavy use of yearlings will reduce their later breeding capabilities.

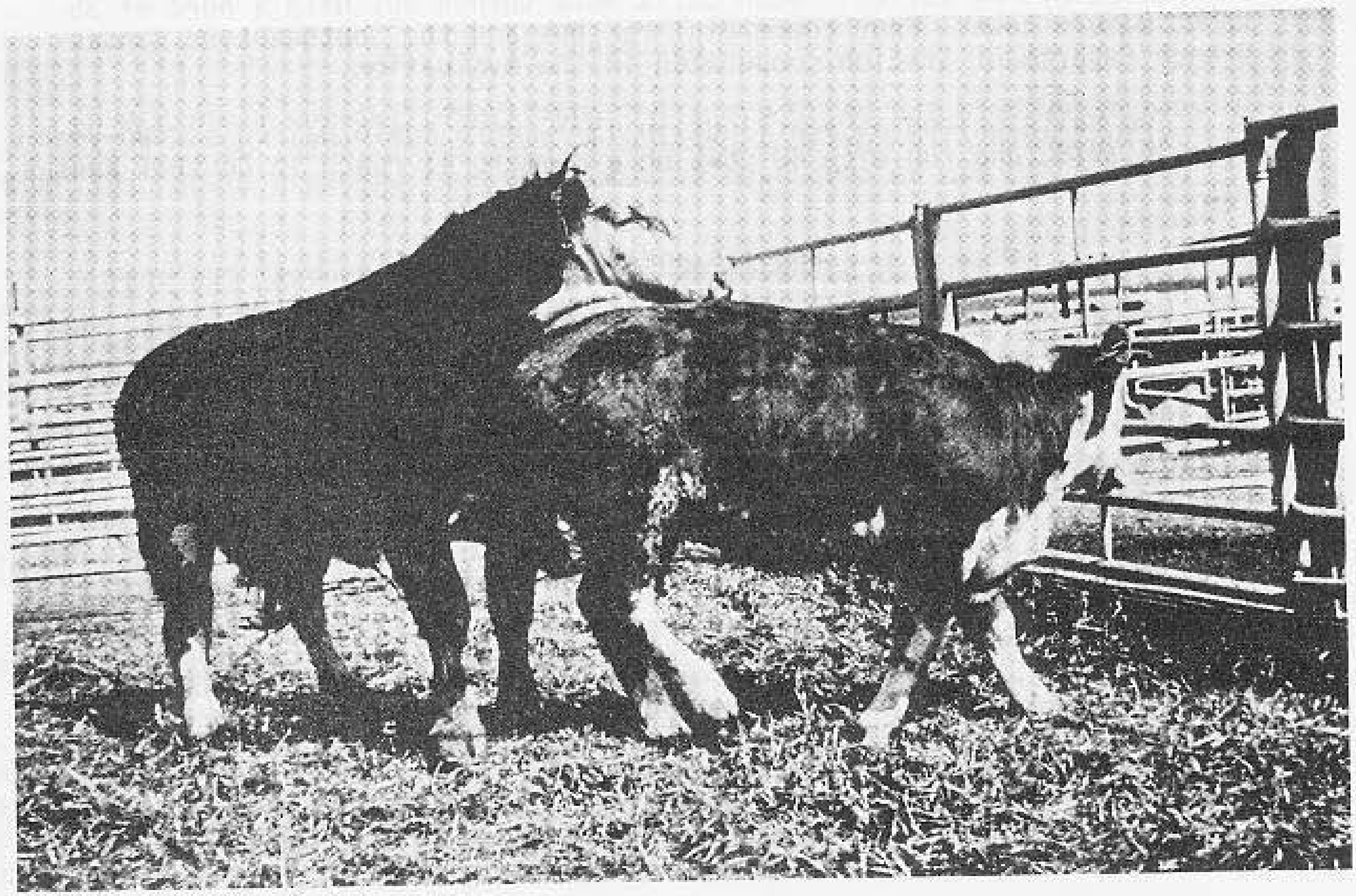
Unlike the previous year where one bull always sired more than 90% of calves, the dominant bull sired from 56.5% to 86.2% of the calves. In three of five herds the pre-determined high-libido bull sired most of the calves.

In herd 5, yearling bulls sired only 13 calves, although they ran with 31 heifers and cows. The dominant bull developed foot problems early in the breeding season, and the less dominant bull was not able to compensate, resulting in a poor conception rate.

Table 8.1. Results from using pre-evaluated yearling bulls in commercial cow herds.

	Herd 1	Herd 2	Herd 3	Herd 4	Herd 5
No. calves sired by yearling bulls	32	23	29	29	13
Calves by dominant bull (No.)	71.8% (23)*	56.5% (13)	62.1% (18)*	86.2% (25)	76.9% (10)*
Calves by less dominant bull (No.)	28.1% (9)	43.5% (10)*	37.9% (11)	13.8% (4)*	23.1% (3)

*Evaluated as the dominant sire.



High-libido bulls were the most successful breeders.

Minerals in Esophageal Samples from Steers on Native Bluestem Pastures

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B. E. Brent, H. A. Peischel,
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Summary

This report summarizes monthly mineral contents of burned and control native bluestem pastures determined with samples from fistulated steers. Burning decreases calcium (Ca), potassium (K), and iron (Fe), and slightly decreases zinc (Zn). All minerals we studied were adequate for grazing cattle except that magnesium (Mg) and Potassium (K) appear to be borderline during winter months.

Introduction

Previous work here indicated that salt is the only mineral needed for cow-calf operations on Flint Hills pastures. To test that idea, we studied the mineral contents of native pastures two years using samples collected from esophageally-fistulated steers.

Neither of the two methods to sample pastures is entirely satisfactory. Hand clipping does not represent the same forage an animal would eat. Esophageal samples represent the forage eaten but they are subject to mineral leaching by saliva and to contamination from minerals (Na and P) in saliva. The minerals in saliva must be considered part of the food supply even though we cannot assess their value as a continuous mineral source if feeds do not replenish eventual losses.

This report presents a summary of two years' sampling of control and burned pastures.

Methods

Burned and control pastures were sampled monthly from esophageally--fistulated steers. Samples were analyzed for calcium, phosphorus, magnesium, sodium, potassium, iron, manganese, and zinc. Results are reported on a dry basis.

Results and Discussion

Mineral composition is summarized in table 9.1. Macroelements are given in percentages and microelements (trace minerals) in milligrams per 100 grams of dry material.

Calcium: The Ca content of these pastures was highest while grasses emerged (June and September). Burning decreased average Ca content (.88% vs. .64%) but never below levels recommended for gestating and lactating cows (0.16 - 0.24%) or growing steers (0.30 - 0.44%). Control pasture ranged from 0.53% to 1.50% Ca; burned pasture, from 0.49% to 1.18%.

Phosphorus: The P content varied from .11% to 0.35% in control pastures; from 0.21% to 0.39% in burned pastures. Both pastures had yearly means of 0.18%--values consistent with recommended levels (0.18 - 0.22%) so the body pool maintained adequate P.

Magnesium: Burning had no effect on Mg content; however, Mg appears to be borderline during winter but usually meets the lower recommended requirement of 0.06%.

Sodium: Esophageal samples averaged 1.57% for both pasture treatments, but largely from salivary contaimination. Animals had access to salt blocks during the year because of low sodium in handclipped samples (Cattlemen's Day Report, 1978). Salt should be kept available because Na turns over rapidly in the body pool.

Potassium: Burning reduced K only slightly; however, its monthly variation in bluestem pastures may be significant. During winter K was below the recommended 0.6 to 0.8%. We are continuing to study effects of adding K to mineral mixes for wintering cattle.

Iron: Burning may affect Fe content of Flint Hills pastures slightly (44.7 vs. 47.7 mg/100g) but contents in the 8 to 80 mg range are thought to be adequate.

Manganese: All Mn values were above the 0.1 - 1.0 mg/100 g recommended by the NRC. Yearly averages for burned pastures were 4.7 and control pastures, 4.8 mg/100g.

Zinc: Yearly means were 4.2 mg/100 g for burned pastures and 3.9 for controls. All Zn values were above the recommended 1.0 - 3.0 mg/100g.

Table 9.1. Mineral contents of forage samples collected from fistulated steers on Flint Hills pastures.

Months	Ca	P	Mg	Na	K	Fe	Mn	Zn
	Percentage					mg/100g		
Pasture not burned								
Jan	.54	.22	.05	1.64	.50	20.8	3.0	4.0
Feb	.55	.26	.07	1.61	.45	37.2	2.2	3.3
Mar	.56	.30	.08	1.66	.48	67.4	4.8	4.2
Apr	.67	.27	.08	1.86	1.09	74.2	5.4	5.4
May	.53	.35	.12	1.57	1.74	55.2	5.5	4.1
Jun	1.14	.32	.27	1.55	1.02	118.3	8.1	6.6
Jul	.53	.23	.12	1.27	.87	34.1	3.8	2.7
Aug	.63	.25	.13	1.48	.77	37.8	4.8	3.2
Sept	1.24	.26	.17	1.56	.98	32.5	6.7	3.4
Oct	1.50	.36	.12	1.62	.73	21.9	4.5	5.1
Nov	.78	.28	.07	1.57	.57	32.2	4.7	3.9
Dec	.70	.23	.06	1.46	.38	33.6	4.6	4.1
Mean	.88	.28	.11	1.57	.80	47.1	4.8	4.2
Burned pasture								
Jan	.57	.26	.06	1.60	.28	32.9	3.0	4.1
Feb	.51	.35	.07	1.60	.31	43.6	3.5	3.1
Mar	.49	.27	.08	1.70	.27	58.8	3.6	2.8
Apr	.56	.28	.09	1.50	1.03	71.0	6.3	5.2
May	.47	.35	.12	1.50	1.58	68.6	5.2	4.5
Jun	.89	.39	.28	1.45	.88	103.5	10.5	6.6
Jul	.45	.24	.11	1.62	1.05	21.6	3.0	2.7
Aug	.60	.23	.13	1.48	.63	21.6	3.9	2.8
Sept	.67	.26	.18	1.58	.99	24.4	6.9	3.8
Oct	1.18	.27	.12	1.52	.67	38.2	3.6	4.4
Nov	.64	.25	.06	1.59	.39	29.5	3.4	2.9
Dec	.68	.21	.07	1.66	.34	22.8	3.0	3.4
Mean	.64	.28	.11	1.57	.70	44.7	4.7	3.9

Milo Stover, Forage Sorghum, Prairie Hay, Soybean Meal and Urea Compared for Growing Heifers

Keith Bolsen, Jim Oltjen and Harvey Ilg

Summary

Milo stover silage, prairie hay or forage sorghum silage was fed in rations containing 10, 12 or 14% protein from soybean meal (SBM) or 12% protein from urea; 100 heifers were fed in the 78-day growing trial (November 11, 1977 to February 2, 1978).

Heifers fed forage sorghum silage, prairie hay or forage sorghum silage + prairie hay had similar rate and efficiency of gains; those fed milo stover silage made slowest and least efficient gains. Rations containing prairie hay were consumed in the greatest amounts. Feeding rations with 12 or 14% protein from SBM gave better performance than rations with 10% protein from SBM. Heifers fed urea gained slower and less efficiently than those fed SBM. Gain from a ration containing equal parts of milo stover silage and forage sorghum silage exceeded predicted gain by 7.8%, and efficiency was 13.9% better than predicted.

Introduction

Milo stover and forage sorghum silages were compared in five previous heifer growing trials at this station (Prog. Rpt. 210, 230, 262, 291 and 320, Kansas Agr. Expt. Sta.). Results show: (1) growing calves fed milo stover silage should gain about 1.0 lb. per day and require 10 to 14 lbs. of dry matter per lb. of gain, (2) milo stover silage has a feeding value of 65% of that of forage sorghum silage, (3) milo stover silage fed in combination with forage sorghum silage is better feed than milo stover alone for growing calves, (4) supplying supplemental protein in milo stover silage rations is a large cost because stover usually contains so little protein, and (5) at least 12% protein rations are needed for maximum rate and efficiency of gain.

This trial was to verify previous results from feeding milo stover and forage sorghum silages, to evaluate prairie hay and to compare three levels of supplemental protein from soybean meal and one from urea.

Experimental Procedure

Shown below are the forage and protein rations compared in a 78-day growing trial (November 11, 1977 to February 2, 1978).

Forages	Protein, % of the ration from (SBM)	Protein, % of the ration from urea
Milo stover silage (MSS)	10, 12 and 14	12
Prairie hay (PH)	10, 12 and 14	12
Forage sorghum silage (FSS)	10, 12 and 14	12
½ MSS + ½ FSS	10, 12 and 14	12
½ PH + ½ FSS	10, 12 and 14	12

The 100 heifer calves averaged 430 lbs. when allotted by breed and weight into 20 pens of five each. Breeds included Angus, Hereford, Angus x Hereford and Hereford x Simmental. Four pens were assigned to each of the 5 forage treatments. All rations were 73% of the appropriate forage and 27% rolled milo plus protein supplement on a dry matter basis and formulated to be equal in minerals, vitamins and additives. All were mixed and fed to appetite twice daily.

All calves were fed 2 lbs. of rolled milo and alfalfa hay free-choice for 5 days before initial weighing and all were fed the same amount of experimental ration for 2 days before final weighing. All feed and water were withheld 16 hours before weights were taken.

Forage sorghum was a high-grain variety harvested in the dough-stage at 70 to 72% moisture. Milo stover was from dryland milo that had been harvested about 30 days before stover was harvested. The stover was about 70% moisture when the grain was harvested. The forage sorghum and milo stover silages were stored in concrete silos (10 ft. x 50 ft.). The native prairie hay was swathed and field-dried before being baled into rectangular bales about 75 to 80 lbs. each, and later processed in a tub grinder before being fed.

Results

Dry matter (%), crude protein (%, DM basis) and crude fiber (%, DM basis), respectively, for the three forages were: 28.0, 8.0, 31.0 for milo stover silage; 88.0, 5.5, 32.6 for prairie hay; and 28.5, 8.9, 26.3 for forage sorghum silage.

There were no interactions between forage and protein. Performances of heifers fed each of the five forages (averaged across protein treatments) are shown in Table 10.1; performances of heifers fed each of the four protein treatments (averaged across forages), in Table 10.2.

Heifers fed forage sorghum silage, prairie hay or FSS + PH had similar rates of gain. Feed intake was higher ($P < .05$) for prairie hay and PH + FSS than for forage sorghum silage. Milo stover silage supported the slowest ($P < .05$) and least efficient ($P < .05$) gains.

The 12 and 14% protein rations from SBM supported the fastest and most efficient gains ($P<.05$)(Table 10.2). Calves fed the 10% protein ration from SBM gained faster and more efficiency ($P<.05$) than calves fed the 12% protein ration from urea. In general, performance of faster gaining calves (those fed forage sorghum silage, prairie hay or FSS + PH) tended to be improved more with additional SBM protein than that of calves gaining slower (those fed milo stover silage).

From these results feed costs and feed cost per lb. of gain can be calculated for each combination of forage and protein. When the price of SBM is high compared with that of urea and grain, the economic advantage of feeding 12 or 14% protein rations from SBM, of course, would be less than when SBM prices are low.

We used gains and feed efficiencies from the milo stover silage and forage sorghum silage rations to calculate predicted gain and efficiency for the 50% MSS + 50% FSS ration (Table 10.3). Observed gain exceeded predicted gain 0.08 lb. per day or 7.8%, and observed feed efficiency exceeded predicted efficiency 1.86 lbs. of feed per lb. of gain or 13.9%. The value of milo stover silage in growing rations for calves, therefore, is improved by feeding it with forage sorghum silage.

Table 10.1. Performances of heifers fed the five forages.

	Forage				
Item	FSS [1]	MSS [1]	PH [1]	MSS + FSS	PH + FSS
No. of calves	20	20	20	20	20
Initial wt., lbs.	429	427	429	429	429
Avg. daily gain, lbs.	1.25 [a]	.79 [c]	1.22 [a]	1.10 [b]	1.32 [a]
Avg. daily feed, lbs.[2]	13.03 [b]	11.84 [c]	15.03 [a]	12.43 [b]	14.26 [a]
Feed/lb. of gain, lbs.[2]	10.59 [a]	16.18 [c]	12.40 [b]	11.52 [b]	11.58 [b]

[1] FSS = forage sorghum silage; MSS = milo stover silage; PH = prairie hay.

[2] 100% dry matter basis.

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

Table 10.2. Performances of heifers fed the four protein treatments.

Item	Protein treatment: source and level			
	SBM			Urea
	10%	12%	14%	12%
No. of calves	25	25	25	25
Initial wt., lbs.	429	428	427	429
Avg. daily gain, lbs.	1.10[b]	1.22[a]	1.28[a]	.94[c]
Avg. daily feed, lbs.[1]	13.39	13.55	13.45	12.90
Feed/lb. of gain, lbs.[1]	12.83[b]	11.33[a]	10.67[a]	15.00[c]

[1] 100% dry matter basis.

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

Table 10.3. Observed and predicted rates and efficiencies of gain by heifers fed milo stover silage, milo stover silage + forage sorghum silage, or forage sorghum silage.

Item	Forage		
	MSS	FSS + MSS	FSS
No. of calves	20	20	20
Avg. daily gain, lbs.			
Observed	.79	1.10	1.25
Predicted	---	1.02	---
Improvement, lb.[1]		+.08	
Improvement, %		+7.8	
Feed/lb. of gain, lbs.			
Observed	16.18	11.52	10.59
Predicted	---	13.38	---
Improvement, lbs.[1]		-1.86	
Improvement, %		+13.9	

[1] Observed minus predicted.

Using Wheat Straw in Beef Cow Rations

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Summary

We conducted two trials to study using wheat straw in rations of either lactating or gestating beef cows maintained in dry lot.

In trial 1, cow weight changes the last 60 days of lactation were: alfalfa hay, + 26.88 lbs; two-thirds alfalfa hay -one third chopped wheat straw, +27.94 lbs; one-third alfalfa hay and two-thirds chopped wheat straw, -26.84 pounds. Gains by the cows' calves; 146, 143, and 144 pounds, respectively, did not differ statistically. Cows receiving one-third alfalfa hay and two-thirds chopped wheat straw lost condition as measured by weight/height ratios, while those on the other two treatments gained condition. The results suggest that beef cows in dry lot can perform satisfactorily on two-thirds alfalfa hay and one-third wheat straw.

In trial 2, gestating cows were fed dry or soaked ground wheat straw and 5 pounds of alfalfa hay. Cows on both rations lost weight. Those on dry straw also lost condition, while those on soaked straw maintained condition. Wheat straw appears to be one way of reducing wintering costs of cows, but it may not be satisfactory for young cattle or thin cows.

Introduction

About 11 million acres of wheat are harvested annually in Kansas. For each ton of grain harvested, one ton of residue (wheat straw, cracked grain, and chaff) is left. This low quality residue is seldom used as feed. Its availability and low cost might make wheat straw economical in a cow-calf operation.

Previous work here has shown that beef cows can maintain or gain weight on rations primarily of wheat straw. We continued the research to find better ways to use wheat straw in beef cow operations.

Experimental Procedure

Wheat straw was collected in big round bales soon after the grain was harvested. Straw was ground to eliminate feed wastage and to help us measure consumption, except for 13 days in Trial 1 when straw was fed from big round bales.

In both Trials, percentage Simmental cows maintained in dry lot were divided into treatment groups by weight and condition. They were in the last 60 days of lactation in trial 1 and in mid-gestation in trial 2.

Cow condition in Trial 1 was established by weight/height ratios (weight in pounds divided by height in inches at the hip). In Trial 2, cow condition was established by visual scores (1 = very thin; 10 = very fat). In both trials, cows were weighed after feed and water had been withheld 14 hours.

Treatments in Trial 1 were 1) alfalfa hay; 2) two-thirds alfalfa hay, one-third straw; 3) one-third alfalfa hay, two-thirds straw fed to appetite, the last 60 days of lactation (8/4/78 - 10/3/78). All rations included 4 pounds of milo per head per day. Calves had access to creep feed the entire test period.

In Trial 2 (gestating cows) were fed either dry or soaked (30% dry matter) wheat straw for 59 days (11/7/78 - 1/4/79).

In both trials, rations were analyzed for crude protein, calcium, phosphorus, and acid detergent fiber (Table 11.1). Low acid detergent fiber indicates more energy.

Results and Discussion

Trial 1. Dry matter intake and cow performance are shown in Table 11.2. Cows receiving alfalfa hay or two-thirds alfalfa hay, one-third straw gained weight but those receiving one-third alfalfa hay, two-thirds straw lost weight. All calves performed equally well.

Trial 2. Cows fed dry straw lost condition and 21.25 lbs while those fed soaked straw lost 38.0 pounds but maintained condition. Cows on dry straw ate 28.2 lbs dry matter, while those on soaked straw ate 24.24 lbs, which may explain different weight losses. In our previous work (Cattlemen's Day, 1978), dry cows fed soaked straw 109 days gained 91 lbs and maintained condition.

This time we fed soaked straw during early winter but extreme cold weather the last few weeks of the trial caused numerous problems in machinery maintenance and feeding. Because soaked straw froze in the bunk, it had to be made up and fed twice daily.

Table 11.1. Roughage composition in Trials 1 and 2 (100% D.M.).

	Trial 1 Dry wheat straw	Trial 2 Dry wheat straw	Trial 1 Alfalfa	Trial 2 Soaked wheat straw
Crude protein, %	4.06	4.03	15.39	4.10
Calcium, %	.302	.306	1.75	.288
Phosphorus, %	.096	.104	.301	.094
Acid detergent fiber, %	54.57	52.47	36.84	48.44

Table 11.2. Effects of ration on cow performance, Trial 1.

Ration	2/3 straw 1/3 alfalfa	1/3 straw 2/3 alfalfa	All alfalfa
Number of cows	19	19	17
Average starting weight, lbs	1081.36	1084.94	1111.05
Average ending weight, lbs	1054.52	1112.89	1137.94
Total weight change, lbs	-26.84[b]	27.94[a]	26.88[a]
Average starting weight/height ratio	21.03	20.94	21.77
Average ending weight/height ratio	20.51	21.49	21.80
Total weight/height ratio change	-0.521[b]	0.547[a]	0.510[a]
60 day average calf gain, lbs	143.78	143.36	145.76
Forage per day, lbs	26.44	27.24	27.04
Milo per day, lbs	4.00	4.00	4.00

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

Table 11.3. Effects of ration on cow performance, Trial 2.

	Soaked straw	Dry straw
Number of cows	27	27
Average starting weight, lbs	1255.7	1242.6
Average ending weight, lbs	1217.7	1221.37
Total weight change, lbs	-38.0	-21.25
Average starting condition*	5.24	5.59
Average ending condition*	5.24	5.35
Total condition change*	.00	-.24
Straw intake (dry basis)	24.1	28.2
Alfalfa hay	5.0	5.0

*Condition score is average of visual appraisal by two men with 1 = extremely thin, 10 = extremely fleshy.

Yield and Quality of Six Summer Annual Forages

Mopoi Nuwanyakpa, Gerry L. Posler,
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Summary

In 1977, all summer annual forages studied produced excellent yields. Based on leafiness and regrowth ability, sudangrasses and pearl millet appeared to be best for early vegetative and boot cutting management. The sorghum-sudan hybrids had suitable yields and quality at all harvest stages. The hybrid forage sorghum appeared best suited for soft-dough-stage harvest although yields of pearl millet and sorghum-Sudan hybrids were also excellent.

Introduction

Many summer annual crops can provide excellent forage during the hot, dry summers in Kansas when other pasture grasses have declined in production and quality. Summer annuals, including sudangrasses, hybrid sudangrasses, sorghum-sudangrass hybrids, sorgos, hybrid forage sorghums, and pearl millets, may be used for pasture, hay, silage, and greenchopping. Differences in their anatomy and growth characteristics reward producers who carefully select the proper crop to match their livestock needs.

Materials and Methods

In 1977 at Manhattan and Hutchinson, we evaluated forage yield and quality of six forages, harvested at early vegetative, boot, and soft-dough stages of growth. Forages tested were 'Piper' sudangrass, Northrup King 'Trudan 6' hybrid sudangrass, Dekalb 'Sudax SX-11', and Ring Around 'Super Chow Maker 235' sorghum-sudangrass hybrids, Dekalb 'FS 25a' hybrid forage sorghum, and Northrup King 'Millex 23' hybrid pearl millet.

The hybrid forage sorghum was planted in 30-inch rows; all others, in 6-inch rows. Plots were 5 x 20 feet for the narrow spacing and 10 x 20 feet for the wide spacing. The center 3 feet or 2 rows were harvested for yield, leaving a 6-inch stubble. Harvests were by stage of growth, not calendar date. At Hutchinson, forages were cut 3 times at the early vegetative stage, 2 times at the boot stage, and 1 time at the dough stage. One additional early vegetative cutting was obtained at Manhattan. Samples were taken from the flail-chopped material for dry matter and quality analyses.

Experimental Results

As shown in Tables 12.1 and 12.2, mean forage yields were similar at Hutchinson and Manhattan for the early vegetative stage, greater at Hutchinson for the boot stage, and greater at Manhattan for the soft-dough stage. The forages sometimes responded differently at the two locations. The most difference was noted for Millex at the soft dough stage; it yielded much better at Manhattan. Cuttings were at different calendar dates, and rainfall patterns differed between locations, but such differences are expected and would be expected in other years.

Crude protein content and *in vitro* digestible dry matter (IVDDM) declined with advancing maturity. Crude protein was always lower at Hutchinson, particularly at the soft dough stage, probably partly because of near-record August rainfall, unusually high yields, and moderate nitrogen fertilization.

Piper sudangrass and Trudan hybrid sudangrass performed best for early vegetative and boot harvests. The FS 25A hybrid forage sorghum, as expected, performed poorly under early vegetative management, and its yield was quite low at the boot stage at Manhattan. At Hutchinson, it yielded well despite being cut only once, while the others were cut twice. Yields of the two sorghum-sudan hybrids and pearl millet varied most at the various stages and locations. Additional years of data are needed to better estimate the forages' true yielding abilities.

Summer annual forages vary in growth characteristics.

Table 12.1. Forage yields and quality of six summer annual forages cut at three stages of growth, Manhattan.

Forage	Forage yield (ton/acre) Dry matter	60% H_2O	Crude protein %	IVDDM[a] %
	Early vegetative stage			
Piper	5.0	14.3	19.2	67.3
Trudan-6	4.9	14.0	17.8	67.6
S.C. Maker 235	5.1	14.7	19.2	66.1
Sudax SX-11	5.4	15.5	20.1	65.1
Millex 23	6.1	17.5	21.5	67.4
FS 25A	2.9	8.4	19.7	65.6
Mean	4.9	14.1	19.6	66.5
	Boot stage			
Piper	6.5	18.7	14.3	63.1
Trudan 6	6.3	18.0	15.6	61.8
S.C. Maker 235	8.2	23.4	14.5	62.6
Sudax SX-11	6.9	19.6	12.6	61.0
Millex 23	7.4	21.2	16.6	63.9
FS 25A	5.0	10.3	12.5	58.6
Mean	6.7	19.2	14.4	62.6
	Soft dough stage			
Piper	7.6	21.7	10.2	49.8
Trudan 6	8.4	24.0	8.9	51.5
S.C. Maker 235	16.6	47.3	8.3	50.9
Sudax SX-11	9.1	26.0	9.9	50.3
Millex 23	13.4	38.2	10.2	52.8
FS 25A	12.2	34.8	8.7	53.1
Mean	11.2	32.0	9.4	51.4
LSD.05	2.3	4.8	1.2	2.5

[a] IVDDM = *In vitro* digestible dry matter.

Table 12.2. Forage yields and qualities of six summer annual forages cut at three stages of growth, Hutchinson.

Forage	Forage yield (ton/acre) Dry matter	60% H_2O	Crude protein %	IVDDM[a] %
	Early vegetative stage			
Piper	5.1	14.5	13.8	66.2
Trudan 6	5.7	16.4	14.3	67.2
S.C. Maker 235	5.8	16.7	13.8	67.4
Sudax SX-11	5.8	16.7	14.9	66.6
Millex 23	4.4	12.6	14.8	70.8
FS 25A	3.9	11.4	17.3	64.6
Mean	5.1	14.7	14.8	67.1
	Boot stage			
Piper	7.8	22.2	9.1	59.8
Trudan 6	8.3	23.6	8.5	62.9
S.C. Maker 235	10.0	28.7	8.3	62.3
Sudax SX-11	12.4	35.3	10.3	61.0
Millex 23	7.0	20.0	11.1	65.8
FS 25A	9.9	28.4	7.8	58.3
Mean	9.2	26.4	9.2	61.7
	Soft dough stage			
Piper	5.4	15.5	6.6	50.9
Trudan 6	8.1	23.1	6.0	51.3
S. C. Maker 235	15.7	44.7	3.3	53.9
Sudax SX-11	11.0	31.0	5.7	56.3
Millex 23	8.4	23.9	3.9	55.3
FS 25A	12.0	34.2	4.0	58.6
Mean	10.1	28.3	4.9	54.4
LSD .05	1.6	3.7	1.7	2.4

[a] IVDDM=*In vitro* digestible dry matter.

Protein Levels With and Without Monensin for Finishing Steers

Will Thompson and Jack Riley

Summary

Ration crude protein levels of 9%, 11%, 15%, 12 declining to 10.5% and 13% declining to 11% and finally to 9% were fed with and without Monensin.[1] Steers fed 9% protein continuously gained the least and were the least efficient. Steers fed the other four protein levels had similar performances.

Averaged across protein levels, Monensin had no significant effect on steer performance but it improved feed efficiency 7.4% with the 11%, 12-10.5% and 13-11-9% rations.

Introduction

Protein requirements of finishing cattle have been the subject of much recent research; most has concerned decreasing crude protein as steer weight and time on feed increased. Monensin, which improves feed efficiency, has recently been suggested to have a "protein-sparing" effect. We conducted this trial to obtain more information on protein requirements, the effect of Monensin on steer performance, and its effect on the protein requirement of finishing cattle.

Experimental Procedure

Thirty yearling Hereford steers initially averaging 617 lbs. were individually fed twice daily. Six were assigned to each of the following crude protein levels: 9%, 11%, or 15% fed continuously; 12% for 63 days (815 lb. average wt.), then 10.5%; or 13% for 42 days (772 lbs.), 11% for 42 days (880 lbs.), then 9% to slaughter.

Rations were 15% ground prairie hay, 4% vitamin-mineral supplement, and the rolled corn and soybean meal necessary for desired protein levels. The 9% crude protein rations included no soybean meal. Three steers in each protein treatment were fed 200 mg of Monensin each daily; three received no Monensin.

Jugular blood and rumen fluid was taken 4.5 hours postfeeding on days 21, 42, 63, 84, 126, 147, and 168 of the trial. Plasma was analyzed for urea nitrogen and the rumen fluid for volatile fatty acids.

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

One steer in poor health on the 13-11-9% crude protein treatment with Monensin was removed from the test.

Individual beginning and ending weights were taken after steers were fed 10 lbs. (dry matter basis) of their respective rations daily for four days then withdrawn from water for twelve hours. Steers were slaughtered when their live weights reached approximately 1000 lbs., except that those on the 9% crude protein rations performed so poorly that they were slaughtered at an average of 891 lbs. Individual carcass data obtained are given in table 13.5.

Results and Discussion

Effects of protein treatment, averaged across Monensin treatments, on steer performance and average daily crude protein intake are shown in Table 13.1. Steers fed the 9% crude protein rations gained the least and were the least efficient (P<.05). Gains and efficiencies were similar for the other four rations. Daily feed intake was not affected by protein level.

Effects of Monensin, averaged across protein levels, are shown in Table 13.2. Monensin did not effect performance.

Individual treatment effects also are shown in Table 13.2. Though the interaction between protein level and Monensin was not significant, Monensin improved feed efficiency (avg. of 7.4%) with the 11%, 12-10.5%, and 13-11-9% rations. Feed efficiency of steers fed the 9% and 15% crude protein rations was not improved by Monensin. Within the 11% crude protein rations Monensin increased average daily gain (14.2%).

Effects of protein level and sampling day on plasma urea nitrogen (PUN) are shown in Table 13.3. PUN has been used as a criteria for establishing protein requirements. PUN levels of 8 to 9 mg/100 ml indicate adequate protein intake during the last 30 to 60 days on finishing rations. PUN was lower (P<.05) for cattle fed the 9% rations at each sampling period except the 168-day period when PUN for the 9% and the 13-11-9% rations were similar. PUN was highest (P<.05) on the 15% ration at each sampling period except at 21 days. All PUN values within each protein treatment were affected (P<.05) by sampling day, however only values for steers fed the 13-11-9% rations followed any trend; with that ration PUN decreased (P<.05) as protein in the ration decreased.

Steers fed Monensin had slightly higher (P<.05) PUN levels (12.21 vs. 12.66 mg/100 ml) than steers not fed Monensin. There were no Monensin-protein or Monensin-sampling time interactions (Table 13.4).

Effects of protein level and Monensin on the ratio of acetic and propionic volatile fatty acids (A:P ratio) are shown in Table 13.4. Monensin lowered the A:P ratio with all rations except the 15% crude protein. Carcass characteristics were not affected by protein or Monensin. Steers fed the 9% crude protein rations tended to have less backfat, probably because of light slaughter weights.

Table 13.1. Effects of protein levels on steer performance and daily protein intake.

	9	11	12-10.5	13-11-9	15
No. steers	6	6	6	5	6
Initial wt., lb.	623	634	613	612.75	602
Avg. daily gain, lb.	1.48[b]	2.48[a]	2.30[a]	2.31[a]	2.26[a]
Avg. daily feed, lb.	17.75	17.85	17.84	17.35	17.54
Feed eff., lbs. feed/lb gain	12.19[a]	7.27[b]	7.77[b]	7.51[b]	7.82[b]
Avg. daily protein intake, lbs.	1.57[a]	1.99[b]	1.90[bc]	1.82[c]	2.63[a]

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

Table 13.2. Effects of Monensin and protein levels on steer performance.

	No. steers	Init wt., lb.	Avg. daily gain, lb.	Avg. daily feed, lb.	Feed/lb. gain, lb.
	------------Averaged across protein treatments------------				
Control	15	608.2	2.12	17.72	8.63
Monensin	14	625.7	2.21	17.63	8.45
	------------Individual treatments------------				
Control					
9%	3	610	1.47	17.69	12.14
11%	3	622	2.32	17.54	7.57
12-10.5%	3	616	2.27	18.19	8.03
13-11-9%	3	608	2.29	17.64	7.70
15%	3	585	2.27	17.51	7.70
Monensin					
9%	3	636	1.49	17.81	12.24
11%	3	646	2.65	18.15	6.96
12-10.5%	3	610	2.33	17.48	7.50
13-11-9%	3	617.5	2.34	16.91	7.24
15%	3	619	2.25	17.56	7.94

Table 13.3. Effects of protein levels and sampling days on plasma urea nitrogen (mg/100 ml).

	Protein level				
Day	9%	11%	12-10.5%	13-11-9%	15%
21	7.77^{dg}	12.04^{cgh}	14.32^{bg}	16.03^{ag}	15.97^{ah}
42	8.75^{eg}	11.66^{dh}	12.99^{cgh}	16.34^{bg}	18.85^{ag}
63	7.73^{dgi}	11.47^{ch}	12.06^{bchi}	^{j}13.21^{bh}	18.85^{ag}
84	7.82^{cgi}	13.12^{bg}	^{j}12.34^{bhi}	12.04^{bh}	18.98^{ag}
126	7.01^{dhi}	11.17^{bh}	12.01^{bhi}	^{j}8.82^{ci}	19.06^{ag}
147	7.09^{chi}	11.64^{bh}	11.09^{bi}	8.93^{ci}	19.01^{ag}
168	7.57^{cgi}	10.93^{bh}	12.07^{bhi}	8.79^{ci}	18.71^{ag}

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

^{g,h,i}Means in the same column with different superscripts differ significantly ($P<.05$)

^{j}Indicates when protein was reduced.

Table 13.4. Effect of protein level and Monensin on the A:P ratio.

	Protein level				
	9%	11%	12-10.5%	13-11-9%	15%
Control	2.25^{ac}	2.01^{ac}	2.06^{ac}	2.07^{ac}	1.59^{ad}
Monensin	1.72^{bc}	1.51^{bc}	1.65^{bc}	1.55^{bc}	1.79^{ac}

^{ab}Means in same column with different superscripts differ significantly ($P<.01$).

^{cd}Means in same row with different superscripts differ significantly ($P<.01$).

Table 13.5. Effects of Monensin and indicated protein levels on carcass characteristics.

Control	No. steers	Backfat in.	Loin eye area sq. in.	USDA Grade No. choice	USDA Grade No. good	Yield grade	Dressing percentage
Control	15	.437	11.34	9	6	2.67	60.56
Monensin	14	.589	11.25	8	6	2.86	60.82
9%	6	.36	11.33	2	4	2.33	60.86
11%	6	.53	11.12	2	4	2.83	60.28
12-10.5%	6	.48	11.62	3	3	2.83	60.43
13-11-9%	5	.58	11.04	4	1	2.60	59.93
15%	6	.62	11.32	6	0	3.17	61.80

Monensin sodium (RUMENSIN[R] 60) has been cleared by FDA for feedlot cattle to improve feed efficiency and for pasture cattle over 400 pounds to increase rate of gain. Feedlot cattle are fed Rumensin at not less than 5 nor more than 30 grams per ton of total air dry (90% D.M.) ration so that each animal receives not less than 50 nor more than 360 mg per head per day. Rumensin is cleared for pasture cattle at not less than 50 nor more than 200 mg per head per day fed in at least 1 pound of supplemental feed. During the first 5 days, pasture cattle should receive no more than 100 mg Rumensin per day. Rumensin improves efficiency of gain in feedlot cattle by about 10.6% and increases daily gain of pasture cattle by about 16.3%. Rumensin can be purchased in commercial supplements or as premixes containing up to 1200 grams per ton. Higher concentrations require a form FD 1800. The only antibiotic presently cleared for simultaneous use with Rumensin is Tylan. No withdrawal is required prior to slaughter. Rumensin must be fed only according to its specific FDA clearances. It may not be fed to dairy cattle, and is toxic to horses.

Predicting Feedlot Performance Using Mathematical Models

Phil George and B. E. Brent

Summary

Tables based on mathematical models illustrate how feed intake, rate of gain, and feed efficiency change during the feeding period and in response to different wind-chill temperatures. The tables were used to calculate costs of gain.

Introduction

Daily gain and feed efficiency are generally calculated for feedlot cattle at the end of the feeding period but they do not show the gradual deterioration in performance during the feeding period. We used mathematical models to compute tables of gain, intake, and feed efficiency on a set of Hereford steers after each 50 pounds gained during the feeding period. Using the tables, a feeder can estimate the cost of each additional unit of gain and when to sell cattle for most profit or least loss.

Experimental Procedure

Twenty Hereford steers averaging 749 lbs. were individually fed the rations listed in Table 14.1. After a 7-day adjustment period, weekly feed consumption, weight, and weather data were collected and used to derive mathematical models of the steers' performance. The mathematical models were translated to tables of intake (Table 14.2), gain (Table 14.3), and feed efficiency (Table 14.4) at constant wind-chill temperatures of 41°F and 5°F.

Results

The cost of each additional pound of gain includes feed costs, yardage costs and interest. Thus, if an animal were fed a long time on a low-cost ration, total cost per pound of gain might be higher, because of yardage and interest costs, than if the animal gained faster on a more expensive ration.

The cost of gain table (Table 14.5) assumes that corn silage costs $25 per ton at 40% dry matter; corn, $2.40 per bu. (90% dry matter), and soybean meal supplement , $200 per ton (90% dry matter), or, respectively, 3.13¢, 4.76¢, and 11.1¢ per pound on a dry matter basis. Ration 8 (Table 14.1) composed of 20.05% corn silage, 67.75% cracked corn, and 12.20% supplement would cost 5.21¢/lb. of dry matter.

Interest on a 700-lb. steer purchased for 70¢/lb. with money borrowed at 10.0% would be 13.42¢ per day, so a yardage cost of 6¢ per head per day would make fixed costs total 19.42¢ a day. Table 14.5 illustrates that as feed efficiency deteriorates with increased steer weight, cost for each additional unit of gain increases. Thus, cost of gain is economical early in the feeding period but increases dramatically at heavier weights. A 900-lb. steer (41°F) on ration 8 is predicted to gain 3.12 lbs. a day, so fixed costs are 6.22¢ per lb. of gain. Feed costs are 29.64¢ per lb. of gain, and total cost is 35.86¢ per lb. of gain. But an 1100-lb. steer (41°F) on ration 8 is predicted to gain 2.39 lbs. per day, so fixed costs are 8.13¢ and feed costs, 41.90¢, so total cost is 50.03¢ per lb. of gain.

A steer's performance declines under heat or cold stress because either kind of stress increases requirements for maintenance. A decrease in temperature increases intake and generally decreases gain for less efficient and more costly gain. The tables compare steer performance and cost of gain at wind-chills of 41°F and 5°F and should help feeders project increased feeding costs and decreased gain during periods of extreme cold. High costs of gain due to cold temperatures usually will not continue for long periods. Gain and feed efficiency tables can be constructed for other combinations of corn and corn silage and wind-chills.

The model was developed with Hereford steers, fed neither DES nor Rumensin. Future trials will let us construct models describing performance of heifers and larger-framed cattle and include adjustments for feed additives.

Table 14.1. Ration fed steers to develop a mathematical model of feedlot performance.

Ration no.	%, dry matter basis Corn silage	Cracked corn	Supplement[1]	NEm Mcal/100 lb. dry matter	NEp[2]
1	89.95	0.00	10.05	71.8	45.8
2	80.01	9.64	10.35	74.9	48.0
3	70.07	19.30	10.63	78.1	50.1
4	60.13	28.94	10.93	81.3	52.3
5	50.13	38.64	11.23	84.4	54.5
6	40.10	48.34	11.55	87.6	56.6
7	30.08	58.05	11.87	90.8	58.8
8	20.05	67.75	12.20	93.9	61.0
9	10.13	77.47	12.50	97.1	63.1
10	0.00	87.16	12.84	100.3	65.3

[1]Supplement composition was varied to assure adequate protein. Ingredients included soybean meal, ground limestone, dicalcium phosphate, salt, trace minerals, and vitamins.

[2]NEm = net energy for maintenance; NEp = net energy for production; Mcal = megacalories.

Table 14.2. Daily dry matter intake (lbs) computed from a steer performance model.

Wind-chill temp. ^{o}F	Steer wt., lbs.	Ration 1	2	3	4	5	6	7	8	9	10
41	700	18.76	18.24	17.73	17.21	16.70	16.18	15.66	15.15	14.63	14.59
5		21.01	20.49	19.98	19.46	18.95	18.43	17.92	17.40	16.89	16.84
41	750	19.55	19.03	18.52	18.00	17.49	16.97	16.46	15.94	15.43	15.38
5		21.80	21.29	20.77	20.25	19.74	19.22	18.71	18.19	17.68	17.63
41	800	20.24	19.72	19.21	18.69	18.18	17.66	17.15	16.63	16.12	16.07
5		22.49	21.97	21.46	20.94	20.43	19.91	19.40	18.88	18.37	18.32
41	850	20.83	20.32	19.80	19.29	18.77	18.26	17.74	17.23	16.71	16.67
5		23.09	22.57	22.06	21.54	21.02	20.51	19.99	19.48	18.96	18.92
41	900	21.35	20.84	20.32	19.81	19.29	18.78	18.26	17.75	17.23	17.18
5		23.60	23.09	22.57	22.06	21.54	21.03	20.51	20.00	19.48	19.44
41	950	21.80	21.29	20.77	20.26	19.74	19.23	18.71	18.20	17.68	17.63
5		24.05	23.54	23.02	22.51	21.99	21.48	20.96	20.45	19.93	19.89
41	1000	22.19	21.68	21.16	20.65	20.13	19.62	19.10	18.59	18.07	18.03
5		24.44	23.93	23.41	22.90	22.38	21.87	21.35	20.84	20.32	20.28
41	1050	22.53	22.02	21.50	20.99	20.47	19.96	19.44	18.93	18.41	18.36
5		24.78	24.27	23.75	23.24	22.72	22.21	21.69	21.18	20.66	20.62
41	1100	22.83	22.31	21.80	21.28	20.77	20.25	19.73	19.22	18.70	18.66
5		25.08	24.56	24.05	23.53	23.02	22.50	21.99	21.47	20.96	20.91
41	1150	23.08	22.57	22.05	21.54	21.02	20.51	19.99	19.47	18.96	18.91
5		25.33	24.82	24.30	23.79	23.27	22.76	22.24	21.73	21.21	21.71
41	1200	23.30	22.79	22.27	21.76	21.24	20.73	20.21	19.70	19.18	19.14
5		25.55	25.04	24.52	24.01	23.49	22.98	22.46	21.95	21.43	21.39

Table 14.3. Average daily gain (lbs.) computed from steer performance model.

Wind-chill temp. ^{o}F	Steer wt., lbs.	Ration 1	2	3	4	5	6	7	8	9	10
41	700	3.05	3.09	3.14	3.19	3.24	3.29	3.34	3.38	3.43	3.44
5		2.15	2.20	2.25	2.30	2.35	2.40	2.44	2.49	2.54	2.54
41	750	3.06	3.11	3.15	3.20	3.24	3.29	3.34	3.38	3.43	3.43
5		2.22	2.27	2.31	2.36	2.40	2.45	2.50	2.54	2.59	2.59
41	800	3.03	3.07	3.12	3.16	3.20	3.25	3.29	3.33	3.37	3.38
5		2.24	2.29	2.33	2.37	2.41	2.46	2.50	2.54	2.59	2.59
41	850	2.96	3.00	3.04	3.08	3.12	3.16	3.20	3.24	3.28	3.29
5		2.22	2.26	2.30	2.34	2.38	2.42	2.46	2.50	2.54	2.55
41	900	2.86	2.90	2.93	2.97	3.01	3.04	3.08	3.12	3.16	3.16
5		2.17	2.21	2.25	2.28	2.32	2.36	2.40	2.43	2.47	2.47
41	950	2.73	2.76	2.80	2.83	2.86	2.90	2.93	2.97	3.00	3.01
5		2.09	2.13	2.16	2.20	2.23	2.26	2.30	2.33	2.37	2.37
41	1000	2.57	2.60	2.64	2.67	2.70	2.73	2.76	2.79	2.82	2.83
5		1.99	2.02	2.05	2.08	2.12	2.15	2.18	2.21	2.24	2.24
41	1050	2.40	2.43	2.45	2.48	2.51	2.54	2.57	2.60	2.63	2.63
5		1.87	1.89	1.92	1.95	1.98	2.01	2.04	2.07	2.10	2.10
41	1100	2.21	2.23	2.26	2.28	2.31	2.34	2.36	2.39	2.42	2.42
5		1.73	1.75	1.78	1.80	1.83	1.86	1.88	1.91	1.93	1.94
41	1150	2.00	2.03	2.05	2.07	2.10	2.12	2.14	2.17	2.19	2.19
5		1.57	1.60	1.62	1.64	1.67	1.69	1.71	1.74	1.76	1.76
41	1200	1.79	1.81	1.83	1.85	1.87	1.89	1.91	1.93	1.95	1.95
5		1.41	1.43	1.45	1.47	1.49	1.51	1.53	1.55	1.57	1.57

Table 14.4. Feed efficiency (units of dry matter per unit of body weight gain) computed from a steer performance model.

Wind-chill temp. °F	Steer wt., lbs.	Ration									
		1	2	3	4	5	6	7	8	9	10
41	700	6.16	5.90	5.64	5.39	5.16	4.92	4.70	4.48	4.26	4.25
5		9.75	9.31	8.88	8.47	8.07	7.69	7.33	6.98	6.65	6.62
41	750	6.38	6.12	5.87	5.63	5.39	5.16	4.93	4.72	4.50	4.48
5		9.81	9.39	8.98	8.59	8.21	7.85	7.50	7.16	6.83	6.81
41	800	6.67	6.41	6.16	5.91	5.67	5.44	5.21	4.99	4.78	4.76
5		10.03	9.61	9.21	8.83	8.46	8.10	7.76	7.43	7.10	7.08
41	850	7.03	6.77	6.51	6.26	6.01	5.77	5.54	5.31	5.09	5.07
5		10.38	9.97	9.57	9.19	8.82	8.46	8.11	7.78	7.45	7.42
41	900	7.47	7.20	6.93	6.67	6.42	6.17	5.93	5.69	5.46	5.44
5		10.87	10.45	10.05	9.66	9.28	8.92	8.56	8.22	7.89	7.86
41	950	8.00	7.71	7.43	7.16	6.89	6.63	6.38	6.13	5.89	5.87
5		11.50	11.07	10.65	10.25	9.86	9.49	9.12	8.76	8.42	8.39
41	1000	8.63	8.33	8.03	7.74	7.46	7.19	6.92	6.65	6.40	6.37
5		12.29	11.85	11.41	10.99	10.58	10.19	9.80	9.43	9.07	9.03
41	1050	9.40	9.07	8.76	8.45	8.15	7.85	7.56	7.28	7.01	6.98
5		13.29	12.81	12.35	11.90	11.47	11.05	10.64	10.24	9.86	9.82
41	1100	10.34	9.99	9.65	9.31	8.99	8.67	8.35	8.04	7.74	7.72
5		14.53	14.02	13.52	13.04	12.57	12.12	11.68	11.25	10.83	10.80
41	1150	11.53	11.14	10.76	10.39	10.03	9.68	9.33	8.99	8.66	8.63
5		16.10	15.55	15.00	14.48	13.97	13.47	12.98	12.51	12.06	12.02
41	1200	13.04	12.61	12.19	11.77	11.37	10.97	10.58	10.20	9.83	9.80
5		18.14	17.52	16.91	16.33	15.76	15.20	14.66	14.14	13.63	13.58

Table 14.5. Cost of gain[1] and computed from steer performance model.

Wind-chill temp. °F	Steer wt., lbs.	Ration									
		1	2	3	4	5	6	7	8	9	10
41	700	30.62	30.56	30.43	30.25	30.03	29.76	29.45	29.09	28.69	29.35
5		47.41	47.14	46.78	46.37	45.91	45.39	44.82	44.20	43.54	44.58
41	750	31.47	31.47	31.40	31.28	31.11	30.90	30.64	30.33	29.98	30.69
5		47.35	47.21	46.98	46.69	46.35	45.95	45.49	44.98	44.42	45.50
41	800	32.68	32.73	32.71	32.64	32.52	32.35	32.13	31.86	31.55	32.31
5		48.12	48.07	47.94	47.74	47.49	47.17	46.80	46.36	45.88	47.01
41	850	34.24	34.34	34.36	34.34	34.25	34.12	33.94	33.70	33.42	34.24
5		49.58	49.62	49.56	49.44	49.25	49.00	48.69	48.32	47.89	49.08
41	900	36.20	36.34	36.40	36.41	36.36	36.26	36.11	35.86	35.54	36.52
5		51.71	51.82	51.82	51.76	51.63	51.44	51.18	50.85	50.46	51.73
41	950	38.59	38.78	38.88	38.92	38.91	38.84	38.71	38.52	38.28	39.23
5		54.53	54.71	54.77	54.77	54.69	54.54	54.32	54.03	53.67	55.03
41	1000	41.51	41.74	41.88	41.96	41.98	41.93	41.82	41.65	41.42	42.46
5		58.15	58.38	58.50	58.55	58.51	58.40	58.22	57.96	57.63	59.09
41	1050	45.09	45.37	45.55	45.66	45.71	45.69	45.60	45.44	45.22	46.36
5		62.70	63.00	63.17	63.27	63.27	63.20	63.05	62.81	62.49	64.09
41	1100	49.51	49.84	50.07	50.22	50.29	50.30	50.23	50.03	49.87	51.13
5		68.43	68.80	69.03	69.18	69.23	69.19	69.06	68.84	68.54	70.30
41	1150	55.07	55.46	55.73	55.92	56.03	56.06	56.01	55.87	55.66	57.07
5		75.72	76.17	76.47	76.66	76.76	76.75	76.65	76.44	76.15	78.11
41	1200	62.20	62.66	62.99	63.23	63.38	63.44	63.40	63.28	63.06	64.66
5		85.16	85.70	86.07	86.33	86.47	86.51	86.43	86.23	85.93	88.15

[1] Corn silage at $25 per ton, 40% dry matter; corn, $2.40 per bu., 90% dry matter; supplement $200 per ton, 90% dry matter. Assume 6¢ per day yardage, and a 700-lb. steer purchased at $70/cwt at 10.0% interest, for 19.42¢ per day fixed cost.

Protein Adjustments During Temperature Stress

David R. Ames

Summary

Adjusting feedlot rations to match the thermal environment can reduce costs of gains. Adjusting protein content of rations does not change average daily gain but it improves protein efficiency.

Introduction

Rations for feedlot cattle are intended to provide a balance that results in the most efficient use of each nutrient. Energy and protein are balanced so about 12 Kcal energy for each gm protein remain after maintenance requirements are met. The most efficient use of both energy and protein result when calorie to protein ratio is appropriate for tissue synthesis. However, when energy required for maintenance increases, (as during thermal stress), energy available to synthesize tissue is reduced and the calorie-to-protein ratio above maintenance levels for both energy and protein is lowered. This results in reduced protein efficiency ratio (lb gain/lb dietary protein) and increased cost of gain during both heat and cold stress.

Dietary protein could be more efficiently used if it were fed in proportion to animal needs; enough for maintenance plus enough for the anticipated rate of growth. During thermal stress (either heat or cold) cattle gain less, so less protein is required. We applied that logic to feedlot situations expecting to improve protein efficiency without reducing average daily gain.

Methods

We conducted two preliminary trials with lambs and then four trials with cattle to evaluate the idea of matching protein to expected gain during thermal stress. In each trial, gain during stress was predicted with equations developed from recent feedlot and research data. Protein for growth (that in excess of maintenance) was adjusted to expected reduced gains. If gain was expected to be 15% lower, we lowered growth protein 15% but not protein for maintenance. A chart indicating the adjustments for a 900-lb steer follows.

Sample Ration Adjusted for Temperature

	Deviation (^{O}F) from critical temperatures	Decline in ADG,%	Protein for maintenance,g	Protein for growth,g	Protein needed in ration,g	Crude protein in ration,%
	45	52.3	251.8	269.7	521.5	7.66
	40	39.1	251.8	344.3	596.1	8.75
	35	27.7	251.8	408.8	660.6	9.70
	30	18.2	251.8	462.5	714.3	10.49
Hot	25	10.5	251.8	506.0	757.8	11.13
	20	4.8	251.8	530.3	790.1	11.60
	15	.7	251.8	561.4	813.2	11.94
	10	----	251.8	565.4	817.2	12.0
	5	----	251.8	565.4	817.2	12.0
Critical	0	----	251.8	565.4	817.2	12.0
temperature	5	2.3	251.8	552.4	804.2	11.81
	10	4.5	251.8	540.0	791.8	11.63
	15	6.8	251.8	527.0	778.8	11.44
	20	9.0	251.8	514.5	766.3	11.26
Cold	25	11.3	251.8	501.5	753.3	11.06
	30	13.5	251.8	489.1	740.9	10.88
	35	15.8	251.8	476.1	727.9	10.69
	40	18.0	251.8	463.6	715.4	10.51
	45	20.3	251.8	450.6	702.4	10.31

One must know the temperatures that required adjustments, i.e., the critical temperature. Estimates of critical temperature for feedlot cattle are given below.

Coat description	Critical temperature
Summer coat or wet	15 C (59 F)
Fall coat	7 C (45 F)
Winter coat	0 C (32 F)
Heavy winter coat	-7 C (18 F)

Results and Discussion

A total of 575 animals were used to evaluate protein adjustments during thermal stress, with the results shown in Table 15.1.

Table 15.1. Summary of six trials with ration protein adjusted to existing thermal environment.

Trial	Species	Mean temp.(°F)	ADG(lb.)[1] Control	Adjusted	PER[2] Control	Adjusted	Protein removed (lb/hd/da)
1	cattle	34	2.0	2.0	.97	1.10	.24
2	cattle	36	2.3	2.4	1.19	1.43	.33
3	cattle	79	2.4	2.5	.79	.91	.29
4	cattle	79	2.8	2.5	1.11	1.16	.35
5	sheep	23	.31	.33	.63	.93	.11
6	sheep	86	.55	.42	1.71	1.96	.09
			Average		1.07	1.25	

[1]No significant difference in mean ADG between control and adjusted groups.

[2]Highly significant (P=.006) difference in mean PER between control and adjusted groups.

Comparing average daily gains between controls on present NRC protein level and animals on adjusted protein levels, shows no difference, as expected. However, when gains are depressed during thermal stress (because energy for growth is reduced), protein efficiency ratio for adjusted rations is superior to the ratio for control rations. Thus, removing protein during thermal stress improved protein efficiency with no penalty in performance.

Adjusting protein reduces cost of gain because protein is more expensive than energy. For example, if the spread between soybean meal and corn is 5¢/lb., removing 1/3 lb. of soybean meal during thermal stress gives a 1.5¢-per-head daily saving. Price difference between protein supplement and energy feeds may increase or decrease such savings.

It is rather easy to use protein adjustments during thermal stress with most feeding systems. If feed is mixed daily, adjustments can be made using the chart given on the previous page. Smaller feeders who use mix batches, could save by developing rations based on monthly temperature records.

High Moisture Corn for Finishing Steers

Keith Bolsen, Jack Riley and Harvey Ilg

Summary

We used 135 yearling steers in two trials to compare dry with high moisture (HM) corn and soybean meal (SBM) supplement with urea supplement.

Results of trial 1 (88 days) show HM corn either rolled and ensiled in a stave silo or ensiled whole in a fiberglass O_2-limiting silo supported faster and more efficient gains than dry rolled, steam-flaked or HM-corn treated with a preservative. A 50% SBM + 50% urea supplement tended to be used more efficiently than either 100% SBM or 100 % urea supplements.

In trial 2 (97 days) steers fed dry rolled corn or HM corn ensiled with a commercial additive had similar gains and 6.2% faster gains then steers fed HM corn ensiled without an additive. HM corn ensiled with the additive produced 7.1% more efficient steer gains than dry rolled corn and 4% more efficient gains than HM corn ensiled without the additive. An all-SBM supplement gave slightly better steer performance than an all-urea supplement.

Introduction

Previous research at Kansas State University has consistently shown high moisture milo superior to dry rolled milo in rations for finishing cattle. Our purpose in these two trials was to evaluate several methods of harvesting, storing, and processing corn grain for feedlot rations. In addition, soybean meal and urea were compared as protein sources.

Experimental Procedure

Trial 1. Seventy-five yearling steers averaging 812 pounds were allotted by weight to 15 pens of five each. Three pens were assigned to each of five corn treatments: (1) dry rolled; (2) steam-flaked; (3) high moisture, treated whole with 1.5% commercial grain preservative[1] (HM preservative) on a dry matter (DM) basis; (4) high moisture, rolled and ensiled in a concrete stave silo (HM-stave); and (5) high moisture, ensiled whole in a fiberglass oxygen-limiting silo (HM-O_2- limiting). One pen from each corn treatment was assigned to each of three supplemental protein treatments: all supplemental protein from (A) soybean meal (SBM); (B) from urea; and (C) 50% from SBM and 50% from urea (SBM + Urea). Supplemental protein

[1] Commercial grain preservative, Chem Stor, provided by Celanese Corporation, Corpus Christi, Texas.

supplied 21% of the total ration protein. All of the corn was harvested from the same field at 26% to 28% moisture. Corn for the dry rolled and steam-flaked treatments was artificially dried and stored at 88% DM; commercially preserved corn was stored in a polyethlene-lined metal bin; and corn stored whole was rolled before being fed. A 3- to 4-day supply of corn was steam-flaked at one time and stored for feeding.

The trial was 88 days (January 28 to March 26, 1977). All rations were 80% of the appropriate corn, 15% corn silage and 5% of the appropriate protein supplement on a DM basis. Rations were formulated to contain 11% protein (DM basis), mixed twice daily and fed free-choice.

Trial 2. Sixty yearling Angus and Angus X Hereford steers were allotted by breed and weight to 12 pens of five each. Four pens were assigned to each of three corn treatments: (1) dry rolled; (2) high moisture, rolled and ensiled (HM-no additive); and (3) high moisture, rolled, treated with 0.1% commercial silage additive[2], and ensiled (HM-additive). Two pens from each corn treatment were assigned to each of two supplemental protein treatments: all supplemental protein from (A) soybean meal or (B) urea. Supplemental protein supplied 17% of the total ration protein. All of the corn was harvested September 7 and 8, 1977, from the same field at approximately 18% moisture. The dry rolled corn was artificially dried, stored at 13.8% moisture, and rolled before being fed. Both the high moisture corn treatments were ensiled in 10- x 50-foot concrete stave silos.

The trial was 97 days (March 7 to June 12, 1978). All rations were 80% of the appropriate corn, 14% corn silage and 6% SBM or urea supplement on a DM basis. Rations were formulated to contain 11.5% protein (DM basis), mixed twice daily and fed free-choice.

In both trials, individual steer weights were taken at the beginning and end of the trial after steers were without feed or water 15 hours. Final live weights were calculated from carcass weights, using a 60.1 dressing percent in trial 1 and 61.6 dressing percent in trial 2.

Results and Discussion

Trial 1. Effects of corn treatment on steer performances are shown in Table 16.1; effects of protein treatment, in Table 16.2. Steers fed HM-stave and HM-O_2-limiting corn gained faster ($P<.05$) than steers fed steam-flaked and HM-preservative corn, however, steam-flaking the corn several days in advance likely influenced the results. Dry rolled corn was consumed in the greatest amount ($P<.05$). Although differences in feed efficiency were not statistically significant, HM-stave and HM-O_2-limiting corn tended to be more efficient than the other corn treatments.

Results show similar daily gains, feed intake and feed efficiency by steers fed rations supplemented with SBM or urea. The SBM + urea supplement tended to improve rate and efficiency of gains over either SBM or urea supplement, although the differences were not significant.

Carcass quality and yield grades were not affected by corn or protein treatments.

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[2]Commercial silage additive, Silo-Best, and partial financial assistance provided by Cadco, Inc., Des Moines, Iowa.

Trial 2. Effects of corn treatment on steer performances are shown in Table 16.3; effects of protein treatment, in Table 16.4. Steers fed dry rolled corn consumed more feed (P<.05) than steers fed either of the two high moisture corns; however, dry rolled corn was used 3.4% less efficiently than HM-additive corn. Although differences in performance between steers fed SBM or urea supplements were not significant, those receiving SBM gained 4.4% faster and 2.7% more efficiently than those receiving urea. Carcass quality and yield grades were not affected by corn or protein treatments.

Table 16.1. Effects of corn treatment on steer performances in Trial 1.

Item	Corn				
	Dry rolled	Steam flaked	HM preservative	HM stave	HM O_2-limiting
No. of steers	15	15	15	15	15
Initial wt., lbs.	808	811	811	810	810
Final wt., lbs.	1045	1018	1036	1063	1053
Avg. daily gain, lbs.	2.69^{ab}	2.35^{b}	2.56^{b}	2.88^{a}	2.76^{a}
Avg. daily feed, lbs.[1]	21.05^{a}	18.61^{c}	20.45^{ab}	19.85^{b}	20.17^{b}
Feed/lb. of gain, lbs.[1]	7.82	8.01	8.00	6.94	7.32
Carcass quality grade[2]	12.6	12.6	12.2	12.4	12.6
Carcass yield grade	2.9	2.7	3.0	2.7	2.8

[1] 100% DM basis.

[2] 12 = low choice, 13 = average choice.

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

Table 16.2. Effects of protein supplement treatment on steer performances in Trial 1.

Item	Protein supplement		
	SBM	Urea	SBM + Urea
No. of steers	25	25	25
Avg. daily gain, lbs.	2.56	2.58	2.82
Avg. daily feed, lbs.[1]	19.82	20.02	20.24
Feed/lb. of gain, lbs.[1]	7.80	7.82	7.24
Carcass quality grade[2]	12.6	12.3	12.5
Carcass yield grade	2.8	2.7	2.9

[1] 100% DM basis.

[2] 12 = low choice; 13 = average choice.

Table 16.3. Effects of corn treatment on steer performances in Trial 2.

Item	Corn		
	Dry Rolled	HM no additive	HM commercial additive
No. of steers	20	20	20
Initial wt., lbs.	699	699	697
Final wt., lbs.	998	981	997
Avg. daily gain, lbs.	3.09	2.91	3.10
Avg. daily feed, lbs.[1]	20.80[a]	18.93[b]	19.33[b]
Feed/lb. of gain, lbs.[1]	6.73[b]	6.51[ab]	6.25[a]

[1]100% DM basis.

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

Table 16.4. Effects of protein supplement treatment on steer performances in Trial 2.

Item	Protein supplement	
	SBM	Urea
No. of steers	30	30
Avg. daily gain, lbs.	3.10	2.97
Avg. daily feed, lbs.[1]	19.81	19.56
Feed/lb. of gain, lbs.[1]	6.41	6.59

[1]100% DM basis.

Conventional versus Accelerated Beef Production for Traditional and Later-maturing Cattle Types

Stan M. Myers, Michael E. Dikeman, and John B. Riley

Summary

Analysis of traditional and later-maturing cattle types fed under accelerated (placed directly on the finishing ration) and conventional (back-grounded on a growing ration before finishing) systems, indicated large differences between feeding systems but smaller differences between cattle types in the same feeding system. Differences between feeding systems stress the economic importance of maintaining maximum gain, and the disadvantages of extended feeding periods, when much of the feed consumed is required for maintenance. Later-maturing cattle on accelerated feeding required the least feed per pound of gain.

Introduction

The cattle feeding industry must produce efficiently a product whose value is subject to quality standards. With the prospect of an extended period of strong feeder cattle prices, inefficient producers will find it increasingly difficult to compete with more efficient producers. This study was designed to provide efficiency comparisons by identifying production differences associated with cattle types and feeding systems, assuming like-quality end products.

Experimental Procedure

Two groups of crossbred steers, 24 Hereford X Angus (traditional) and 23 Simmental-sired steers from either Chianina X Angus or Chianina X Hereford females (later-maturing), were obtained from the U.S. Meat Animal Research Center at Clay Center, Nebr. They were approximately 8 months old and averaged 568 lb. when purchased. Following an adjustment period, half of each group was allotted by weight to one of two feeding regimes. Twelve traditional and thirteen later-maturing steers were allocated to the accelerated feeding system. Twelve of each type were allocated to the conventional feeding system.

Accelerated feeding consisted of a 4-week adjustment period then a finishing phase. Lengths of finishing periods for cattle types differed to facilitate the production of end products similar in eating quality. The conventional feeding system consisted of adjusting, backgrounding, and finishing phases with the length of backgrounding adjusted to promote end products similar in eating quality. Feeding systems are summarized in Table 17.1.

Weight and average feed consumption were recorded every other week for each cattle type in a given feeding system. All steers were slaughtered at Kansas State University where quality and yield grades were determined.

Rib steaks were evaluated by a trained taste panel for flavor and juiciness and evaluated for tenderness by the taste panel and Warner-Bratzler shear.

Results and Discussion

The accelerated feeding system was more efficient (less feed per pound of gain) because much of the feed consumed during backgrounding in the conventional system was used for maintenance.[1] Sixty-seven percent of the backgrounding ration was low-energy-density prairie hay, which was the major contributor to high feed/gain ratios characteristic of the backgrounding phase. With the conventional feeding system, 1 lb. of finishing ration substituted for 2.65 lb. of the backgrounding ration. Thus, the backgrounding ration would have to be purchased at 37.57%[2] of the cost of the finishing ration for costs of gain to be equal. Feasibility of backgrounding depends upon: consumption, energy density of the backgrounding ration, cost ratio comparing backgrounding and finishing rations, beginning weight, projected length of finishing period, and desired end weight.

Differences between cattle types in feeding systems were not as large as differences between feeding systems. Within the accelerated feeding system later-maturing steers performed more efficiently so higher daily gains would reduce yardage and interest costs. Within the conventional feeding system traditional steers were more efficient, partly due to a shorter backgrounding period. Daily gains were slightly lower for traditional cattle, so yardage costs per pound of gain were slightly higher. However, interest costs per pound of gain were higher for the later-maturing, conventionally fed steers because of accumulated interest for additional time. A production summary is provided in Table 17.2.

Ribs steaks from steers on the accelerated system and from those on the conventional system, were judged equally flavorful by a trained taste panel, and equally tender by the Warner-Bratzler shear, even though steers slaughtered on the accelerated system graded lower.

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[1]Maintenance computations assumed production within the thermal neutral zone. That facilitates comparison, but maintenance requirements were higher than those stated.

[2]Includes additional yardage and interest costs associated with extended time required to produce equal gain.

Table 17.1. Feeding systems for two cattle types.

	Traditional, accelerated		Later-maturing, accelerated		Traditional, conventional			Later-maturing, conventional		
	Adjustment period	Finishing period	Adjustment period	Finishing period	Adjustment period	Backgrounding period	Finishing period	Adjustment period	Back-Grounding period	Finishing period
	Percentages on dry matter basis (D.M.B.)									
Feed ingredients										
Corn (89% D.M.)	57.2	86.0	57.2	85.3	15.7	----	82.5	15.7	----	81.3
Grain sorghum (89% D.M.)	----	----	----	----	15.1	29.8	----	15.1	28.9	----
Corn silage (40% D.M.)	11.8	9.6	11.8	10.4	----	----	8.0	----	----	2.5
Sorghum silage (40% D.M.)	25.4	----	25.4	----	15.9	----	5.1	15.9	----	11.8
Prairie hay (91% D.M.)	----	----	----	----	48.6	66.3	----	48.6	67.3	----
32.6% Crude protein (D.M.B.) Supplement (85% D.M.)	5.6	4.4	5.6	4.3	4.7	3.9	4.4	4.7	3.8	4.4
% Dry matter	61	79	61	79	75	90	77	75	90	76
% Crude protein	10.6	10.8	10.6	10.8	10.2	10.3	10.7	10.2	10.3	10.7
Days on feed	28	112	28	154	28	113	117	28	155	123
(Total days)		(140)		(182)			(258)			(306)

Table 17.2. Summary of production data from feeding tests with traditional and later-maturing steer types.

	Traditional, accelerated			Later-maturing, accelerated			Traditional, conventional			Later-maturing, conventional		
	Beginning weight	Ending weight	Gain	Beginning weight	Ending weight	Gain	Beginning weight	Ending weight	Gain	Beginning weight	Ending weight	Gain
Weight gains, lbs.												
Adjustment	572	648	76	563	645	82	568	638	70	568	656	88
Backgrounding	---	---	---	---	---	---	638	755	117	656	842	186
Finishing	648	947	299	645	1113	468	755	1172	417	842	1303	461
Total	572	947	375	563	1113	550	568	1172	604	568	1303	735
Consumption/day	lbs. (D.M.) per head per day											
Adjustment		17.0			17.0			16.7			16.0	
Backgrounding		----			----			17.8			21.7	
Finishing		17.0			18.2			24.2			27.5	
Total		17.0			18.0			20.6			23.4	
% of Feed consumption required for maintenance	percent											
Adjustment		35.2			34.4			46.5			49.1	
Backgrounding		----			----			53.8			47.0	
Finishing		38.2			38.5			31.3			30.3	
Total		37.5			38.1			41.2			39.8	
Average daily gain	lbs. per head per day											
Adjustment		2.7			2.9			2.5			3.1	
Backgrounding		---			---			1.0			1.2	
Finishing		2.7			3.1			3.6			3.8	
Total		2.7			3.0			2.3			2.4	
Efficiency (F/G)	lbs. feed (D.M.) per lb. gain											
Adjustment		5.6			5.3			6.4			4.9	
Backgrounding		---			---			17.4			18.1	
Finishing		6.1			4.7			6.5			6.9	
Total		6.0			4.7			8.6			9.5	
Quality grade[1]		8.7			8.0			9.8			9.1	
% Choice		25.0			23.1			83.3			50.0	
Yield grade		3.33			2.30			4.00			2.30	

[1]Quality grade: 15, 14, 13 = Prime; 12, 11, 10 = Choice; 9, 8, 7 = Good; 6, 5, 4 = Standard.

Performance, Carcass, and Meat Traits of Different Cattle Types

M. E. Dikeman

Summary

Different crossbred (X) cattle types were evaluated for growth, feed efficiency, carcass and meat traits. Steers were studied from mating Angus (A), Hereford (H), Brahman (B), Sahiwal (S), Pinzgauer (P), and Tarentaise (T) sires to Angus and Hereford females.

Average daily gain (ADG) and feed efficiency were similar for all the crosses except that SX gained slower and required more feed per pound of gain. Brahman crosses tended to have higher, and PX tended to have lower dressing percentages than the other crosses. Quality grades ranged from low choice (HAX) to average good (BX and SX). HAX had higher fat trim percentages and lower retail product percentages than other crossbred types because they had more fat covering. All other crosses were similar in fat trim, retail product, and bone percentages. Taste panel flavor and juiciness scores did not differ between crosses. However, PX and HAX tended to be more tender than TX or BX, and considerably more tender than SX.

If all crossbred types had been slaughtered at the same percentage of body fat rather than at the same age, there would likely be no advantage of PX, TX, BX or SX over HAX in feedlot performance, carcass or meat traits.

Introduction

Two-year results from the U.S. Meat Animal Research Center's "cattle germ plasm program" are reported here. Kansas State University and the Standardization Branch, Food Safety and Quality Service, USDA, cooperated on carcass and meat aspects of the study.

Data on calving difficulty and preweaning performance resulting from matings in this study were obtained in addition to reproduction and maternal traits of the female progeny. That information is in Progress Report No. 5 from the "germ plasm evaluation program", Roman L. Hruska U.S. Meat Animal Research Center, Clay Center, NE 68933.

Appreciation is expressed to Jean Riggs and Garland Lewis, Department of Housing, KSU, for use of the meat processing facilities in the Pittman building in conducting this research.

Experimental Procedure

Different crossbred (X) cattle types were produced by mating Angus (A), Hereford (H), Brahman (B), Sahiwal (S), Pinzgauer (P), and Tarentaise (T) sires to Angus and Hereford females. The two calf crops were born in March, April, and May of 1975 and 1976, castrated at birth and weaned when approximately 200 days old. All male calves were fed in a feedlot by sire breed groups to obtain growth and feed efficiency data. They were fed a corn silage-and-concentrate ration that approximated 80% TDN (total digestible nutrients) on a dry matter basis.

Approximately one-third of each crossbred type was slaughtered at each of three slaughter times. Steers born in 1975 were slaughtered after 192, 218, and 246 days on feed after a 40-day postweaning adjustment period. Steers born in 1976 were fed 180, 208, and 236 days after a 34-day postweaning adjustment period. All steers were slaughtered in a commercial slaughter plant. After a 48-hr chill, carcasses were evaluated for yield grade and quality grade. The right carcass side of an average of 45 steers per sire breed for each slaughter group (except for 34 Tarentaise-sired steers) were brought to Kansas State University for detailed cut-out and meat quality evaluations. The sides were fabricated into essentially boneless, closely trimmed retail cuts.

One rib steak was removed from each of the carcasses for Warner-Bratzler shear determinations of tenderness. Another rib steak was removed from six carcasses per crossbred group per slaughter time and evaluated for tenderness, flavor, and juiciness by a trained taste panel.

Results and Discussion

Feedlot average daily gain (ADG) was similar for all crossbred types except the SX which gained significantly slower (Table 18.1). Steers from H females had higher ADG than those from A females regardless of sire breed. Final weights of SX were the lightest of all crosses; BX the heaviest because they were heavier at weaning. Final weights were similar for HAX, PX and TX. Sahiwal crosses were less efficient in feed utilization than other crosses, and PX slightly more efficient than the other crosses. The remaining crosses were similar in feed efficiency.

Hot carcass weights were similar for all crossbred types except that SX were lighter (Table 18.2). Dressing percentages did not differ between HAX, TX, and SX; however, BX tended to dress highest and PX lowest. Quality grades ranged from low choice (HAX) to average good (BX and SX).

The range in yield grades for the different crosses was relatively narrow (3.2 to 3.8, Table 18.3), with no differences in rib eye areas but HAX had more fat cover which gave them a less desirable yield grade. TX had higher kidney knob percentages than the other crossbred types.

Hereford X Angus crosses had lower retail product and higher fat trim percentages than other crosses because they had more fat covering, with no advantage in muscle thickness (Table 18.4). All other crossbred types were similar in retail product, fat trim, and bone percentages. Taste panel flavor and juiciness scores did not differ statistically among crosses

(Table 18.5). However, PX and HX tended to be more tender than TX or BX, and considerably more tender than SX.

The only meaningful differences between crosses in this study probably were that SX have the least growth potential and Zebu-type cattle (S and B) tend to have less marbling and less tender meat. Most other differences can be attributed to differences in fatness at slaughter. If all crosses had been slaughtered at a constant percentage of body fat rather than at the same age, HAX probably would be at least equal to PX, TX, or BX in ADG, feed efficiency, quality grade, yield grade, retail product percentage, and meat palatability. That is, there appears to be no advantage of PX, TX, BX or SX over HAX in feedlot performance, carcass, or meat traits when all are managed as in this study.

Table 18.1. Postweaning average daily gains, final weights, and TDN efficiencies of different crossbred cattle types.

Breed of steer		No. steers[a]				Postweaning average daily gain				Final weight					Feed efficiency (TDN per lb gain)[c]			
Sire	Dam	S1	S2	S3	Total	S1	S2	S3	Avg	S1	S2	S3	Avg	Ratio	S1	S2	S3	Avg
Angus	Hereford	24	24	26	74	2.53	2.50	2.42	2.48	1011	1071	1119	1067	99.4				
Hereford	Angus	36	35	35	106	2.48	2.43	2.33	2.42	1030	1086	1128	1081	100.7				
	Average	60	59	61	180	2.51	2.46	2.38	2.45	1021	1079	1124	1074	100.0	5.93	6.13	6.37	6.14
Brahman	Hereford	17	17	18	52	2.56	2.50	2.48	2.51	1059	1113	1170	1114	103.7				
	Angus	34	34	33	101	2.40	2.36	2.41	2.39	1061	1125	1180	1122	104.5				
	Average	51	51	51	153	2.48	2.43	2.44	2.45	1060	1119	1175	1118	104.1	5.99	6.19	6.18	6.12
Sahiwal	Hereford	19	19	21	59	2.38	2.34	2.27	2.33	997	1045	1116	1053	98.0				
	Angus	32	32	31	95	2.22	2.13	2.11	2.15	984	1035	1084	1034	96.3				
	Average	51	51	52	154	2.30	2.24	2.19	2.24	991	1040	1100	1044	97.2	6.08	6.41	6.55	6.35
Pinzgauer	Hereford	22	23	23	68	2.65	2.54	2.51	2.57	1031	1090	1144	1088	101.3				
	Angus	36	36	36	108	2.48	2.42	2.30	2.40	1041	1096	1130	1089	101.4				
	Average	58	59	59	176	2.56	2.48	2.41	2.49	1036	1093	1137	1089	101.4	5.76	6.00	6.26	6.01
Tarentaise	Hereford	12	10	9	31	2.58	2.50	2.42	2.50	1042	1080	1141	1088	101.3				
	Angus	23	25	24	72	2.41	2.32	2.27	2.33	1043	1078	1137	1086	101.1				
	Average	35	35	33	103	2.50	2.41	2.35	2.42	1043	1079	1139	1087	101.2	5.86	6.18	6.37	6.14
Averages of all sires	Hereford	94	93	97	284	2.54	2.48	2.42	2.48	1028	1080	1138	1082	100.7				
	Angus	161	162	159	482	2.40	2.33	2.28	2.34	1032	1084	1132	1082	100.7				
	Average					2.47	2.40	2.35	2.41	1030	1082	1135	1082	100.7	5.92	6.18	6.35	6.15

[a] S1, S2, and S3 represent slaughter groups 1, 2, and 3. Steers born in 1975 were slaughtered after 192, 218, and 246 days on feed after a 40-day postweaning adjustment period; 1976 steers were slaughtered after 180, 208, and 236 days on feed after a 34-day postweaning adjustment period.

[b] Ratio relative to 1074 lb average of Hereford-Angus reciprocal crosses.

[c] TDN = Total digestible nutrients determined on a 100% dry matter basis.

Table 18.2. Hot carcass weights, dressing percentages, quality grades, and marbling scores of different crossbred types.

Breed of steer		Hot carcass wt, lb				Dressing percentage[a]				U.S.D.A. quality grade[b]				Marbling score[c]			
Sire	Dam	S1	S2	S3	Avg	S1	S2	S3	Avg	S1	S2	S3	Avg	S1	S2	S3	Avg
Angus	Hereford	603	643	686	644	59.8	60.4	61.5	60.6	11.4	12.3	12.7	12.2	10.0	12.2	13.5	11.9
Hereford	Angus	623	664	703	663	60.3	61.0	62.1	61.1	11.7	12.3	12.1	12.0	10.3	12.1	11.6	11.4
	Average	613	653	694	654	60.0	60.7	61.8	60.9	11.6	12.3	12.4	12.1	10.2	12.1	12.6	11.6
Brahman	Hereford	615	653	700	656	60.3	61.3	61.6	61.0	10.5	9.8	11.0	10.4	9.2	7.8	9.5	8.8
	Angus	638	685	720	681	61.6	62.6	62.5	62.2	10.6	11.1	11.3	11.0	8.8	9.7	10.1	9.5
	Average	627	669	710	668	60.9	62.0	62.0	61.6	10.5	10.4	11.1	10.7	9.0	8.8	9.8	9.2
Sahiwal	Hereford	569	609	656	612	59.9	60.8	61.7	60.8	10.3	10.2	11.0	10.5	8.5	8.4	9.4	8.8
	Angus	580	619	646	615	60.8	61.9	61.2	61.3	10.4	11.8	11.8	11.4	8.8	11.2	11.1	10.4
	Average	575	614	651	613	60.3	61.3	61.5	61.0	10.3	11.0	11.4	10.9	8.6	9.8	10.3	9.6
Pinzgauer	Hereford	590	638	669	632	57.8	59.5	59.7	59.0	10.7	11.4	11.2	11.1	8.9	10.9	9.9	9.9
	Angus	620	657	695	657	59.4	59.9	61.2	60.2	11.8	11.9	12.6	12.1	10.8	11.5	12.7	11.7
	Average	605	648	682	645	58.6	59.7	60.5	59.6	11.2	11.7	11.9	11.6	9.8	11.2	11.3	10.8
Tarentaise	Hereford	602	639	677	639	59.8	60.8	60.7	60.4	10.5	11.3	11.0	10.9	8.9	9.6	10.4	9.6
	Angus	624	658	691	658	60.7	61.5	61.6	61.3	10.9	11.4	12.1	11.4	9.5	10.0	11.5	10.3
	Average	613	649	684	649	60.2	61.2	61.1	60.8	10.7	11.3	11.5	11.2	9.2	9.8	10.9	10.0
Average of all sires	Hereford	596	636	678	637	59.5	60.6	61.0	60.4	10.7	11.0	11.4	11.0	11.1	9.8	10.5	9.8
	Angus	617	657	691	655	60.5	61.4	61.7	61.2	11.1	11.7	12.0	11.6	11.6	10.9	11.4	10.6
	Average	606	646	684	646	60.0	61.0	61.4	60.8	10.9	11.3	11.7	11.3	9.4	10.3	11.0	10.2

[a]Dressing percentage equals hot carcass weight divided by final weight on feed and water (without shrink).

[b]U.S.D.A. quality grade as revised in 1976. 10 = average good, 11 = high good, 12 = low choice, 13 = average choice, etc.

[c]Marbling Score; 9 = slight+, 10 = small-,....21 = slightly abundant+.

Table 18.3. Yield grades, rib eye areas, fat thicknesses, and estimated kidney, pelvic, and heart fat percentages of different crossbred types.

Breed of steer		U.S.D.A. yield grade				Ribeye area, sq. in.				Fat thickness, in.				Est. kidney, pelvic and heart fat, %			
Sire	Dam	S1	S2	S3	Avg	S1	S2	S3	Avg	S1	S2	S3	Avg	S1	S2	S3	Avg
Angus	Hereford	3.2	3.7	4.0	3.6	10.8	10.7	11.0	10.8	.52	.60	.68	.60	3.0	3.4	3.4	3.3
Hereford	Angus	3.6	3.9	4.2	3.9	10.6	10.8	11.0	10.8	.65	.68	.74	.69	2.8	3.3	3.5	3.2
	Average	3.4	3.8	4.1	3.8	10.7	10.8	11.0	10.8	.58	.64	.71	.65	2.9	3.3	3.4	3.2
Brahman	Hereford	3.2	3.3	3.8	3.4	10.5	10.9	10.8	10.7	.43	.49	.57	.50	3.1	3.1	3.7	3.3
	Angus	3.5	3.9	3.9	3.8	10.8	11.2	11.4	11.1	.52	.64	.63	.60	3.6	3.9	4.1	3.9
	Average	3.3	3.6	3.9	3.6	10.6	11.0	11.1	10.9	.48	.56	.60	.55	3.3	3.5	3.9	3.6
Sahiwal	Hereford	3.1	3.2	3.6	3.3	10.2	10.5	10.9	10.5	.45	.47	.54	.49	2.8	2.8	3.6	3.1
	Angus	3.3	3.6	3.6	3.5	10.5	10.9	11.2	10.9	.52	.61	.62	.58	3.4	3.5	3.7	3.5
	Average	3.2	3.4	3.6	3.4	10.4	10.7	11.0	10.7	.48	.54	.58	.53	3.1	3.1	3.6	3.3
Pinzgauer	Hereford	2.7	3.0	3.2	3.0	10.9	11.1	11.4	11.2	.33	.42	.48	.41	3.1	3.1	3.4	3.2
	Angus	3.1	3.4	3.7	3.4	11.1	11.5	11.7	11.5	.46	.51	.61	.52	3.4	3.9	4.2	3.9
	Average	2.9	3.2	3.5	3.2	11.0	11.3	11.6	11.3	.40	.47	.54	.47	3.3	3.5	3.8	3.5
Tarentaise	Hereford	2.9	2.8	3.7	3.1	10.7	11.3	11.1	11.0	.36	.33	.52	.40	3.4	3.4	4.1	3.6
	Angus	3.2	3.5	3.7	3.5	10.9	11.4	11.4	11.2	.41	.51	.52	.48	3.9	4.4	4.7	4.3
	Average	3.0	3.1	3.7	3.3	10.8	11.3	11.3	11.1	.38	.42	.52	.44	3.7	3.9	4.4	4.0
Average of all sires	Hereford	3.0	3.2	3.6	3.3	10.6	10.9	11.0	10.8	.42	.46	.56	.48	3.1	3.2	3.6	3.3
	Angus	3.3	3.6	3.8	3.6	10.8	11.2	11.3	11.1	.51	.59	.62	.57	3.4	3.8	4.0	3.7
	Average	3.2	3.4	3.7	3.4	10.7	11.0	11.2	11.0	.46	.53	.59	.53	3.3	3.5	3.8	3.5

Table 18.4. Carcass percentages of retail product, fat trim, and bone of different crossbred types.[a]

Breed of steer		Retail product, %[b]				Fat trim, %				Bone, %			
Sire	Dam	S1	S2	S3	Avg	S1	S2	S3	Avg	S1	S2	S3	Avg
Angus	Hereford	69.2	66.4	63.5	66.3	18.3	21.6	24.8	21.6	12.5	12.0	11.7	12.1
Hereford	Angus	67.3	65.0	62.8	65.0	20.6	23.3	25.8	23.2	12.1	11.7	11.4	11.8
	Average	68.3	65.7	63.1	65.7	19.4	22.5	25.3	22.4	12.3	11.9	11.6	11.9
Brahman	Hereford	70.5	69.3	66.3	68.7	16.0	17.8	21.1	18.3	13.5	12.9	12.6	13.0
	Angus	69.4	67.2	65.3	67.3	18.1	21.0	22.8	20.6	12.5	11.8	11.8	12.0
	Average	70.0	68.2	65.8	68.0	17.0	19.4	22.0	19.5	13.0	12.4	12.2	12.5
Sahiwal	Hereford	70.9	69.4	66.3	68.9	15.9	17.5	21.3	18.2	13.2	13.1	12.4	12.9
	Angus	69.4	67.6	65.3	67.4	18.2	20.8	23.1	20.7	12.4	11.6	11.6	11.9
	Average	70.1	68.5	65.8	68.1	17.1	19.2	22.2	19.5	12.8	12.4	12.0	12.4
Pinzgauer	Hereford	70.9	69.1	66.8	68.9	15.3	17.5	20.1	17.6	13.7	13.5	13.1	13.4
	Angus	69.3	67.6	64.5	67.1	17.7	19.6	23.6	20.3	13.0	12.9	12.0	12.6
	Average	70.1	68.3	65.6	68.0	16.5	18.5	21.8	19.0	13.4	13.2	12.5	13.0
Tarentaise	Hereford	70.1	69.4	66.1	68.5	16.7	17.2	22.0	18.6	13.1	13.4	11.9	12.8
	Angus	70.2	67.3	65.1	67.5	17.5	20.7	23.2	20.5	12.4	12.0	11.7	12.0
	Average	70.2	68.3	65.6	68.0	17.1	19.0	22.6	19.6	12.7	12.7	11.8	12.4
Average of all sires	Hereford	70.3	68.7	65.8	68.3	16.5	18.3	21.9	18.9	13.2	13.0	12.3	12.8
	Angus	69.1	66.9	64.6	66.9	18.4	21.2	23.7	21.1	12.5	12.0	11.7	12.1
	Average	69.7	67.8	65.2	67.6	17.4	19.7	22.8	20.0	12.9	12.5	12.0	12.5

[a] Detailed carcass cutout data obtained on an average of 45 steers per sire breed by slaughter group subclass for all sire breeds except Tarentaise (average of 34 were included in each slaughter group.

[b] Retail product, % = Actual yield of boneless, closely trimmed beef from the carcass.

Table 18.5. Warner-Bratzler shear values and taste panel scores of rib steaks from different crossbred types.

Breed of steer		W-B shear, lb.[a]				T.P. tenderness[b]				T.P. flavor[b]				T.P. juiciness[b]			
Sire	Dam	S1	S2	S3	Avg	S1	S2	S3	Avg	S1	S2	S3	Avg	S1	S2	S3	Avg
Angus	Hereford	7.2	7.4	6.5	7.0	7.4	7.3	7.6	7.4	7.2	7.3	7.3	7.3	7.3	7.3	7.5	7.4
Hereford	Angus	7.4	7.9	6.9	7.4	7.2	7.1	7.5	7.2	7.1	7.0	7.0	7.0	7.1	7.1	7.1	7.1
	Average	7.3	7.7	6.7	7.2	7.3	7.2	7.5	7.3	7.1	7.1	7.1	7.1	7.2	7.2	7.3	7.2
Brahman	Hereford	9.4	8.8	7.3	8.5	5.9	6.1	6.6	6.2	6.9	6.9	7.2	7.0	6.4	6.8	6.9	6.7
	Angus	9.4	8.6	7.5	8.5	6.5	6.4	7.0	6.6	7.0	7.0	7.0	7.0	7.0	7.1	6.8	7.0
	Average	9.4	8.7	7.4	8.5	6.2	6.3	6.8	6.4	6.9	7.0	7.1	7.0	6.7	7.0	6.8	6.8
Sahiwal	Hereford	9.9	10.1	8.3	9.4	5.6	4.9	6.1	5.5	6.8	6.8	6.9	6.9	6.8	6.8	6.9	6.8
	Angus	9.9	9.4	8.1	9.1	6.1	5.9	6.3	6.1	7.0	6.9	6.9	6.9	6.9	6.9	7.0	6.9
	Average	9.9	9.8	8.2	9.3	5.8	5.4	6.2	5.8	6.9	6.9	6.9	6.9	6.9	6.8	7.0	6.9
Pinzgauer	Hereford	8.4	7.3	7.0	7.6	7.0	7.0	7.4	7.1	7.2	7.3	7.3	7.2	7.2	7.1	7.3	7.2
	Angus	7.9	7.0	6.5	7.1	6.5	7.2	7.6	7.1	6.9	7.2	7.2	7.1	6.8	7.1	7.4	7.1
	Average	8.1	7.2	6.7	7.3	6.8	7.1	7.5	7.1	7.1	7.2	7.3	7.2	7.0	7.1	7.3	7.1
Tarentaise	Hereford	8.9	7.4	7.6	8.0	6.2	6.7	6.9	6.6	6.9	7.0	7.3	7.1	6.9	6.9	7.0	6.9
	Angus	9.4	8.2	7.0	8.2	6.2	6.9	7.2	6.7	7.1	7.3	7.1	7.2	6.9	7.0	7.1	7.0
	Average	9.1	7.8	7.3	8.1	6.2	6.8	7.0	6.7	7.0	7.2	7.2	7.1	6.9	7.0	7.0	7.0
Average of all sires	Hereford	8.7	8.2	7.3	8.1	6.4	6.4	6.9	6.6	7.0	7.1	7.2	7.1	6.9	7.0	7.1	7.0
	Angus	8.8	8.2	7.2	8.1	6.5	6.7	7.1	6.8	7.0	7.0	7.0	7.0	6.9	7.1	7.1	7.0
	Average	8.8	8.2	7.2	8.1	6.5	6.5	7.0	6.7	7.0	7.1	7.1	7.1	6.9	7.0	7.1	7.0

[a] Warner-Bratzler shear is a measure of the pounds of force required to shear one-half inch cores of steaks cooked at 350°F to 150°F internal temperature and cooled for 30 minutes at room temperature. Warner-Bratzler shear was measured on the same steers from which detailed carcass cutout data were obtained.

[b] Taste panel scores are based on a 9-point scale, with higher scores indicating more flavor, juiciness, or tenderness. Traits taste panel members evaluated were measured on steaks from an average of 6 steers per sire-dam breed group per slaughter date per year.

Processing Retail Beef Cuts from Boxed Beef

Mark O. Leafgreen and John H. McCoy

Summary

This analysis measured efficiencies of a centralized retail meat-fabrication facility receiving all beef as boxed or as carcasses. Moving vacuum-packaged, boxed-beef subprimals through a central meat processing facility was more efficient than a corresponding operation with beef carcasses. Boxed beef saved approximately 6.0 cents per pound on wholesale cuts.

Introduction

Since boxed beef was developed, several studies have compared its costs with other beef distribution techniques. Several studies of various methods of distributing beef reported a centrally located facility that processed carcass beef for a number of retail outlets cost the least. We compared results from processing boxed and carcass beef in a centrally located facility.

Methods

A relatively small retail food chain operating a central meat facility processing beef carcasses cooperated. It averaged 100,000 pounds of beef, pork, and poultry (65% beef, 35% pork and poultry) per week, distributed through 16 retail stores. We assumed that converting to boxed beef would make no change in pork and poultry operations. Data were calculated from 1973 to 1977.

Investment costs, operating expenses, and revenues for the central facility were estimated for an operation handling carcass beef and simulated for a corresponding operation using boxed beef. Operating efficiencies were estimated by calculating the ratio of the return on investment of a processing facility using boxed beef to that of a facility using carcass beef. Operating efficiencies were then translated and reported on an average savings per pound of wholesale cuts. In our analysis, 650 lbs. of carcass beef yielded 556 lbs. of vacuum packaged primals and wholesale cuts.

Results and Discussion

Our analysis suggests that a centralized retail meat processing facility receiving boxed beef uses resources 2.6 times more efficiently than an identical system receiving carcass beef. Operating efficiencies increased because resources used in marketing beef decreased markedly while the quantity of beef marketed decreased only slightly. Cost reductions come from the following average savings per pound of wholesale cuts processed:

1) Reduced labor requirements - 0.6 cent
2) Reduced transportation cost - .03 cent
3) Reduced handling cost - 0.06 cent
4) Reduced product shrinkage -1.6 cents
5) Reduced purchase cost - 3.3 cents

Total average savings for the boxed beef technique is approximately 6.0 cents per pound of wholesale cuts, or $33.36 (6 cents x 556 lbs.) per carcass.

If a centralized retail meat processing facility converted from beef carcasses to boxed beef, maximum savings would be limited by excess building capacity, and equipment designed for earlier technologies. However, if an organization built a new central processing plant specifically designed to fabricate retail cuts from boxed beef, savings would come from reduced inventory space requirements, decreased refrigeration and building costs, and fewer meat cutters unless prevented by labor-management contracts.

By 1980 boxed beef will account for almost 80% of the beef received by retailers. Carcasses weighing 600-700 lbs. are processed after chilling for 24 to 72 hrs. Excess fat and frequently all the bone are removed from the wholesale cuts, or their subdivisions before they are vacuum packed in clear plastic bags. Lean trim destined for ground beef is handled similarly. Packages are packed in boxes of 50 to 75 lbs., which may contain all one cut or may be mixed. Vacuum-packaged boxed beef may be stored at 30°F for up to 6 weeks, although 7 to 10 days storage is more likely. Aging proceeds during storage, the same as in carcass beef.

Nutritional Effects on Beef Palatability

D. E. Burson, M. C. Hunt, L. H. Hayward
C. L. Kastner, D. H. Kropf, and D. M. Allen

Summary

We assigned 112 Angus yearling steers to 14 nutritional treatments including control, submaintenance, and 12 different combinations of ration energy (low, medium or high) and feeding period (56, 91, 119, 147, or 175 days). Boneless rib steaks were evaluated by a trained taste panel and Instron Warner-Bratzler shear.

Average daily gains increased as energy level increased. Slaughter weight, and USDA quality and yield grades increased as both ration energy and days fed increased.

Taste panel scores were not significantly affected by ration energy level, but muscle fiber tenderness, juiciness, flavor and overall tenderness scores tended to increase as days fed increased.

Peak shear force was not affected by ration energy level or days fed.

Introduction

Economic and social pressures have focused interest on feeding beef cattle less grain and on consumers' acceptance of beef thus produced. This study relates ration energy (grain) inputs and days on feed to beef-eating quality as determined by a trained taste panel.

Procedure

We put 112 Angus yearling steers of similar background on feed after a 21-day adjustment period. Eight were randomly assigned to each of 14 nutritional treatments. The control group was slaughtered at the start of the experiment; another group (submaintenance) was fed prairie hay for 28 days, then slaughtered. The 12 remaining groups were fed low, medium, or high energy rations (Table 20.1) and slaughtered at a commercial packing plant) after 56, 91, 119, 147 (medium and high energy rations only), or 175 (high energy ration only) days on feed.

Ribs were delivered to Kansas State University Meats Laboratory and steaks were cut seven days postmortem.

Taste panel and shear evaluations of boneless rib steaks (longissimus muscle) were analyzed by American Meat Science Assocation guidelines.

Results

Slaughter weights, average daily gains, and USDA yield and quality grades increased with increasing ration energy (Table 20.2), but peak shear forces and muscle fiber tenderness, detectable connective tissue, juiciness, flavor and overall tenderness scores were not significantly affected by ration energy level.

Slaughter weights and USDA yield and quality grades increased with increasing days on feed (Table 20.3). Taste panel scores for muscle fiber tenderness, juiciness, flavor and overall tenderness, tended to improve with longer feeding time. Peak shear force differences were small and followed no consistent pattern related to days fed. Increasing days on feed did not greatly improve eating quality. However, meat from steers fed 56 days is not necessarily equivalent to that from steers fed 175 days, as ultimate consumer acceptance also depends on factors such as display color stability, muscle size, and, under the present marketing system, USDA quality grade.

Table 20.1. Ration components (% on as-fed basis).

Ingredient	Energy level[a] Low	Medium	High
Corn	17.9	27.1	38.6
Wheat	17.9	27.1	38.6
Sorghum silage	16.8	16.5	16.3
Prairie hay	42.9	24.2	0
Supplement[b]	4.6	5.0	6.4

[a]Calculated to contain 35, 45, and 58 megacal NEp/100 lbs., respectively. Expected daily gains of 1.1, 2.2, and 3.3 lbs./day, respectively.

[b]Included soybean meal, ground limestone, dicalcium phosphate, salt, trace minerals, and vitamins.

Table 20.2. Taste panel, shear, carcass, and performance means for indicated ration energy level groups.

Criteria	Control	Submaintenance	Ration energy level		
			Low	Medium	High
Slaughter weight (lbs.)	573.2	630.1	741.1	857.6	908.5
Average daily gain (lbs/day)		-0.46	1.78	2.60	3.00
USDA quality grade[a]	St[65]	St[40]	St[60]	G[24]	G[60]
USDA yield grade	1.4	1.6	1.5	2.0	2.5
Taste panel trait[b]					
Muscle fiber tenderness	6.8	6.8	6.8	6.8	6.9
Detectable connective tissue	6.8	6.5	7.0	7.1	7.0
Overall tenderness	6.7	6.6	6.7	6.8	6.8
Juiciness	6.4	6.4	6.0	6.0	6.1
Flavor	6.5	6.8	6.4	6.4	6.5
Peak shear force (lbs.)	4.37	4.76	4.54	4.74	4.59

[a] St = Standard, G = Good; 01 - 33 = low, 34 - 66 = average, 67 - 100 = high.
[b] Scores based on an 8 point scale (1 = abundant connective tissue, extremely tough, dry, or bland flavor, 8 = no connective tissue, extremely tender, juicy, or intense flavor) for each factor.

Table 20.3. Taste panel, shear, carcass, and performance means for days on feed before slaughter.

Criteria	Days on feed[a]				
	56	91	117	147	175
Slaughter weight (lb)	744.9	793.0	863.8	991.6	1025.1
Average daily gains (lbs/day)	2.80	2.36	2.34	2.78	2.67
USDA quality grade[b]	St[65]	G[06]	G[28]	G[87]	C[08]
USDA yield grade	1.3	2.0	2.0	2.9	3.4
Taste panel traits[c]					
Muscle fiber tenderness	6.9	6.8	6.8	6.7	7.2
Detectable connective tissue	7.0	7.1	7.0	7.0	7.1
Overall tenderness	6.8	6.8	6.8	6.7	7.1
Juiciness	5.9	5.9	6.0	6.1	6.4
Flavor	6.3	6.3	6.5	6.4	6.6
Peak shear force (lbs.)	4.21	5.05	4.67	4.96	3.79

[a] Means for low, medium and high energy levels except at 147 days (medium and high energy only) and 175 days (high energy only).
[b] St = Standard, G = good, C = choice; 01 - 33 = low, 34 - 66 = average, 67 - 100 = high.
[c] Scores based on an 8 point scale (2 = abundant connective tissue, extremely tough, dry or bland flavor; 8 = no connective tissue, extremely tender, juicy, or intense flavor) for each factor.

Mechanical Blade Tenderization of Meat

D. E. Burson, L. H. Hayward, M. C. Hunt,
C. L. Kastner, and D. H. Kropf

Summary

We randomly assigned 112 Angus yearling steers to 14 nutritional groups fed varied ration energy levels and varied lengths of time. Blade tenderized and non-tenderized boneless rib steaks were evaluated by a taste panel and a mechanical (Instron) shearing technique.

Blade tenderizing significantly improved taste panel scores for both muscle fiber and overall tenderness and decreased the amount of detectable connective tissue, but did not affect juiciness and flavor scores. Peak shear force decreased with blade tenderization; but total cooking loss increased. Blade tenderizing narrowed the range of detectable connective tissue scores for ration energy level groups, leading to more uniform palatability.

Introduction

Mechanical blade tenderization is the most widely used mechanical tenderization method. Boneless or bone-in cuts are tenderized by one or more passes through a machine where rows of blades "puncture" the muscle and connective tissue. The process improves tenderness of table grade cuts, equalizes tenderness within a cut containing several muscles, and improves tenderness of lower grade cuts.

Procedure

We randomly assigned 112 Angus yearling steers to one of 14 nutritional groups (8 per group) including controls, submaintenance and low, medium, and high energy rations (34, 45, or 58 megacalories NEp per 100 lbs. ration) fed for 28, 56, 91, 119, 147, or 175 days. Carcass and ration information were given on page 79 of the 1978 Cattlemen's Day Report.

Boneless rib steaks (longissimus muscle) for taste panel and shear evaluations were cut seven days postmortem. Remaining rib eye portions were tenderized by one pass through a Ross mechanical tenderizer (37 punctures/square inch). Additional steaks were cut for taste panel and shearing. Steaks were cooked, evaluated, and sheared by American Meat Science Association guidelines. A six member trained taste panel scored steaks for muscle fiber tenderness, detectable connective tissue, juiciness, flavor, and overall tenderness. Half-inch diameter cores were sheared with an Instron model 1123 equipped with a Warner-Bratzler head.

Results

Taste panel tenderness improved and detectable connective tissue decreased with blade tenderization (Table 21.1), but juiciness and flavor scores were not affected. Peak shear force decreased with blade tenderization, which agreed with taste panel tenderness scores. Although blade tenderization increased cooking loss 2 percent, it did not affect juiciness scores.

Effects of blade tenderization by ration group means on detectable connective tissue are shown in Figure 21.1. Greatest improvement in connective tissue scores was achieved by blade tenderizing the less tender control and submaintenance steaks.

The narrower range of detectable connective tissue scores for blade tenderized control, submaintenance and low, medium, and high ration energy steaks indicates more uniform palatability. The meat industry could use blade tenderization to improve tenderness of lower grade or less tender cuts or muscles and to "assure" tenderness of higher grades-cuts.

Table 21.1. Taste panel and objective scores (means) for nontenderized and blade-tenderized, beef boneless rib steaks.

Criteria	Non-tenderized	Blade tenderized	Significance level
Taste panel traits[a]			
Muscle fiber tenderness	6.8	7.2	.01
Detectable connective tissue	7.0	7.2	.01
Overall tenderness	6.8	7.2	.01
Juiciness	6.1	6.2	.66
Flavor	6.5	6.5	.11
Peak shear force (lb)	4.63	4.08	.01
Total cooking loss (%)	21.05	23.18	.01

[a]Scores based on 8 point scale (1 = abundant connective tissue, extremely tough, dry, or bland flavor; 8 = no connective tissue residue, extremely tender, juicy, or intense flavor) for each factor.

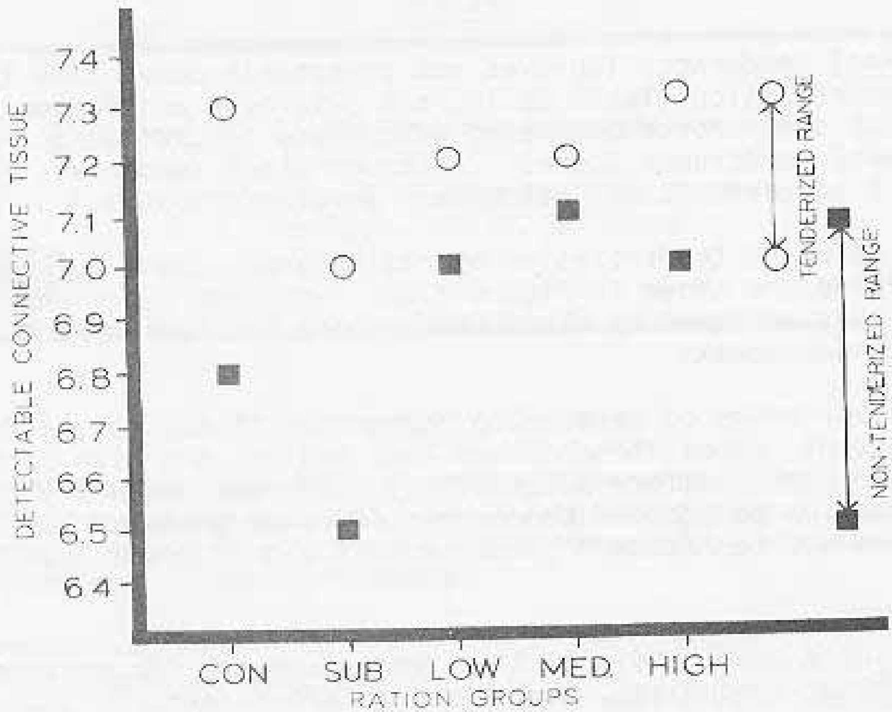
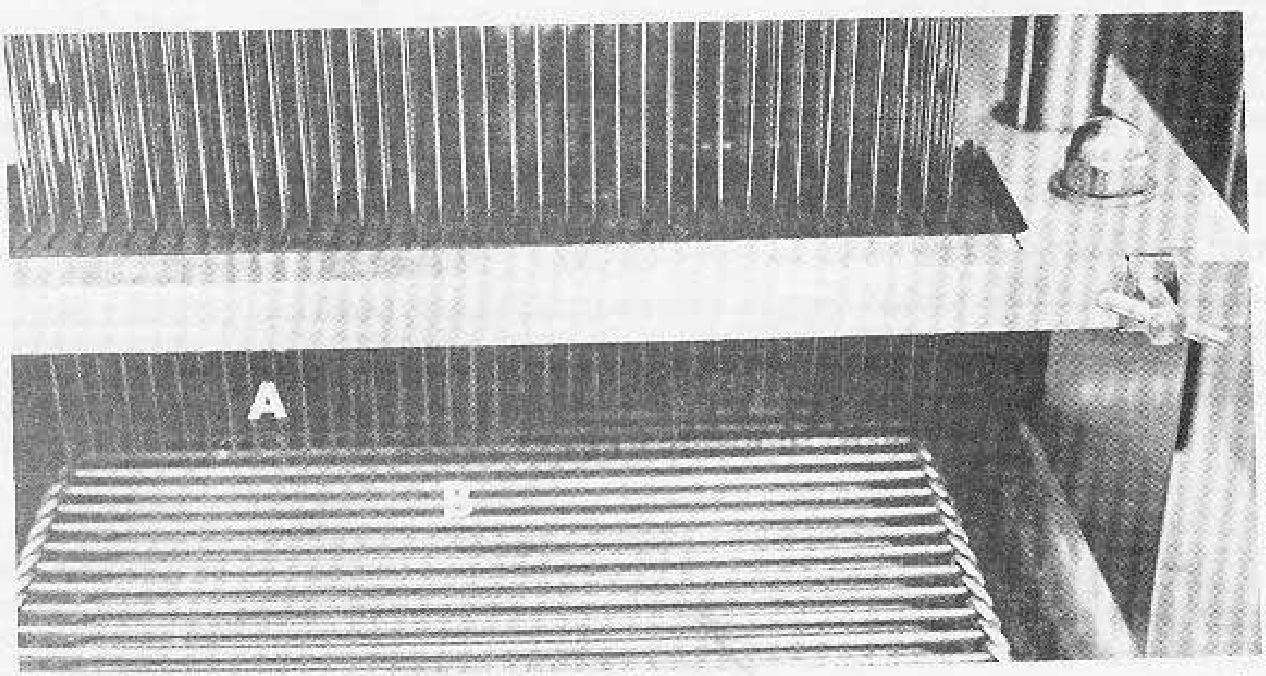


Figure 21.1. Effects of blade tenderizing on detectable connective tissue in ribeye steaks from cattle of control, submaintenance, low, medium, or high energy ration groups. O = tenderized; = non-tenderized; 6 = traces of detectable connective tissue; 7 = practically no detectable connective tissue.



Blade Tenderizer. Blades (A) move up and down puncturing the meat as it passes through on the conveyor (B).

Rumen Bacterial Endotoxins and Their Possible Role in the Sudden-death Syndrome

T. G. Nagaraja, Erle Bartley, Lou Fina,
Harry Anthony, and Horst Leipold

Summary

We have found that rumen bacteria contain endotoxins that are released into rumen fluid. Also rumen fluid from grain-fed cattle contains considerably more free endotoxin than rumen fluid from hay-fed cattle. Injecting cattle with rumen bacterial endotoxin produced endotoxic or anaphylactic shock. We believe that rumen bacterial endotoxins may be involved with such diseases associated with high-grain feeding as the sudden death syndrome.

Introduction

Bovine sudden death syndrome (SDS) is a fatal disease of unknown origin, chiefly affecting healthy feedlot cattle that have been on high energy grain rations for more than 100 days. Affected animals stop eating, step back, and die with no other clinical sign. We have been trying for seven years to determine what causes SDS. One of the first areas we investigated was rumen metabolism, because we thought some end-products of rumen fermentation in cattle fed high energy rations might be toxic. We found none that could be linked to SDS. Then we investigated the role of rumen bacteria, thinking rumen gram negative bacteria might release endotoxin, which when absorbed might cause shock and sudden death.

Procedure and Results

We obtained samples of rumen contents from hay-fed and grain-fed cattle, extracted the bacterial fraction and tested it by standard procedures for endotoxin. The purified extract was endotoxic based on the following characteristics: 1. Proved lethal to mice and chick embryos. Toxicity in mice was increased by actinomycin D (an established characteristic of endotoxins). 2. Made mice more susceptable to streptococcal infection.
3. Caused a characteristic fever and white blood cell response in rabbits.
4. Caused local tissue degeneration in rabbits after a sensitizing dose.
5. Caused gelation of limulus lysate (a test for estimating endotoxin).

Those tests confirmed that rumen bacteria contained endotoxin. Next we had to determine if the endotoxin was released from the bacteria. Unless it is released, it could not be absorbed or cause a problem.

We looked for endotoxin in rumen fluid from hay- and from grain-fed cattle. Using the tests just described, we consistently demonstrated that endotoxin had been released from rumen bacteria. Additionally, we found more free endotoxin in grain-fed than in hay-fed cattle. Certain factors, still unknown, may favor release of endotoxin from rumen bacteria when cattle are fed large quantities of grain.

To determine the effect of rumen endotoxin on cattle, we intravenously injected 3- to 7-month-old calves with rumen endotoxin in doses from .5 to 2 mg per lb. body weight. Calves that did not die of endotoxin toxicity were reinjected on the 15th day to see if the second injection caused anaphylactic shock, on the assumption that a nonfatal first injection might sensitize all animals so the next dose caused anaphylaxis.

After the first injection, signs were typical of endotoxin poisoning. Within a few minutes the calves showed rapid and labored breathing and they usually collapsed on their sides in about 30 minutes. The various first doses we tested did not kill any calf.

When the animals were reinjected the 15th day, response was more dramatic. The signs were similar, but happened strikingly sooner. Before the needle was removed from the jugular vein, the animals were down in shock, gasping for breath. Two of 8 calves died, but the remaining 6 recovered in a few hours. Blood samples taken after the first and second injections were characteristic of endotoxin poisoning. The 6 calves that survived the second endotoxin dose were killed after 24 hours and posted. The hemorrhagic lesions we observed were typical of endotoxin poisoning. The most significant damage was in the lungs. Bronchial constriction was the most typical lesion. Because the lungs are the target organ for anaphylaxis in cattle, our findings suggest that we probably sensitized the calves with the first injection of endotoxin and then produced anaphylaxis after the second injection.

Discussion

Free endotoxin in rumen fluid and its higher concentration in grain-fed cattle suggests that rumen bacterial endotoxin is involved in diseases, like lactic acidosis or the sudden-death syndrome, that are associated with high-grain feeding. The fate of free endotoxin from the rumen is not known. It may be absorbed and detoxified in the liver or passed on to the abomasum and small intestine where it may be inactivated by acid or enzymes or absorbed into the portal blood. There is no evidence that endotoxin may be absorbed through the rumen lining. However, absorption from the rumen cannot be ruled out in conditions like ruminitis and lactic acidosis where the rumen lining is inflamed or damaged. The sudden release of large quantities of endotoxin in the rumen, if rapidly absorbed by damaged rumen lining, could produce endotoxic or anaphylactic shock--and sudden death of cattle.

Effects of Rumensin[1] or Lasalocid[2] on Rumen Fermentation in Vitro

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Summary

A series of artificial-rumen studies tested effects of Rumensin and lasalocid on rumen fermentation. At concentrations of 22, 44, and 66 ppm both depressed microbial protein synthesis. Both severely inhibited protein synthesis at 176 ppm. Both increased propionic acid and decreased acetic acid concentrations. However, only Rumensin increased lactic acid. Both inhibited total gas production and decreased the percentage of methane. We concluded that lasalocid and Rumensin have similar effects on rumen fermentation.

Introduction

Rumensin (monensin sodium) and lasalocid sodium are both polyether antibiotics that have been used as anticoccidials in poultry rations. Because Rumensin has improved feed efficiency in beef cattle, we compared it with lasalocid, although lasalocid is not approved for ruminant animals.

Procedure

Rumen fluid was taken from a rumen-fistulated Angus X Holstein steer before the morning feeding. The steer was fed twice daily 12 lb. of alfalfa hay and 10 lb. of a concentrate mixture containing 80.3% sorghum grain, 9.0% soybean meal, 8.0% Starea-70, 2.0% dicalcium phosphate, 0.5% trace mineralized salt, and .2% vitamin A and D supplement. The rumen fluid was strained immediately through two layers of cheesecloth and the pH determined. To 1.0 g substrate (67% ground corn, 25% brome hay, 8% Starea-70), previously weighed into 50-ml, plastic centrifuge tubes, was added 10 ml rumen fluid and 20 ml mineral buffer. The tubes were flushed with CO_2, capped with Bunsen valves, and incubated for 6 hr at 39 C. The quantity of microbial protein synthesized during fermentation was determined by the method of Barr et al. (J. Dairy Sci. 58:1308). The dried microbial fraction was analyzed for amino acids.

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[1]A product of Elanco Products Co., Indianapolis, IN.

[2]A product of Hoffman-LaRoche Inc., Nutley, NJ. Presently lasalocid is approved for poultry <u>but not for ruminants</u>.

Five grams of substrate, 100 ml buffer, and 50 ml rumen fluid were incubated in a water bath (39 C) for 6 hours. Gas production was measured, and samples of headspace gas were analyzed for hydrogen, carbon dioxide, and methane by gas chromotography. At the same time pH of the fermentation mixture was determined and samples were saved for determination of lactic and volatile fatty acids.

Both Rumensin and lasalocid were added at 0, 22, 44, 88, and 176 ppm of substrate. The experiment was repeated four times with each antibiotic. Each dose was tested in duplicate.

Results

Both antibiotics decreased microbial protein synthesis (Table 23.1). The decrease in synthesis at 44 ppm or more was proportional to the increase in antibiotic concentration.

Gas production was increased by both Rumensin and lasalocid, particularly at the lower concentrations (Table 23.1). When those two antibiotics were used, the organisms apparently fermented the substrate without synthesizing protein efficiently.

Rumensin and lasalocid decreased the proportion of methane and increased the proportion of carbon dioxide (CO_2) in rumen gas (Table 23.1). Lasalocid decreased methane (CH_4) more than did Rumensin.

Both Rumensin and lasalocid increased rumen propionic and decreased acetic acid (Table 23.2). Neither Rumensin nor lasalocid increased volatile fatty acid production. Rumensin significantly increased lactic acid production.

Discussion

As previously observed, Rumensin decreased rumen acetic production, increased propionic acid production, and depressed methane production. The effects of lasalocid were similar to those of Rumensin, except that lasalocid did not enhance lactic acid production.

Both Rumensin and lasalocid inhibited microbial protein production. Van Nevel and Demeyer reported a similar effect of monensin on microbial protein synthesis (Appl. and Environmental Microbiol. 34:251).

It appears that Rumensin decreases degredation of protein to ammonia. Because most rumen microorganisms prefer ammonia as a nitrogen source to peptides or amino acids, microbial protein synthesis is reduced.

We concluded that lasalocid and Rumensin affect the rumen fermentation similarly. Studies by Davis (70th Ann. Meet. American Soc. Anim. Sci. p. 414) and preliminary studies conducted here showed that, like Rumensin, lasalocid decreases feed intake and improves feed efficiency. If cleared by the Food and Drug Administration for use with ruminants, lasalocid could be substituted for Rumensin.

Table 23.1. Effects of Rumensin and lasalocid on gas production, carbon dioxide to methane ratio, and microbial protein synthesis.

Drug content of substrate	Monensin Gas production	Monensin CO_2/CH_4 ratio	Monensin Protein synthesis[a]	Lasalocid Gas production	Lasalocid CO_2/CH_4 ratio	Lasalocid Protein synthesis
ppm	(ml)		(mg)	(ml)		(mg)
0	158±35[b]	1.40±.19	16.3±1.2	106±13	1.34±.19	22.4±2.4
22	210±22	1.46±.11	10.5±1.8	143±6	1.56±.16	8.1± 3.1
44	195±20	1.76±.15	11.9±1.6	147±10	1.70±.11	12.5±1.0
88	193±14	1.62±.18	6.5± .4	133±8	1.96±.06	11.6± .6
176	189±13	1.73±.16	.7±.1	113±7	2.14±.18	5.2±1.4

[a]Milligrams microbial protein synthesized per gram of substrate.
[b]Mean ± standard error.

Table 23.2. Effects of Rumensin and lasalocid on lactic and volatile fatty acid production in rumen fluid.

Compound	Conc ppm	Acetic/propionic ratio	VFA concentration in molar % Acetic	Propionic	Butyric	Valeric	Total VFA μM/ml	Total lactate mg/ml
Rumensin	0	2.78 ± .17[a]	52.6 ± .6	18.8 ± .9	20.6 ± .5	8.0 ± .7	116.8 ± 5.2	1.0 ± .4
Rumensin	22	2.27 ± .08	49.0 ± .6	21.4 ± 1.1	21.9 ± 1.1	7.4 ± .4	119.9 ± 4.7	3.5 ± 2.7
Rumensin	44	2.11 ± .19	47.4 ± .5	23.5 ± 2.0	21.7 ± 1.6	8.0 ± .4	114.3 ± 4.3	9.3 ± .2
Rumensin	88	2.02 ± .11	48.4 ± .7	24.1 ± 1.1	20.0 ± 1.0	7.5 ± .1	115.3 ± 2.2	8.6 ± .4
Rumensin	176	1.80 ± .13	45.7 ± 1.6	25.6 ± 1.4	20.8 ± 1.5	7.9 ± .5	114.8 ± 2.8	8.7 ± .4
Lasalocid	0	2.35 ± .32	51.6 ± 2.3	22.7 ± 2.4	18.3 ± 1.1	7.4 ± 1.1	05.2 ± 9.0	3.4 ± 2.8
Lasalocid	22	2.24 ± .27	50.6 ± 2.6	22.9 ± 1.5	18.0 ± .8	8.5 ± .4	96.7 ± 10.9	3.8 ± 2.6
Lasalocid	44	1.65 ± .24	46.5 ± 2.8	28.5 ± 2.9	16.9 ± .9	8.2 ± .2	103.9 ± 4.0	4.6 ± 1.4
Lasalocid	88	1.65 ± .19	47.5 ± 2.3	29.2 ± 1.8	16.4 ± .5	6.9 ± .5	96.2 ± 9.8	1.8 ± 1.3
Lasalocid	176	2.37 ± .25	52.1 ± 1.8	22.4 ± 1.8	17.2 ± .9	8.1 ± .6	100.0 ± 1.9	3.3 ± 2.6

[a]Mean ± standard error.

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The Livestock and Meat Industry Council, Inc.

Funds generated by the Livestock and Meat Industry Council, Inc. have helped make many of the projects in this Cattlemen's Day Report possible. The Council is a non-profit, educational and charitable corporation that receives, pools and distributes funds for livestock and meat research and related activities in the Department of Animal Sciences and Industry. Over the past eight years, the almost one million dollars contributed have played an important role in the department's teaching, research and extension programs.

June 8, 1966, a tornado destroyed the department's beef, swine, and sheep field facilities. Emergency state and federal funds were used to rebuild, but funds were short for new equipment and to support the research in the new facilities. Thus, in September, 1968, industry leaders formed the Livestock and Meat Industry Committee to work for increased appropriations from the Legislature and to encourage individual contributions. The Livestock and Meat Industry Council, Inc. (LMIC) evolved from that committee.

Funds contributed to the Council are deposited with the Kansas State University Foundation and are used as directed by the Council's Board of Directors, or by its Project Review Committee that includes the Council's officers and KSU's Vice President for Agriculture, Director of the Agriculture Experiment Station, and the Head of the Department of Animal Sciences and Industry.

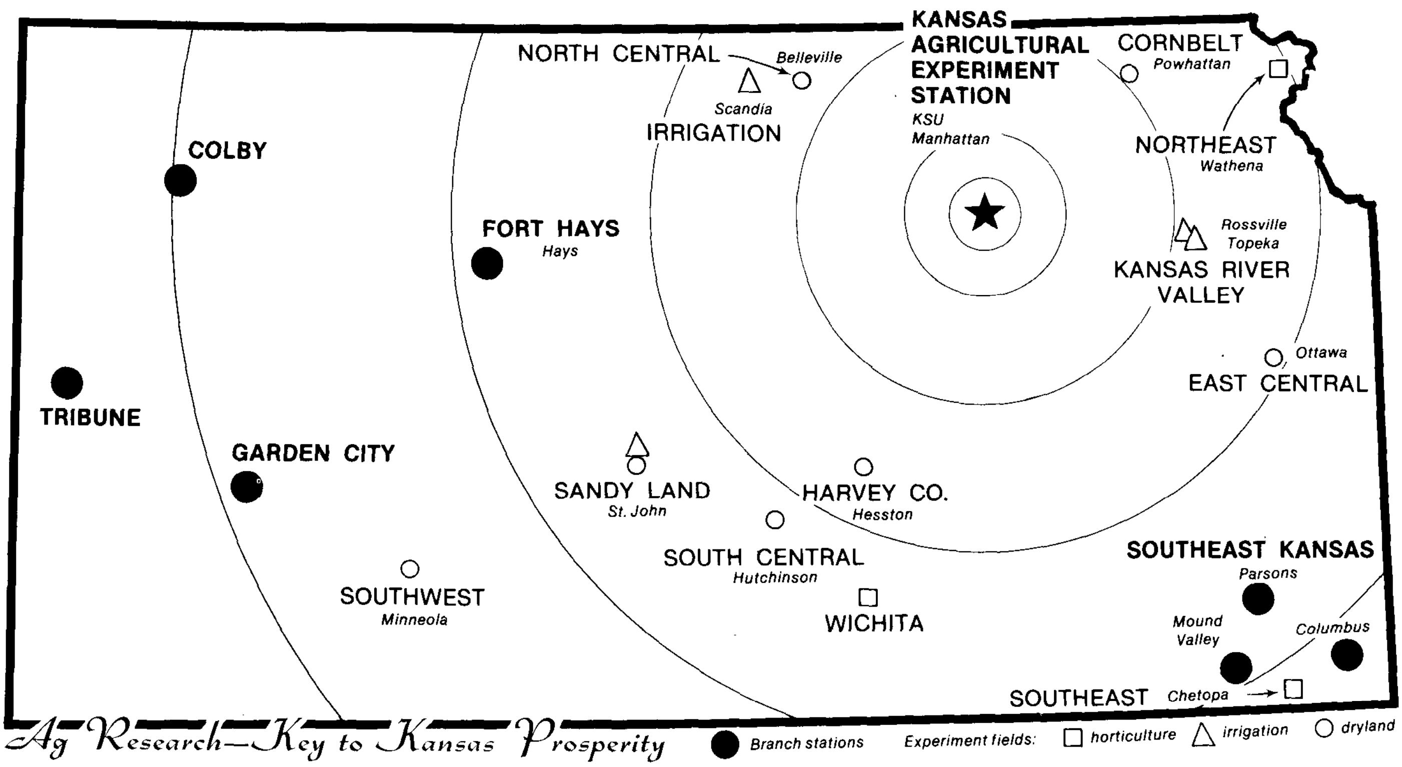
Officers and directors of the Livestock and Meat Industry Council are: Henry Gardiner, president and chairman; Walter Lewis, immediate past president; Calvin Drake, executive vice president; Fred Germann, secretary; Wayne Rogler, treasurer; and Earl Brookover, Charles Cooley, Orville Burtis, Jr., Kalo Hineman, W. C. Oltjen, Gene Watson, and A. G. Pickett.

Dr. Calvin L. Drake recently joined the Council as its executive vice president replacing Dr. A. D. "Dad" Weber, who will continue as a lifetime honorary director and special consultant.

The Council has established and funded a "cattle flow" project where large numbers of cattle can be studied experimentally under feedlot conditions. It financed studies on the "Buller Steer" syndrome, animal pesticides, frozen meat research, lipid metabolism, and environmental physiology. It has helped develop land for cow herd research, and through gifts in kind and monetary donations has provided research animals and equipment to the department. Teaching has been aided through a "Student Education" fund, a "Staff Improvement" fund that helps defray expenses of faculty educational sabbatical leaves, and contributions to the department's Staff Memorial Library, especially through the Rogler Memorial Book Collection.

Because the need is crucial, the LMIC is asking stockmen, agri-businesses, and friends of the livestock and meat industry for liberal contributions. All contributions, including gifts in kind, are tax-deductible and all active contributors become Council members. Checks should be made to the KSU Foundation, LMIC Fund and mailed to:

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



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