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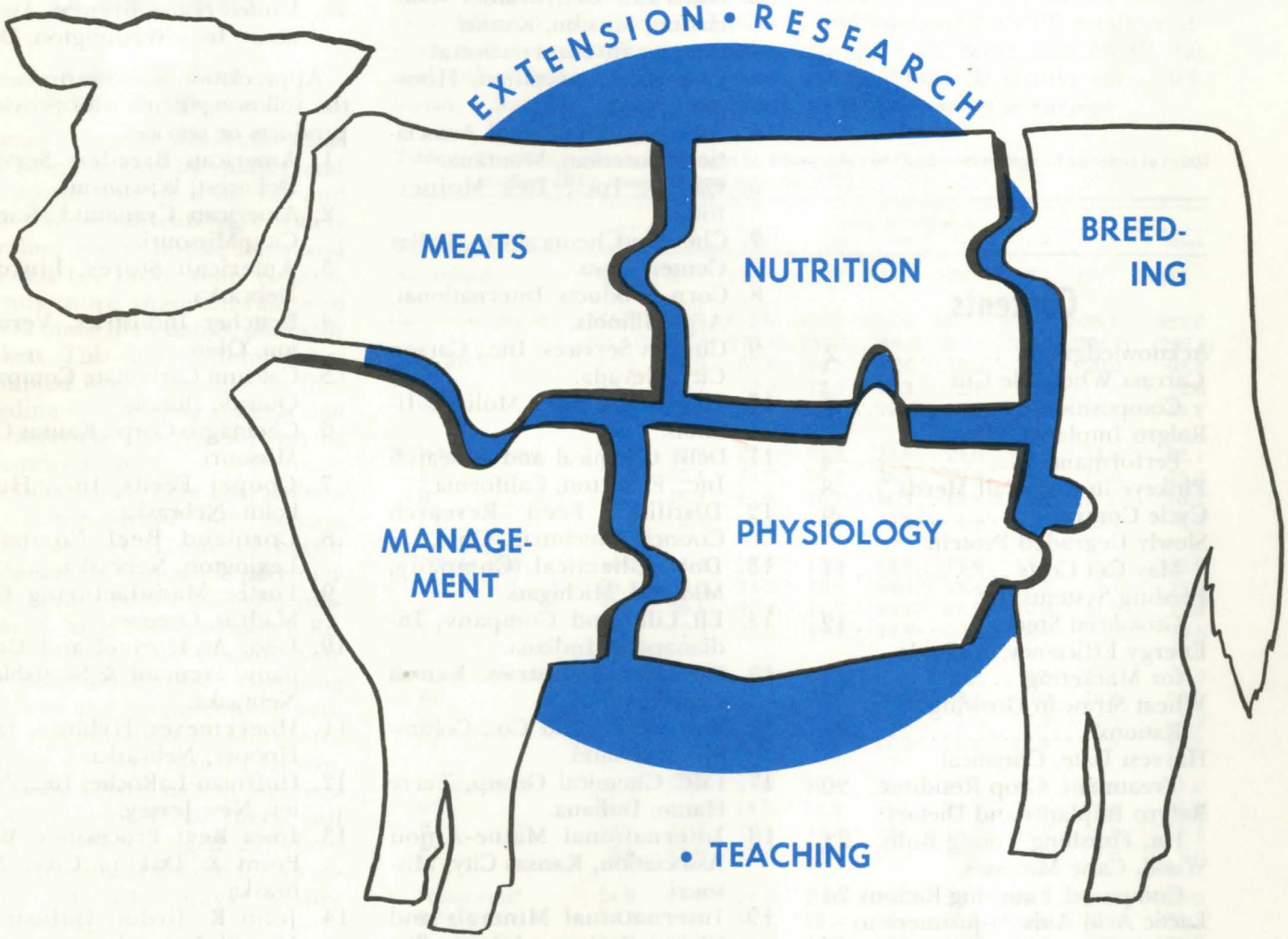
1978 NEBRASKA BEEF CATTLE REPORT



Prepared by the staff in Animal Science and cooperating Departments for use in the Extension and Teaching programs

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Carcass Wholesale Cut Composition

Of Breed Groups

Robert M. Koch
Michael E. Dikeman[1]

Retail value of wholesale meat cuts is influenced by quality and the proportion of lean, fat and bone. Wholesale cuts vary widely in value; for example, loins and ribs sell for more than rounds, rounds more than chucks, and chucks more than flanks, plates, or briskets. This value difference has prompted many attempts to find breeding and feeding systems that will increase the proportion of high-priced cuts.

Results shown here characterize the composition of carcass wholesale cuts from 14 breed combinations that were part of a cattle germ plasm evaluation program at the U.S. Meat Animal Research Center, Clay Center, Neb. The program involved breeding Hereford and Angus cows by artificial insemination to Hereford, Angus, Jersey, South Devon, Limousin, Charolais and Simmental sires to produce three calf crops. Calves averaged 215-days-old at weaning and were fed an average of 243 days before slaughtering.

The right side of each carcass was transported to Kansas State University Food Service. Carcasses were broken into wholesale cuts and cut into roasts or steaks (trimmed to approximately .3 in. (8 mm) external fat), lean trim (containing about 25 % fat), fat trim and bone (including connective tissue). A small amount of bone was left in the short loin and rib roasts, all other cuts were made boneless.

Wholesale Cuts and Their Composition

The average chilled carcass weights, the percentage of carcass in each wholesale cut and composition of cuts are shown in Table 1. Breed groups differed in wholesale cut percentages, but the differences were relatively smaller than differences in retail product and fat trim. Round and kidney fat percentages differed more among breed groups than other wholesale cuts differed; the largest difference was between Jersey crosses and other breed groups. Limousin, Charolais and Simmental groups had more retail product and less fat trim in most wholesale cuts than other breed groups. Breed groups with higher fat trim percentages also tended to have higher percentages of fat in the ribeye muscle. It takes about 5.0% fat in the ribeye muscle to qualify for U.S.D.A. Choice.

Although not shown in Table 1, wholesale flanks averaged 7.0% of the carcass weight and were 48.8% retail product and 51.2% fat trim. Wholesale plates were 8.5% of the carcass with a composition of 57.6% retail product, 11.0% bone and 31.4% fat trim. Wholesale briskets were 4.6% of the carcass and contained 56.3% retail product, 10.4% bone and 33.3% fat trim. Wholesale shanks were 3.9%

(continued on next page)

Table 1. Percentage of carcass weight in wholesale cuts and percentage of cut that is retail product (RP), bone (B) and fat trim (FT).

	Breed groups[a]								
Item	H	A	HAX	JX	SDX	LX	CX	SX	Mean
No. animals	69	85	210	133	124	175	177	177	1121
Carcass weight, lb	585.3	590.7	612.6	568.1	637.2	622.3	673.4	658.6	622.9
	(265.5)[b]	(267.9)	(277.8)	(257.7)	(289.0)	(282.3)	(305.4)	(298.7)	(282.5)
% RP	67.5	65.9	65.6	64.8	67.0	72.0	71.0	70.0	68.3
% B	12.7	11.7	12.0	12.5	12.3	12.7	12.9	13.3	12.6
% FT	19.8	22.4	22.4	22.7	20.6	15.3	16.1	16.7	19.2
% Whole round	23.7	22.2	22.6	21.3	22.6	24.0	24.1	23.8	23.1
RP	75.2	75.4	74.7	75.2	76.2	79.8	78.2	77.6	76.8
B	16.1	15.3	15.6	16.7	16.3	15.8	16.4	17.0	16.2
FT	8.7	9.4	9.6	8.1	7.4	4.4	5.3	5.4	6.9
% Whole loin	14.0	13.4	13.7	13.3	13.6	13.9	13.7	13.5	13.6
RP	72.1	72.6	71.3	73.6	74.4	78.4	78.3	77.4	75.2
B	11.2	10.1	10.4	11.7	10.8	10.9	10.9	11.7	11.0
FT	16.7	17.3	18.3	14.7	14.9	10.8	10.9	10.9	13.8
% Whole rib	8.3	8.4	8.4	8.3	8.4	8.3	8.3	8.1	8.3
RP	74.5	73.5	73.2	75.5	75.6	80.1	80.0	79.6	76.9
B	7.3	7.0	7.2	7.4	7.2	7.4	7.4	7.5	7.3
FT	18.2	19.4	19.7	17.1	17.3	12.4	12.5	12.9	15.7
% Whole chuck	26.9	27.0	27.0	26.8	26.7	27.1	27.0	27.2	27.0
RP	75.8	73.7	73.7	74.2	75.1	79.3	78.4	77.4	76.2
B	14.5	13.7	13.8	14.4	14.2	14.5	14.7	15.0	14.4
FT	9.6	12.6	12.4	11.4	10.6	6.2	6.9	7.6	9.4
% Minor cuts[c]	24.0	25.2	24.8	24.6	24.3	22.9	23.0	23.4	23.9
RP	54.2	52.8	52.2	52.2	54.7	60.3	59.0	57.9	55.7
B	11.6	10.7	10.8	11.6	11.5	12.3	12.5	12.8	11.8
FT	34.2	36.5	37.0	36.2	33.8	27.4	28.5	29.3	32.5
% Kidney fat	3.1	3.8	3.5	5.7	4.4	3.8	3.9	4.0	4.1
Ribeye muscle ether extract, %	5.0	6.9	5.9	6.8	5.5	4.0	4.6	4.6	5.3

[a]H = Hereford, A = Angus, J = Jersey, SD = South Devon, L = Limousin, C = Charolais, S = Simmental, X = average of crosses with Hereford and Angus cows.

[b]Kilograms

[c]Minor cuts = flank, plate, brisket and foreshank.

Carcass Composition

(continued from page 3)

of the carcass and averaged 63.3% retail product, 36.7% bone and essentially no trimmable fat.

Distribution in the Carcass

The percentage of total retail product, bone, or fat trim in each wholesale cut is shown in Table 2. Similarities of breed groups in percentage of retail product and bone in each cut were more striking than the differences. Jersey crosses had the lowest percentage of round, but the highest percentage of roasts and steaks and were the fattest breed group. Retail product includes muscle and a small amount of fat (including fat in the muscle), which likely accounts for some of the breed group differences shown in Table 2.

Distribution of fat trim (Table 2) varied much more among breed groups than did distribution of retail product or bone. The most striking breed group differences were in kidney fat and external fat from the four major cuts. Hereford, Angus and Hereford-Angus crosses had distinctly less of their total fat in kidney knob and more in external fat than other breed groups.

From these results, it would seem that changing proportion of wholesale cuts in carcasses is more likely to result from differences in relative amount and distribution of fat than from differences in muscle and bone.

---

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Table 2. Percentage of total retail product (RP) or bone (B) or fat trim (FT) in each wholesale cut.

	Breed groups[a]								
Item	H	A	HAX	JX	SDX	LX	CX	SX	Mean
Round									
RP	26.4	25.4	25.8	24.7	25.7	26.6	26.5	26.4	26.0
B	30.1	28.9	29.5	28.5	29.8	29.9	30.7	30.4	29.8
FT	10.4	9.3	9.7	7.6	8.2	6.9	8.0	7.7	8.3
Loin									
RP	15.0	14.8	14.8	15.1	15.1	15.1	15.1	15.0	15.0
B	12.4	11.6	11.8	12.5	11.9	11.9	11.5	11.9	11.9
FT	11.8	10.4	11.2	8.6	9.8	9.7	9.2	8.8	9.8
Rib									
RP	9.1	9.4	9.3	9.7	9.5	9.3	9.4	9.2	9.3
B	4.8	5.0	5.0	4.9	4.9	4.9	4.8	4.6	4.8
FT	7.6	7.3	7.3	6.2	7.1	6.7	6.5	6.2	6.8
Chuck									
RP	30.2	30.2	30.3	30.7	29.9	29.8	29.8	30.1	30.1
B	30.8	31.5	31.1	31.0	30.7	31.0	30.7	30.6	30.9
FT	13.1	15.2	15.0	13.5	13.8	10.9	11.5	12.4	13.2
Minor cuts[b]									
RP	19.3	20.2	19.8	19.8	19.9	19.2	19.2	19.4	19.5
B	22.0	23.2	22.7	23.2	22.8	22.4	22.4	22.6	22.7
FT	41.4	41.1	41.1	39.0	40.0	41.1	40.9	41.1	40.6
Kidney fat	15.7	16.8	15.7	25.1	21.2	24.6	24.0	23.8	21.3
External fat trim[c]	16.8	14.4	16.5	9.8	13.3	12.5	11.3	11.5	13.0
Roasts and steaks[c]	51.5	51.4	51.6	52.0	51.2	51.1	51.2	51.2	51.4

[a]H = Hereford, A = Angus, J = Jersey, SD = South Devon, L = Limousin, C = Charolais, S = Simmental, X = average of crosses with Hereford and Angus cows.

[b]Minor cuts = flank, plate, brisket, shank.

[c]External fat trim and roasts and steaks are from the round, loin, rib and chuck.

Birth Through Finishing

Ralgro Implant

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Steers responded in weight gains to Ralgro implants during nursing, growing, and finishing phases of production. Those receiving implants during all three phases gained 169 lb (77 kg) more than non-implanted controls. Heifers responded primarily to the growing phase implants. Implanting calves during the nursing phase had a positive carry-over effect upon performance during the growing phase. Also, implanting during the growing phase had a positive carry-over effect upon performance in the finishing phase. However, nursing phase implants had a negative carry-over effect upon finishing phase performance.

Integrating the performance from the three into one value (weight per day of age or final weight) indicated that both nursing implants produced 33 extra pounds (15 kg) while the birth implant gave no response. This indicates that if a birth implant is given, a second nursing implant should also be given. Growing implants produced an extra 57 lb (26 kg) while finishing implants produced 28 extra pounds (13 kg) in steers and nothing in heifers.

Ralgro Promotes Growth

Ralgro, a growth promoting substance, has been shown to enhance animal performance at various stages of cattle production. Data are limited on the use of Ralgro implanted at birth and at regular intervals throughout growing and finishing phases. An experiment was designed to study the effect of Ralgro implanted during nursing (phase 1), growing (phase 2) and finishing (phase 3) and carry-over effects from one phase to another. Implant treatments are shown in Table 1.

Affect Performance

In the nursing phase 119 calves (¾ Hereford and ¼ Angus) born in March and April were used. Within 24 hours of birth half of the calves were implanted with 36 mg of Ralgro. At an average of 92 days of age half of the calves implanted at birth were reimplanted and half of those not implanted at birth received a 92-day implant. Cows were pastured on bromegrass from calving until July 15, at which time 61 cow-calf pairs were moved to drylot until the calves were weaned on October 11. Cow-calf pairs were selected and assigned to drylot in such a manner as to equalize calf sex and implant treatments.

The third implanting time was on October 5, at an average calf age of 189 days with implant groups again divided providing eight groups with one group having been implanted for the third time (III), one group having received no implants (- - -) and six groups having received either one or two implants (Table 1).

The growing phase began October 13, when calves were weaned and placed in drylot. The growing ration was fed *ad libitum* and consisted of 73.1% corn silage, 18% high moisture corn, and 8.9% brewers dried grains-urea based supplement (dry matter basis). Vitamin A and trace minerals were added and 200 mg of Rumensin were fed per head daily. Calves were reimplanted during phase 2 at an average age of 283 days with no further division of groups so that all calves implanted eight days prior to weaning received a second implant during the growing phase which lasted 167 days.

The finishing phase involved splitting of the eight implant groups from phase 2, giving 16 groups, so that group 16 (IIIII) consisting of eight head had been implanted for the fifth time and group 1 (-----) had received no implants. Animals were fed a starting ration consisting of 50% concentrate and 50% roughage for the first five days. The second five days the concentrate-roughage ratio was 70:30 and 90.4:9.6 from the eleventh day on. On the 57th day of the finishing phase 20.5% (dry matter basis) of the corn was replaced with wheat. All rations were formulated to meet National Research Council requirements and Rumensin was fed at the rate of 30 g/ton of feed. All cattle were

(continued on next page)

Table 1. Design of implant trial.[a]

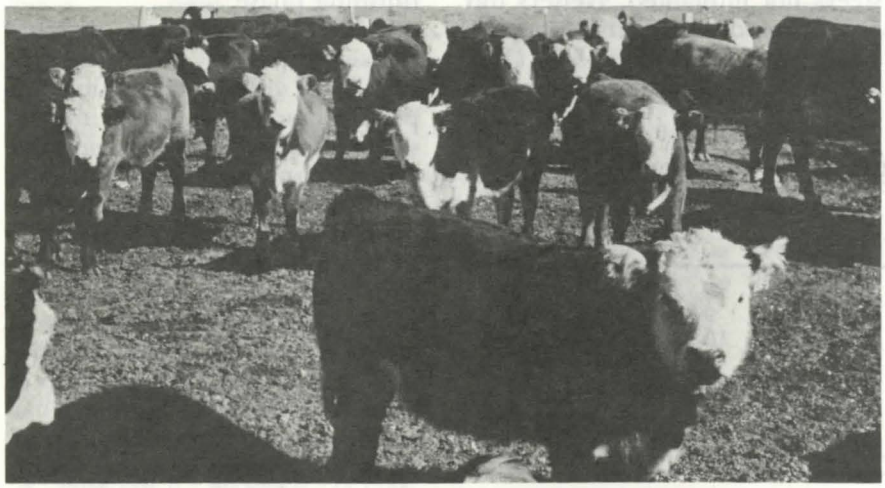
	Average age when implanted				
	Nursing (Phase 1)		Growing (Phase 2)		Finishing (Phase 3)
Group	At birth	92 Days	189 Days	283 Days	366 Days
1	–	–	–	–	–
2	–	–	–	–	I
3	–	–	I	I	–
4	–	–	I	I	I
5	–	I	–	–	–
6	–	I	–	–	I
7	–	I	I	I	–
8	–	I	I	I	I
9	I	–	–	–	–
10	I	–	–	–	I
11	I	–	I	I	–
12	I	–	I	I	I
13	I	I	–	–	–
14	I	I	–	–	I
15	I	I	I	I	–
16	I	I	I	I	I

a—Not implanted; I—Implanted with 36 mg Ralgro.

Table 2. The effect of Ralgro on adjusted calf weaning weight (phase 1).

Implant treatments			Adj. wn. wt.			
			Steers		Heifers	
At birth	At 92 days	No. of calves	lb	(kg)	lb	(kg)
–	–	30[a]	483[e]	(220)	443	(201)
–	I	29[b]	509[e,f]	(231)	457	(208)
I	–	31[c]	503[e,f]	(229)	449	(204)
I	I	29[d]	519[f]	(236)	457	(208)

[a]Includes calves in final treatments 1–4.
[b]Includes calves in final treatments 5–8.
[c]Includes calves in final treatments 9–12.
[d]Includes calves in final treatments 13–16.
[e,f]Means with unlike superscripts differ (P<.05).



Calves (¾ Hereford-¼ Angus) during the nursing phase of the Ralgro study.

Effect of Ralgro Implants

(continued from page 5)

slaughtered at the end of a 110-day finishing trial.

Results and Discussion

Nursing (phase 1). There was a significant (P<.05) increase in adjusted weaning weight [36 lb (16 kg)] of steer calves implanted both at birth and 92 days compared to no implants (Table 2). Steer calves implanted only at birth were 20 lb (9 kg) heavier than controls with steer calves implanted only at 92 days of age 26 lb (12 kg) heavier at weaning. However, these differences were not statistically significant. Implanting did not significantly affect heifer weaning weights; however, weaning weights were 6 (3), 14 (6) and 14 lb (6 kg) heavier for heifers implanted at birth, 92 days and both birth and 92 days, respectively.

Growing (phase 2). The overall response by calves to implants during the growing phase was 1.91 *vs* 1.68 lb/day (.87 *vs* .76 kg) (Table 3). Steers and heifers responded similarly, therefore, the data are averaged.

Determining "carry-over" effects from one phase to another was an important objective of this experiment. Response to growing phase implants is shown as influenced by all combinations of nursing phase implants (Table 4). In general there was a positive carry-over effect since calves implanted during the nursing phase gained faster during the growing phase than calves not implanted during the nursing phase. When calves were implanted during the growing phase there was a positive carry-over only from the 92-day implant.

Finishing (phase 3). Finishing gains are shown in Table 5. Steers responded to a finishing implant regardless of previous treatment with daily gains of 2.81 lb (1.28 kg) compared to 2.47 lb (1.12 kg) for steers not implanted. Heifers did not respond to the finishing implant, with gains of 2.35 lb (1.07 kg) and 2.31 lb (1.05 kg), respectively for implant *vs* non-implant groups.

Carry-over effects from nursing and growing phases to the finishing phase are summarized in Table 6. Growing implants tended to have a positive carry-over effect upon finishing performance; the effect being greater in steers and heifers not implanted during the finishing phase.

With one exception, nursing phase implants had negative carry-over effects upon finishing performance. The birth implant seemed to have a greater negative effect than the 92-day implant. Some of this effect could have been due to heavier weights at weaning and at the start of the finishing period for calves implanted during the nursing phase.

Weight per day of age at market is shown for the 16 treatments in Table 7. This is a means of evaluating main effects and carry-over effects integrated into one value. Growing phase implants in steers

Table 4. Effect of previous implant treatment on average daily gain in the growing trial (phase 2.)

	No growing implant		Growing implant	
	lb	(kg)	lb	(kg)
No previous implant	1.59	(.72)	1.92	(.87)
Previous implants	1.71	(.78)	1.90	(.86)
Carry-over effect	.12	(.06)	–.02	(–.01)
No birth implant	1.57	(.71)	1.91	(.87)
Birth implant	1.78	(.81)	1.90	(.86)
Carry-over effect	.21	(.10)	–.01	(–.01)
No 92-day implant	1.65	(.75)	1.82	(.83)
92-day implant	1.71	(.78)	2.01	(.91)
Carry-over effect	.06	(.03)	.19	(.08)

Table 5. The effect of Ralgro implants on average daily gain during finishing.[a]

Implant treatments	Average daily gain					
	Steers			Heifers		
	No.	lb	(kg)	No.	lb	(kg)
1 (-----)	3	2.49	(1.13)	3	2.47	(1.12)
2 (----I)	5	2.89	(1.31)	3	2.44	(1.11)
3 (--II-)	4	2.48	(1.13)	4	2.45	(1.11)
4 (--III)	3	3.22	(1.46)	5	2.37	(1.08)
5 (-I---)	2	2.65	(1.20)	3	2.20	(1.00)
6 (-I--I)	3	2.97	(1.35)	7	2.47	(1.12)
7 (-III-)	4	2.88	(1.31)	4	2.41	(1.10)
8 (-IIII)	3	2.53	(1.15)	3	2.56	(1.16)
9 (I----)	4	2.37	(1.08)	4	2.01	(0.91)
10 (I---I)	4	2.84	(1.29)	4	2.48	(1.13)
11 (I-II-)	4	2.39	(1.09)	3	2.44	(1.11)
12 (I-III)	5	2.79	(1.27)	3	2.33	(1.06)
13 (II---)	3	2.25	(1.02)	4	2.06	(0.94)
14 (II--I)	5	2.63	(1.20)	3	1.73	(0.79)
15 (IIII-)	3	2.29	(1.04)	3	2.54	(1.15)
16 (IIIII)	4	2.73	(1.24)	4	2.32	(1.05)

[a] - = Not implanted; I = Implanted with 36 mg Ralgro.

Table 3. The effect of Ralgro on average daily gain during the growth period (167 days).

Implant treatments	Average daily gain					
	Steers			Heifers		
	No.	lb	(kg)	No.	lb	(kg)
1 and 2 (----)	8	1.68[a]	(.76)	6	1.45[a]	(.66)
3 and 4 (--II)	7	1.92[ab]	(.87)	9	1.92[bc]	(.87)
5 and 6 (-I--)	5	1.83[ab]	(.83)	10	1.43[a]	(.65)
7 and 8 (-III)	7	2.01[ab]	(.91)	7	1.80[bc]	(.82)
9 and 10 (I---)	8	1.72[ab]	(.78)	8	1.69[ab]	(.77)
11 and 12 (I-II)	9	1.72[ab]	(.78)	6	1.72[ab]	(.78)
13 and 14 (II--)	9	1.83[ab]	(.85)	6	1.82[bc]	(.83)
15 and 16 (IIII)	7	2.15[b]	(.98)	7	2.06[c]	(.94)

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

accounted for 0.1 lb/day (.05 kg) or 47 total lb (22 kg). Finishing implants accounted for .06 lb/day (.03 kg) or 28 total lb (13 kg). There were two implants in the growing phase so the effect per implant may have been similar. Heifers showed a similar response to growing phase implants but no response to finishing implants.

Because of the negative carry-over from nursing implants to finishing performance, the effects of nursing implants on weight per day of age were small. Birth implants appeared to be ineffective in either steers or heifers while 92-day implants were effective only in steers. Both implants were effective in both steers and heifers giving an average increase in weight per day of age 0.07 lb (.03 kg) or 33 lb (15 kg) total weight. It appears from these data that if birth implants are given, a second nursing implant should also be given.

Heavier final weights for implanted cattle are reflected in heavier carcass weights (Table 8). Other carcass characteristics were not significantly affected by implant treatments.

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Table 6. Effect of previous implant treatment on average daily gain in the finishing trial (phase 3).

	Steers				Heifers			
	No finishing implant		Finishing implant		No finishing implant		Finishing implant	
	lb	(kg)	lb	(kg)	lb	(kg)	lb	(kg)
No birth implant	2.63	(1.20)	2.89	(1.31)	2.36	(1.07)	2.45	(1.11)
Birth implant	2.33	(1.06)	2.74	(1.25)	2.24	(1.02)	2.24	(1.02)
Carry-over effect	–.30	(–.14)	–.15	(–.06)	–.12	(–.05)	–.21	(–.09)
No 92-day implant	2.43	(1.10)	2.91	(1.32)	2.33	(1.06)	2.40	(1.09)
92-day implant	2.52	(1.15)	2.69	(1.22)	2.29	(1.04)	2.30	(1.05)
Carry-over effect	.11	(.05)	–.22	(–.10)	–.04	(–.02)	–.10	(–.04)
No growing implant	2.42	(1.10)	2.81	(1.28)	2.17	(.99)	2.32	(1.05)
Growing implant	2.52	(1.15)	2.81	(1.28)	2.45	(1.11)	2.38	(1.08)
Carry-over effect	.10	(.05)	0	(0)	.28	(.12)	.06	(.03)

Table 7. Weight per day of age through finishing.[a]

	No finishing implant				Finishing implant					
	No growing implant		Growing implant		No growing implant		Growing implant		Avg.	
Steers:	lb	(kg)	lb	(kg)	lb	(kg)	lb	(kg)	lb	(kg)
No nursing implant	2.16	(0.98)	2.27	(1.03)	2.21	(1.00)	2.39	(1.09)	2.26	(1.03)
Birth implant	2.14	(0.97)	2.13	(0.97)	2.30	(1.04)	2.34	(1.06)	2.23	(1.01)
92-day implant	2.33	(1.06)	2.50	(1.14)	2.27	(1.03)	2.24	(1.02)	2.34	(1.06)
Both implants	2.21	(1.00)	2.34	(1.06)	2.31	(1.05)	2.51	(1.14)	2.34	(1.06)
Avg.	2.21	(1.00)	2.31	(1.05)	2.27	(1.03)	2.37	(1.08)		
Finishing avg.	2.26 (1.03)				2.32 (1.05)					
Heifers:										
No nursing implant	1.98	(0.90)	2.21	(1.00)	1.99	(0.90)	2.06	(0.94)	2.06	(0.94)
Birth implant	1.98	(0.90)	2.13	(0.97)	2.06	(0.94)	2.10	(0.95)	2.07	(0.94)
92-day implant	1.98	(0.90)	2.08	(0.94)	2.00	(0.91)	2.16	(0.98)	2.06	(0.94)
Both implants	2.06	(0.94)	2.27	(1.03)	2.00	(0.91)	2.13	(0.97)	2.12	(0.96)
Avg.	2.00	(0.91)	2.17	(0.99)	2.01	(0.91)	2.11	(0.96)		
Finishing avg.	2.09 (0.95)				2.06 (0.94)					

[a]Weight/day of age in lb, with kg in parentheses (474 days).

Table 8. Carcass characteristics of Ralgro implanted calves.

	Steers						Heifers					
Implant treatment	Hot carcass weight		REA	Fat thickness	Quality[a] grade	Marbling[b] scores	Hot carcass weight		REA	Fat thickness	Quality[a] grade	Marbling[b] scores
	lb	(kg)	sq in (sq cm)	in (cm)			lb	(kg)	sq in (sq cm)	in (cm)		
1 (-----)	609.7	(277.1)	11.1 (72.2)	.43 (1.1)	11.3	10.7	568.7	(258.5)	10.2 (66.3)	.50 (1.3)	11.3	11.0
2 (----I)	609.4	(277.0)	11.1 (72.2)	.40 (1.0)	11.0	10.0	585.0	(265.9)	10.5 (68.3)	.60 (1.5)	12.0	11.3
3 (--II-)	620.5	(282.1)	10.9 (70.9)	.41 (1.0)	11.0	10.0	619.5	(281.6)	11.3 (73.5)	.55 (1.4)	11.8	11.8
4 (--III)	650.7	(295.8)	11.3 (73.5)	.35 (0.9)	10.0	9.0	582.4	(264.7)	11.5 (74.8)	.47 (1.2)	11.8	11.4
5 (-I---)	653.0	(296.8)	11.7 (76.1)	.38 (1.0)	11.3	10.7	568.6	(258.5)	10.4 (67.6)	.50 (1.3)	10.8	9.8
6 (-I--I)	639.5	(290.7)	11.5 (74.8)	.40 (1.0)	11.5	11.5	563.2	(256.0)	11.6 (75.4)	.50 (1.3)	11.8	12.2
7 (-III-)	694.8	(315.8)	12.6 (81.9)	.56 (1.4)	11.0	10.0	579.5	(263.4)	11.3 (73.5)	.55 (1.4)	11.8	12.3
8 (-IIII)	616.7	(280.3)	10.2 (66.3)	.52 (1.3)	11.0	10.3	600.7	(273.1)	12.3 (80.0)	.62 (1.6)	11.0	10.0
9 (I----)	593.0	(269.6)	10.6 (69.0)	.44 (1.1)	11.8	11.8	561.0	(255.0)	10.6 (69.0)	.50 (1.3)	12.0	11.5
10 (I---I)	624.5	(283.9)	12.6 (81.9)	.39 (1.0)	12.0	11.3	587.8	(267.2)	11.3 (73.5)	.55 (1.4)	11.0	11.5
11 (I-II-)	595.3	(270.6)	11.1 (72.2)	.39 (1.0)	11.0	10.8	588.7	(267.6)	12.3 (80.0)	.45 (1.1)	10.0	9.0
12 (I-III)	648.8	(294.9)	11.7 (76.1)	.43 (1.1)	10.2	9.2	606.3	(275.6)	11.8 (76.7)	.45 (1.1)	11.0	10.3
13 (II---)	617.8	(280.8)	11.3 (73.5)	.49 (1.2)	10.5	9.5	570.7	(259.4)	10.6 (68.9)	.60 (1.5)	13.0	14.7
14 (II--I)	645.6	(293.5)	11.5 (74.8)	.53 (1.3)	11.0	10.0	564.0	(256.4)	11.8 (76.7)	.52 (1.3)	11.0	10.3
15 (IIII-)	680.7	(309.4)	12.0 (78.0)	.60 (1.5)	10.3	9.7	629.3	(286.1)	11.3 (73.5)	.62 (1.6)	12.0	13.0
16 (IIIII)	719.3	(337.0)	11.5 (74.8)	.58 (1.5)	9.8	8.8	606.3	(275.6)	10.3 (67.0)	.59 (1.5)	11.3	9.7

[a]10 = average good, 11 = high good, 12 = low choice.
[b]Slight 7, 8, 9; small 10, 11, 12; modest 13, 14, 15.

Hereford showing effects of a severe case of pinkeye.

Incidence, Severity and Effects

Pinkeye in Cow-Calf Herds

J. K. Ward
M. K. Nielsen
M. Stauffer[1]

Eyelid pigmentation did not significantly affect the incidence or severity of pinkeye in cows. In Hereford X Angus-Hereford (¾ Hereford-¼ Angus) calves, there was significantly greater incidence and severity of pinkeye due to a lack of eyelid pigmentation. The average date of pinkeye incidence was significantly affected by age and year. Cows were infected an average of 15 days earlier than calves. Younger cows were more frequently affected by pinkeye than older cows. Calf weaning weight was significantly decreased by severity of pinkeye.

Pinkeye [infectious bovine keratoconjunctivitis] is one of the frequent causes of reduced summer performance of cattle, particularly calves and yearlings. It occurs primarily in early to mid-summer during the period of maximal sunlight; however, it has been observed during all seasons of the year. This study was started to observe effect of pinkeye on animal performance and to determine whether eyelid pigmentation is a factor in incidence and severity.

Procedure

Data were collected over a three year period (1974-1976) on cows and calves in the University herd at the field laboratory near Mead, Nebraska. Cows ranged from two to eight years of age and consisted of Hereford and Angus X Hereford crosses. Calves were both pre- and post-weaning groups consisting of Hereford, Hereford X Angus-Hereford, and Charolais X Angus-Hereford.

Pigmentation was classified for each eyelid with an average degree of pigmentation determined for each animal. Eyelids that were more than half pigmented were considered to be totally pigmented for classification purposes. The code used in assigning eyelid pigmentation scores was as follows: light (1), medium red (2), dark red (3), and black (4).

The number and severity of treatments per animal were recorded. Treatments were assigned numbers on a one to three scale as shown below to indicate type of treatment used:

Severity Score	Severity Condition	Treatment
1	Watery eye	Spray containing neomycin
2	Severe discharge with swelling	Spray or powder containing furasone and occasional use of eye patch
3	Bloodshot, clouding or whiteness appearing in the eye	Powder and eye patch

Cattle were treated frequently in an attempt to prevent loss of sight and minimize effect on animal performance. Fly control measures included the use of back rubs or dust bags which were maintained in each pasture and use of larvicide (rabon blocks) from June 1 to July 15 during the third year of the study.

All cows and calves were pastured on bromegrass from about April 15 to June 1. From approximately June 1 to October 15 Hereford cows and calves were pastured on warm season grass. The Angus X Hereford cows with calves were kept on bromegrass until July 15, at which time some were moved into drylot through October 15. All calves were weaned before October 15.

Incidence and severity of pinkeye was observed in all cow and calf breed and sire groups as was the effect of pinkeye on cow and calf performance.

Results

Pigmentation. Eyelid pigmentation was affected significantly ($P<.01$) by breed with Hereford cows showing average pigmentation values of 1.4 and Angus X Hereford 3.4. Pigmentation values for calves were 1.3, 2.4 and 2.0 respectively, for Hereford, Hereford X Angus-Hereford, and Charolais X Angus-Hereford.

Incidence. The average date of pinkeye incidence in cows and calves was significantly affected by year ($P<.01$). Average cow infection dates for 1974, 1975, and 1976, respectively, were July 2, July 30, and June 29. Average calf infection dates for 1974, 1975, and 1976, respectively, were July 17, August 18, and July 14. Cows with pinkeye had a 15 day earlier average infection date than did calves.

Incidence of pinkeye tended to

be lower, however, not statistically different, in animals with more eyelid pigmentation with the average number of times treated per cow being .14 for Hereford and .05 for Angus X Hereford. Date of infection did not significantly affect incidence indicating that apparently animals usually are infected only once during the season. The number of cows treated for pinkeye was 38, 13, and 16 with number of calves treated 78, 19, and 31, respectively for years 1974, 1975, and 1976.

Severity. A severity score was determined by adding all treatments for a given animal within a specific pinkeye season. Average severity for pinkeye was 2.4 and 2.9 for infected cows and calves, respectively. In cows, severity was not affected significantly by breed or time of infection. Younger cows (two and three-year-olds) had a significantly ($P<.05$) greater degree of severity than older cows. Severity was slightly higher in Hereford as compared to Angus X Hereford cows. Severity in calves was not significantly affected by breed, sex or date of infection, however, slightly more bull than heifer calves had pinkeye (67 *vs* 61) with degree of severity being 2.7 *vs* 2.4, respectively.

The effect of eyelid pigmentation on the incidence and severity of pinkeye was significant in Hereford X Angus-Hereford calves. It was not statistically significant in Hereford and Charolais X Angus-Hereford calves. In Hereford X Angus-Hereford calves each unit increase in pigmentation resulted in a .10% decrease in incidence and a .20% decrease in severity of pinkeye. Since both black and red Hereford X Angus-Hereford calves were observed, differences in pinkeye as influenced by pigmentation could be detected more easily.

Effect on Performance

Calf weaning weight was significantly affected ($P<.05$) by pinkeye severity with a loss of 3.4 lb (1.55 kg) for each unit increase in pinkeye severity. With the scoring system used one unit is the equivalent of a watery eye and three units equal to a case of pinkeye causing extreme irritation, reddening, cloudy condition and with treatment being the eye patch with medication. A calf with severe pinkeye in one eye treated one time would be losing about 10 lb (4.55 kg) in weaning weight.

Incidence of pinkeye did not significantly affect weaning weight, although infected calves were somewhat lighter. Calves in drylot during mid and late summer had lower pinkeye incidence ($P<.10$) than calves on pasture.

Pregnancy rate was not affected by pinkeye since a high percentage of the cows would have conceived before the start of the pinkeye season. Cows infected with pinkeye did have a calving interval two days longer than cows not infected. The difference was not significant.

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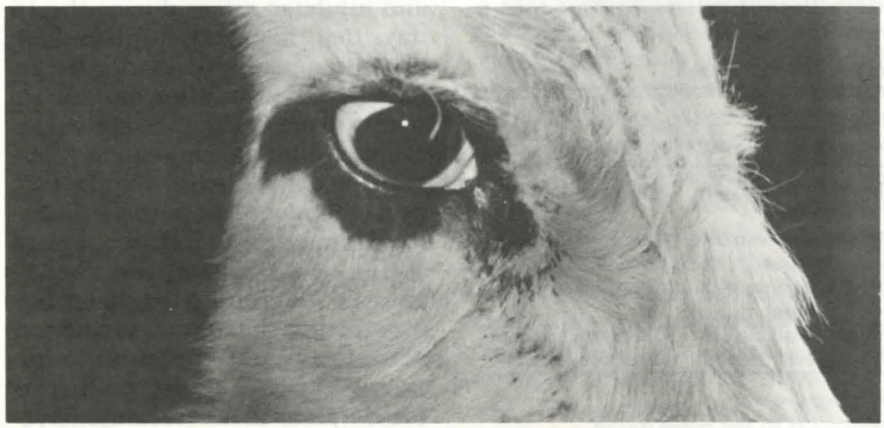
[1]J. K. Ward is Professor of Ruminant Nutrition, M. K. Nielsen is Assistant Professor of Animal Breeding and M. Stauffer is a graduate student.



Typical black eyelid pigmentation in Angus x Hereford cow.

Progestogen, Releasing Hormone, Prostaglandin

Cycle Control

Earl F. Ellington
John L. Lesmeister

Ear implants containing a progestogen were effective in synchronization of estrus but had a detrimental effect on fertility in cattle. Gonadotropin releasing hormone injections at the time of implant removal had detrimental effects on both synchronization of estrus and resulting fertility. Prostaglandin given intravaginally at the time of artificial insemination was without any measurable effect on fertility.

Introduction

Extensive experimentation has been conducted with progestogen treatments to develop effective estrous cycle control procedures for the cow. Previous results dealing with precision of cycle control and resulting fertility have been encouraging when progestogen impregnated implants were utilized (1972 Nebraska Beef Cattle Report, E.C. 72-218; 1977 Nebraska Beef Cattle Report, E.C. 77-218).

Regulation of ovulation with gonadotropin releasing hormone (GnRH) preparations and the effects of prostaglandins (PG) on the estrous cycle and uterine muscle with possible sperm transport implications offer promising avenues for developing usable cycle control procedures. The present cycle control investigation was conducted to study the value of GnRH administration in addition to the progestogen implants and the value of PG when administered at the time of insemination.

Study Design

Ear implants impregnated with

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Cycle Control

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progestogen (6 mg of SC21009, G. D. Searle and Co.) were used alone and in combination with GnRH (gonadotropin releasing hormone, Abbott Laboratories) to study their effectiveness for estrous cycle control in beef cattle on a spring calving program. In addition, the value of administering prostaglandin ($PGF_{2\alpha}$, G. D. Searle and Co.) at the time of the first insemination was studied.

A total of 123 lactating 2- to 7-year-old Hereford cows and 22 yearling Hereford heifers were assigned randomly within age and length of post-partum interval to five groups consisting of 29 animals each (Table 1). Treatment groups included: (1) untreated control, (2) 16-day implant and (3), (4) and (5) 16-day implant + GnRH 24 hours after implant removal. Implants were subcutaneously placed on the outer side of the ear and removed by making an incision with a scalpel directly over the implant. GnRH was given intramuscularly at the rate of 100 ug dissolved in 1 ml of sterile saline solution.

Animals in groups 1, 2 and 3 were artificially inseminated 12 hours after the onset of estrus. Animals in group 4 were artificially inseminated 12 hours after GnRH administration without regard for the time of exhibition of estrus. Similarly, all animals in group 5 were artificially inseminated 24 hours after GnRH administration. Immediately following artificial insemination (AI), alternate animals within each treatment group received intravaginally 1 mg of PG dissolved in 1 ml of a saline solution.

Epididymectomized bulls were utilized for twice daily estrous checks before, during and following the treatment period. Cows standing to be mounted by bulls or other cows were considered to be in estrus. Cows showing estrus during a 16-day period immediately following implant removal (groups 1, 2 and 3) and cows scheduled for fixed time breeding (groups 4 and 5) were artificially inseminated by an experienced technician utilizing frozen semen from a Polled Hereford bull. Pressure sensitive heat detectors were used on the rump of cows during the actual AI period to facilitate detection of estrus. Subsequent to the AI period the epididymectomized bulls were placed with intact Angus bulls for an additional 44 days. The calving dates together with color markings of the calves were used to establish the breeding dates at which conception occurred.

The cattle were maintained on alfalfa-brome pasture during the spring and early summer months (including the AI period) and again during the autumn months. Native grass pastures were utilized during the remaining summer and winter months. Hay and supplemental concentrates were provided as needed during the winter.

Table 1. Experimental design for the study of estrous cycle control.

Group	No. animals	16-day progestogen implant[a]	GnRH injections[b]	Insemination times	$PGF_{2\alpha}$ treatment[c]
1	29	no	no	12 hours post estrous onset	Alternate animals
2	29	yes	no	12 hours post estrous onset	Alternate animals
3	29	yes	yes	12 hours post estrous onset	Alternate animals
4	29	yes	yes	12 hours post GnRH	Alternate animals
5	29	yes	yes	24 hours post GnRH	Alternate animals

[a]Subcutaneously placed ear implant containing 6 mg of Searle 21009 progestogen.
[b]Intramuscular injections of 100 ug of gonadotropin releasing hormone at 24 hrs after implant removal.
[c]Intravaginal administration of 1 mg of prostaglandin.

Table 2. Estrous activity of cattle during the 16-day AI period.

Group	No. cows	No. exhibiting estrus	Avg. days to estrus	No. exhibiting estrus at interval[a]							
				1	2	3	4	5	6	7	8
1	29	15	9.0	1	2	2	4	0	2	1	3
2	29	27	2.6	2	23	0	2	0	0	0	0
3	29	14	3.2	0	11	0	1	2	0	0	0
4	29	9	6.7	5	0	0	0	1	1	0	2
5	29	8	2.8	7	0	0	0	0	0	0	1

[a]Consecutive, 2-day, post-treatment intervals.

Table 3. Effect of treatments on breeding and calving results.

Group	No. cows	No. bred AI	AI Conception rate, %			AI+natural conception, %			Avg. calving date
			$PGF_{2\alpha}$	No $PGF_{2\alpha}$	Overall rate	$PGF_{2\alpha}$	No $PGF_{2\alpha}$	Overall rate	
1	29	15	71.4	87.5	80.0	100.0	100.0	100.0	4–9
2	29	27	42.9	38.5	40.7	100.0	84.6	89.7	4–9
3	29	14	28.6	14.3	21.4	85.7	100.0	89.7	4–12
4	29	29[a]	14.3	13.3	13.8	100.0	93.3	96.6	4–13
5	29	29[a]	21.4	26.7	24.1	71.4	93.3	82.8	4–11

[a]All animals in the groups inseminated at 12 (group 4) or 24 hours (group 5) post estrus.

Study Findings

Estrous Activity. Implants remained in position without any loss or other noticeable problems and inhibited estrus during the 16 days that they were in place. The progestogen implant-alone treatment (group 2) was the most effective treatment for cycle control as evidenced by the expression of estrous activity during the 16-day, post-treatment, AI period (Table 2). Twenty-seven (23 on days 3 and 4 post-treatment) of the 29 animals in group 2 exhibited estrus during the 16-day AI period as compared to 15 or less for other groups. This supports results for the implant-alone treatment reported earlier.

GnRH treatment 24 hours after implant removal (groups 3, 4 and 5) inhibited estrus when compared to the implant alone group (P<.005). Such inhibition could be because ovulation is induced before follicles produce enough estrogen to cause estrus.

The interval from the time of implant removal to onset of estrus was shorter for implanted animals than for controls (3.4 *vs* 9.0 days, Table 2). Estrus expression was delayed in the group inseminated 12 hours after GnRH (group 4) compared to those inseminated 24 hours post GnRH (group 5) (6.7 *vs* 2.8 days). The insemination in group 4 may have occurred at a time when follicular development and/or estrogen secretion could be disrupted.

Conception. The control group had a higher conception rate to artificial insemination than did any of the treated groups (Table 3). GnRH treated animals had a lower conception rate than animals which received only the implant. AI conception rates among the GnRH-treated groups were comparable. The detrimental effects on conception were apparently temporary since they tend to disappear when conception rates for the total breeding period (AI + natural) are examined.

In contrast, our previous work has not indicated any detrimental effect of the implant alone on fertility. Possibly seasonal differences could account for at least part of the discrepancy as the studies were conducted in different years. The lowered conception of GnRH-treated cattle in the current study could have happened because of the induced hormonal imbalances.

Intravaginal placement of 1 mg of PG at the time of insemination had no significant effect on conception rate. If an effect of PG on the reproductive system were induced, it neither augmented or depressed conception. None of the treatments significantly altered the calving date.

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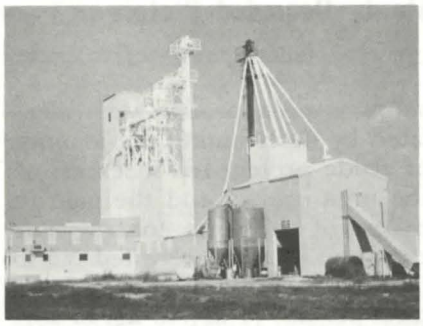
Slowly Degraded Protein May Cut Costs

Terry Klopfenstein
Neal Merchen
John Waller[1]

Supplemental protein costs can be cut in half through the use of slowly degraded proteins, such as corn gluten meal, brewers grains, distillers grains, dehydrated alfalfa and blood meal. When fed with urea, these proteins have been shown to reduce the cost of protein supplementation while providing performance equal to soybean meal.

Proteins included in beef cattle rations are broken down by rumen microbes to volatile fatty acids (VFA's) and ammonia, with some of the ammonia produced reformed into microbial protein. The extent to which a particular protein source is broken down depends upon its rate of degradation. Soybean meal, for example, is degraded to a greater extent than protein found in such products as corn gluten meal, brewers grains, distillers grains, dehydrated alfalfa and blood meal (herein referred to collectively as slowly degraded proteins).

Previous research indicates that growing animals fed high-roughage rations utilize natural protein supplements most efficiently when a large portion escapes ruminal degradation and is digested in the lower intestinal tract. Since the microorganisms occupying the rumen have a nitrogen requirement (in the form of ammonia), supplementation of rations with such slowly degraded proteins alone may result in a less efficient utilization of dietary fiber. This problem can be circumvented by adding urea as part



Protein supplements prepared in this modern mill.

of the supplemental protein. Theoretically, performance of animals fed combinations of urea and slowly degraded proteins should be equal to that of animals fed the soybean meal, thus maximizing the use of nonprotein nitrogen (NPN) and optimizing the use of natural protein.

Such combinations are feasible from two standpoints. Economically, combinations of urea and slowly degraded proteins may be appreciably less costly than soybean meal on a per unit protein basis. Secondly, slowly degraded proteins frequently are byproducts of other industries (i.e., the corn-milling, fermentation and packing industries) and as such, represent a potential protein source for beef production which is less competitive than soybean meal for other classes of livestock and, in recent years, for human consumption. Individually, these sources do not supply large quantities of protein but collectively they probably would meet the needs of beef cattle in the United States.

In many cases, protein sources have been tested above the animal's protein requirement and no differences were observed between sources. Also, some slowly degraded proteins have been tested without adding urea to the ration to supply ammonia for the rumen microorganisms. The proteins tested at Nebraska were evaluated in combination with urea and at levels below the animal's protein requirement.

The protein sources were tested in individual trials and compared to soybean meal, which was the positive control in each trial. The

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Slowly Degraded Protein

(continued from page 11)

value of each protein was calculated by determining the amount of crude protein fed in excess of the urea control and the gain in excess of the urea control. For example, if calves were fed .45 lb (.20 kg) of protein from soybean meal per day [1 lb (.45 kg) of soybean meal] and gain was .25 lb (.11 kg) per day greater than the urea control, then the protein value for soybean meal would be .25 lb (.11 kg) ÷ .45 lb (.20 kg) or .56. This value is an estimate of the utilization efficiency of added natural protein. All proteins were related as a percent of the soybean meal value. The values thus obtained are shown in the third column of Table 1.

Theoretically, a combination of a slowly degraded protein, urea and carrier (corn) can be formulated to simulate the performance obtained with soybean meal. This mixture could be used interchangeably in any situation where soybean meal is used without changing performance. The formulations thus obtained are also shown in Table 1. With low protein sources such as dehy, more than 1 ton (1.02t) of dehy is required to replace 1 ton (1.02t) of soybean meal. Energy contents of these mixtures would be comparable to that in 1 ton (1.02t) of soybean meal. Cattle feeders or the feed industry could formulate these mixtures depending upon their ability to purchase the specific protein sources. The protein sources which are byproducts of grains may be best used when fed in combination with the blood meal or dehy. When slowly degraded proteins are fed, protein quality becomes important and the blood meal and dehy should complement the grain byproducts.

Savings possible through the use of slowly degraded proteins have been calculated for two prices of soybean meal (Table 1). The first price was $270/ton ($270/1.02t) during early May 1977. The second price was $150/ton ($150/1.02t) during early August 1977. All sources saved money when soybean meal was high priced; several saved nearly ½. When soybean meal was priced lower, the slowly degraded proteins would save money but relatively less because of the value of the protein source and the corn for supplying energy.

This list of protein sources is not meant to be comprehensive. Meat meal, for example, is slowly degraded but its value has not been accurately determined. The availability of these protein sources may vary. One should be able to shift among sources as economics dictate without sacrificing cattle performance. The data presented should be considered tentative.

[1]Terry Klopfenstein is Professor, Ruminant Nutrition. Neal Merchen and John Waller are graduate assistants.

Table 1. Value of slowly degraded proteins for beef cattle.

Item	% Protein	Protein value, % of soybean meal	Protein source, corn and urea to equal 1 ton of soybean meal, lb: Protein source	Urea	Corn	Cost[c], $: 5/9/77	8/1/77
Soybean meal	45	100	2000	--	--	270	150
Corn gluten meal	62	200[a]	537	160	1304	147	122
Brewers grains	28	190	1621	152	227	125	95
Distillers grains[b] (light)	28	150	2143	107	--	168	141
Distillers grains[b] plus solubles (dark)	28	130	2471	74	--	190	159
Dehydrated alfalfa	17	150	3529	107	--	148	111
Blood meal	85	176	452	138	1410	170	100

[a]When fed in combination (50:50) with a high quality (high lysine) protein source.

[b]Determined primarily with centrifuged milo grains.

[c]Prices from *Feedstuffs* 5/9/77 for urea, corn, soybean meal, corn gluten meal, brewers grains, distillers grains (light), distillers grains plus solubles (dark), dehydrated alfalfa, and blood meal: $140, 86, 270, 296, 129, 150, 150, 80, 440/ton; 8/1/77: $140, 64, 150, 258, 95, 125, 125, 59, 200/ton.

Feeding Systems fo

D. C. Clanton
J. D. Heldt
M. E. England
L. L. Berger[1]

Two experiments at the North Plate Station have shown that Simmental and Charolais cross steers from Angus X Hereford cows can be fed similarly to Angus x Hereford steers with satisfactory results. The different breeds responded similarly on both a fast growing-finishing program (high grain ration) and a slow growing-finishing program (silage for 112 days followed by a high grain ration). Likewise, there was little economic difference in the two feeding programs. The Charolais and Simmental steers required longer feeding in both programs.

The Charolais and Simmental cross steers gained faster and more efficiently than Angus x Hereford steers, in both feeding programs. When finished to low choice grade the Charolais and Simmental cross steers averaged 11% heavier carcasses, 10% larger rib eye area per hundred weight of carcass, 16% more desirable yield grade, 23% less outside fat and 4% higher cutability.

The Experiments

Two and three-way cross calves resulting from the use of bulls of introduced breeds have become quite common. Charolais cross calves are appearing in feedlots. It has not been fully understood what, if any, changes in feeding systems should be used with these type cattle as compared to the English breeds.

In December 1975 one hundred twenty steers born in March and April 1975 [40 Angus-Hereford crosses (AxH), 40 ½ Charolais, ¼ Angus, ¼ Hereford (CxAH) and 40 ½ Simmental, ¼ Angus, ¼ Hereford (SxAH)] were started on experiment. There were two replications of each breed cross fed in one of two feeding systems: (1) placed on a high grain finishing

Crossbred Steers

ration immediately (fast growing-finishing) and (2) grown on silage and appropriate supplement for 112 days then placed on a high grain finishing ration (slow growing-finishing). The average daily ration (dry matter) the first 112 days for the fast-fed group was 18% corn silage, 73% corn grain and 9% supplement; for the slow-fed group it was 91% corn silage and 9% supplement. From 112 days to slaughter the average daily ration (dry matter) for the fast-fed group was 10% corn silage, 80% corn grain and 10% supplement; for the slow fed group it was 13% corn silage, 77% corn grain and 10% supplement.

In November, 1976, eighty steer calves (40 Red AxH and 40 SxAH crosses) were started on a similar experiment. The Charolais crosses were not used the second year because first year results indicated they were not different from the Simmental crosses, also data from other research indicate the same.

The same Hereford cow herd was used both years to produce the AxH calves. The calves were sired by different bulls for the two experiments but in each case high performing bulls were selected from A.I. studs.

Most of the AxH cows that were used to produce the three-way cross calves were daughters of the same Hereford cow herd used for the production of the AxH calves. In 1975 the Charolais cross calves were sired by three different bulls and the Simmental cross calves were sired by one bull. In 1976 the Simmental cross calves were sired by five different bulls. All of the calves except a few of the Charolais calves were from an A.I. program and born within a 30-day period. They were about 9-months of age at the start of the experiments.

The calves were handled similarly before the start of the experiments. No creep feed was used. Calves in each experiment were weaned together at the same time with the exception of a few Charolais calves in the first experiment. During the post-weaning, pre-experimental period, nearly 60 days, the calves were fed corn silage, alfalfa hay and a small amount of supplement.

Steers were slaughtered when it was felt they would grade a high percent choice with a minimum of yield grade 4's. Visual appraisal, weight, total feed consumed, and time on feed were all taken into consideration when determining slaughter dates.

In calculating cost of gains only feed cost and 12 cents per head per day yardage were included.

Table 1. Fast growing-finishing vs slow growing-finishing programs for breed crosses (Experiment 1 1975–76).

	Fast-feeding			Slow-feeding		
	AxH	SxAH	CxAH	AxH	SxAH	CxAH
No. steers	20	19	20	20	20	20
Days on feed	190	218	218	218	260	260
Weights, lb (kg)						
Initial	516	533	528	516	539	528
	(234)	(242)	(240)	(234)	(244)	(240)
112 days	812	849	842	728	767	754
	(368)	(384)	(382)	(330)	(348)	(342)
ADG (Initial to 112 days)	2.64	2.82	2.81	1.89	2.03	2.02
	(1.20)	(1.28)	(1.27)	(.86)	(.92)	(.92)
Final[a]	1005	1093	1113	1022	1174	1166
	(456)	(496)	(505)	(464)	(533)	(529)
ADG (112 days to slaughter)	2.48	2.30	2.56	2.78	2.75	2.78
	(1.12)	(1.04)	(1.16)	(1.26)	(1.25)	(1.26)
ADG (Initial to slaughter)	2.58	2.57	2.69	2.32	2.44	2.45
	(1.17)	(1.17)	(1.22)	(1.05)	(1.11)	(1.11)
Feed consumed						
First 112 days						
Avg daily est. ME[b]	19.35	19.99	19.43	16.23	16.47	16.39
DM/gain	5.20	5.04	4.93	6.61	6.26	6.26
112 days to slaughter						
Avg daily est. ME	23.32	23.88	23.60	25.86	25.34	24.14
DM/gain	6.50	7.15	6.39	6.50	6.42	6.07
Initial to slaughter						
Est. ME/lb gain (/kg gain)	8.15	8.52	8.01	9.01	8.81	8.48
	(17.93)	(18.74)	(17.62)	(19.82)	(19.38)	(18.66)
DM/gain	5.71	5.97	5.60	6.55	6.36	6.14
Cost of gain/cwt[c] (/100 kg)	33.86	35.14	33.14	34.69	34.40	33.20
	(74.65)	(77.47)	(73.06)	(76.48)	(75.84)	(73.19)
Carcass data						
Hot weight, lb (kg)	623	677	690	634	728	723
	(283)	(307)	(313)	(288)	(330)	(328)
Quality grade[d]	12.5	11.8	12.0	11.2	12.2	12.1
Yield grade	3.3	2.8	2.3	3.3	2.3	2.1
Rib eye area, in²/cwt. (cm²/kg)	1.81	1.85	1.99	1.79	1.90	2.07
	(.26)	(.26)	(.28)	(.25)	(.27)	(.29)
Outside fat, in (cm)	.53	.41	.37	.50	.33	.36
	(1.35)	(1.04)	(.94)	(1.27)	(.84)	(.91)
Internal fat, %[e]	3.3	3.4	3.5	3.7	3.2	3.5
Cutability, %	49.31	50.37	51.36	49.26	51.45	51.97

[a]Live weight adjusted to 62% dress.

[b]ME = metabolizable energy

[c]Corn silage (32% DM) – $20/T, rolled corn – $2.50 bu., supplement for growing – $160/T, supplement for finishing – $120/T, yardage – 12 cents/head/day.

[d]High good = 11 and low choice = 12.

[e]Kidney, heart and pelvic fat.

Results

In the first experiment the AxH fast growing-finishing steers were finished in 190 days while the SxAH and CxAH steers took 218 days. The time for the slow growing-finishing steers was 218 days for the AxH steers and 260 days for the SxAH and CxAH steers. The length of feeding was the result of subjective determinations as to when the steers were ready for slaughter. The carcass data indicate that the steers were slaughtered at almost an ideal time with 89% grading low choice or

(continued on next page)

Feeding Systems

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better and 99% yield graded 3 or better. The slow growing-finishing steers did not quality grade as well as their counterparts on the fast growing-finishing program.

Breed or feeding program did not affect grade indicating the cattle were killed at comparable finish. There was a breed by feeding program interaction caused by the slow growing-finishing group of AxH steers not quality grading as well as their fast growing-finishing counterparts.

The SxAH and CxAH steers gained more than the AxH steers the first 112 days within each feeding program [2.03 and 2.02 lb (.92 and .92 kg)/day vs 1.89 lb (.86 kg) in the slow growing-finishing group and 2.82 and 2.81 lb (1.28 and 1.27 kg) vs 2.64 lb (1.20 kg) in the fast growing-finishing group]. There was no breed difference in weight gain from 112 days to slaughter, likewise, there was no significant difference when combining the two periods for the entire feeding program.

Steers on the fast growing-finishing program gained the fastest the first 112 days. Their gains were the slowest from then until slaughter but had a faster average daily gain for the entire feeding period [2.61 lb (1.19 kg) vs 2.40 lb (1.09 kg)]. Steers on the fast growing-finishing program reached slaughter weight in less time (average of 39 days) at 32 lb (14.5 kg) lighter carcass weights.

A feeding program by breed interaction for gain was due to the poor gains of the SxAH steers on the fast growing-finishing program during the time between 112 days to slaughter.

The SxAH and CxAH steers were more efficient than the AxH the first 112 days in both feeding systems. The same trend in efficiency was also present from 112 days to slaughter. When comparing the total feeding period there was no difference in efficiency due to breed. The lack of a trend for better efficiency in the three way cross steers was attributed to one steer that bloated and one steer that was foundered in the SxAH cross steers in the fast growing-finishing group.

The fast growing-finishing steers were more efficient the first 112 days but less efficient from 112 days to slaughter. During the total feeding program the fast growing-finishing steers required less feed per unit of gain than the slow growing-finishing steers.

There was not a great difference in the cost of gains although a trend favored the Charolais and Simmental cross steers and the fast growing-finishing steers. The exception was the group of fast growing-finishing SxAH steers which had the bloater and the foundered steer.

The 3-way cross steers when compared to the AxH steers had the heaviest carcasses, largest rib eye areas per unit of weight, more desirable yield grades and higher cutability. They had less outside fat over the 12th rib with no difference in kidney, heart and pelvic fat (internal fat).

Table 2. Fast growing-finishing vs slow growing-finishing programs for breed crosses (Experiment 2 1976–77).

	Fast-feeding		Slow-feeding	
	AxH	SxAH	AxH	SxAH
No. steers	20	20	19	20
Days on feed	191	212	226	254
Weights, lb (kg)				
Initial	536	551	533	550
	(234)	(250)	(242)	(250)
112 days	844	872	778	792
	(383)	(396)	(353)	(359)
ADG (Initial to 112 days)	2.75	2.87	2.19	2.16
	(1.25)	(1.30)	(.99)	(.98)
Final[a]	1011	1118	1068	1173
	(486)	(508)	(484)	(532)
ADG (112 days to slaughter)	2.12	2.46	2.54	2.68
	(.96)	(1.12)	(1.15)	(1.22)
ADG (Initial to slaughter)	2.49	2.68	2.37	2.45
	(1.13)	(1.22)	(1.08)	(1.11)
Feed consumed				
First 112 days				
Avg daily est. ME[b]	22.03	20.85	18.21	17.78
DM/gain	5.39	5.36	7.34	7.25
112 days to slaughter				
Avg daily est. ME	23.86	24.41	25.90	25.36
DM/gain	7.80	6.95	7.14	6.57
Initial to slaughter				
Est ME/lb gain (/kg gain)	9.16	8.42	9.33	8.98
	(20.15)	(18.52)	(20.53)	(19.76)
DM/gain	6.24	6.05	7.23	6.84
Cost of gain/cwt.[c] (/100 kg)	37.49	34.86	36.19	34.75
	(82.65)	(76.85)	(79.78)	(76.61)
Carcass data				
Hot weight, lb (kg)	627	693	662	727
	(284)	(314)	(300)	(330)
Quality grade[d]	12.4	12.1	12.3	12.0
Yield grade	3.2	2.6	3.3	2.5
Rib eye area, in²/cwt. (cm²/kg)	1.69	1.83	1.63	1.84
	(.24)	(.26)	(.23)	(.26)
Outside fat, in (cm)	.38	.34	.44	.33
	(.97)	(.86)	(1.12)	(.84)
Internal fat, %[e]	3.7	3.2	3.3	3.3
Cutability	49.50	50.85	49.10	51.10

[a]Live weight adjusted to 62% dress.

[b]ME = Metabolizable energy.

[c]Corn silage (32% DM) – $20/T, rolled corn – $2.50/bu., supplement for growing – $160/T, supplement for finishing – $120/T, yardage – 12 cents/head/day.

[d]High good = 11 and low choice = 12.

[e]Kidney, heart and pelvic fat.

In the second trial the arbitrary selecting of slaughter dates resulted in 99% carcasses grading low choice or better and 94% yield graded 3 or better.

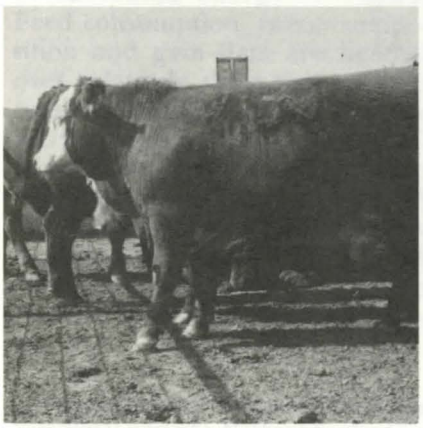
There were no breed differences in average daily gains the first 112 days, however the SxAH cross steers gained the fastest from 112 days until slaughter [2.57 lb (1.17 kg) vs 2.33 lb (1.06 kg) and during the entire feeding period 2.56 lb (1.16) vs 2.43 lb (1.10 kg)].

As in the first experiment, the fast growing-finishing steers gained the fastest the first 112 days, the slowest from 112 days to slaughter and the fastest over the entire feeding program [2.58 lb (1.17 kg) vs 2.41 lb (1.10 kg)].

The fast growing-finishing steers were more efficient in terms of feed per unit of gain but the gains were more costly. There were no interacting effects between breed and feeding program.

The SxAH steers when compared to the AxH steers had the heaviest carcasses, largest rib eye areas per unit of weight, more desirable yield grades and higher cutability. They had less outside fat with slightly less internal fat. Their quality grade averaged lower although both groups averaged low choice.

D. C. Clanton is Professor, Animal Science. J. D. Heldt is District Extension Specialist (Livestock). M. E. England and L. L. Berger are Research Assistants.



Angus-Hereford cross steers used in Experiment 2.

Energy Efficiency

A Guide For Marketing?

James D. Heldt
Marijane England
Donald C. Clanton[1]

Choosing the best marketing time is related to whether or not cattle will produce a profitable and desirable end product. Cattle feeders have traditionally used final weight, total days fed or some combination of these traits to make this choice.

Recent research at other experiment stations has suggested that cattle feeders could use an energy efficiency end point to determine when to slaughter. This idea says that when cattle reach a crertain comparative compositional end point, such as low choice, yield grade 3 carcasses, there will be a reduction in efficiency of their energy utilization. The end point (weight, age, days on feed) at which this change in efficiency of energy utilization occurs is the most desirable time to slaughter the cattle.

Energy efficiency is measured as the megacalories (Mcal) of net energy for gain (NE_g) per pound (kg) of body weight gain or

$$\frac{NE_g \text{ [Mcal/lb (kg)]}}{\text{1 lb (kg) gain}}$$

The net energy (NE) of a feedstuff or ration is composed of net energy for maintaining the animal (NE_m) plus the net energy available for gain or production (NE_g). This can be expressed as $NE = NE_m + NE_g$. Thus, the NE of a feed or ration is the remaining energy after all metabolism losses and is the energy utilized by the animal for maintenance and gain (production).

Calculations necessary to determine energy efficiency are: (1) using the National Research Council table for NE, determine the NE_m required for the weight of the animal being considered, (2) then, determine:

(a) $\frac{NE_m \text{ required for animal}}{NE_m \text{ content of ration.}}$

(b) Subtract (a) from daily dry matter intake and multiply by NE_g content of ration.

(c) Divide (b) by average daily gain.

(3) Final product is NE_g, [Mcal/lb (kg)] per lb (kg) gain.

In summary, energy efficiency is:

$$NE_g \text{ per unit gain} = \frac{DDMI - \frac{(NE_m \text{ req})}{(NE_m \text{ diet})}(NE_g \text{ diet})}{ADG}$$

Where

DDMI = Daily dry matter intake

NE_m req = Net energy for maintenance required by animal.

NE_m diet = Net energy content of ration for maintenance.

NE_g diet = Net energy content of ration for gain.

ADG = Average daily gain.

Although the NE system is widely accepted in the feeding industry for balancing rations, predicting gain, costs of gain and returns, selecting type of feeder cattle and feeding alternatives, use of energy efficiency ratios to determine time to market is much more limited. The research work that has been done in this area is

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Energy Efficiency

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somewhat restrictive in its application to the feedlot industry.

Experiments

An evaluation of the usefulness of using the decrease in energy efficiency to determine correct time to market was included as an objective in an experiment designed to determine if different (genetic) types of cattle require different feeding systems to reach an optimum end product (similar quality and yield grade).

The cattle used in evaluating this system are described in this report in another article entitled "Feeding Systems for Different Crossbred Steers." Steer calves were sired by bulls of Angus (A), Red Angus (RA), Simmental (S) and Charolais (C) breeds. The C and S sired calves were out of Angus x Hereford crossbred cows. The A and RA sired calves were produced by Hereford dams. The calves began the feeding program early in the winter (December 1975 – November 1976), about 60 days post weaning. They were fed *ad libitum* until they were slaughtered at a range in age of 14½ – 16½ months.

Different energy levels were fed to the steers during both years. The two feeding systems were either (a) to grow the steers for 112 days on a corn silage and protein supplement ration, then finish them on a ration containing 0.63 Mcal NE_g/lb of ration (1.39 Mcal NE_g/kg); or (b) to start the steers on a ration containing 0.63 Mcal NE_g/lb of ration (1.39 Mcal NE_g/kg) and feed for the entire feeding period.

An attempt was made to slaughter the two genetic types of cattle fed the two feeding programs at the same physiological end point. This would allow an evaluation of the efficiency of producing a similar relative amount of lean and fat in the carcasses (NE/gain).

Carcass data and feedlot performance data are summarized in Table 1. This shows the overall similarity in the carcasses compared between feeding systems. Thus, it seemed as if the cattle were slaughtered at comparable physiological end points as they produced low choice, yield grade 2.5 – 3.0 carcasses when averaged over both years of the study.

Table 1. Average performance of steers fed differently.

Item	Grown & finished[a] 1975–76		Grown & finished[a] 1976–77		Finished[b] 1975–76		Finished[b] 1976–77	
No. steers	60[c]		39		59		40[d]	
Days on feed	246		240		209		202	
Initial wt, lb (kg)	527.7	(239.4)	541.6	(245.7)	525.5	(238.4)	543.3	(246.5)
Final wt, lb (kg)	1120.4	(508.2)	1120.5	(508.2)	1070.3	(485.5)	1064.8	(483.6)
ADG, lb (kg)	2.40	(1.09)	2.41	(1.09)	2.61	(1.19)	2.59	(1.18)
DM/gain	6.35		7.04		5.76		6.15	
Hot carcass wt, lb (kg)	694.7	(315.1)	694.7	(315.1)	663.6	(301.0)	660.2	(299.9)
Quality grade[e]	11.8		12.2		12.1		12.3	
Yield grade	2.6		2.9		2.8		2.9	
Outside fat[f], in (cm)	.40	(1.01)	.39	(.99)	.44	(1.11)	.36	(.91)

[a]Grown for 112 days on 91% (DM basis) corn silage + 9% protein supplement, then finished.
[b]Received (DM basis) 80.5% corn, 10.0% corn silage + 9.5% protein supplement throughout entire feeding period.
[c]1975–76 – 20 Angus x Hereford, 20 Simmental x Hereford and 20 Charolais x Hereford.
[d]1976–77 – 20 Red Angus x Hereford, 20 Simmental Angus Hereford.
[e]High good = 11, low choice = 12.
[f]Fat thickness at the 12th rib.

Table 2. Energy efficiency during week of slaughter.

Feeding program	Growing-finishing						Finishing					
Breed type	AxH		SxAH		CxAH		AxH		SxAH		CxAH	
Year	75-76	76-77	75-76	76-77	75-76	76-77	75-76	76-77	75-76	76-77	75-76	76-77
Mcal NE/ unit gain	45.19	5.37	4.08	4.61	4.65	—	24.28	3.90	8.61	5.12	6.85	—

Evaluating the net energy efficiency during the final portion of the finishing period was done by using dry matter intake for a pen of steers between experimental weigh periods (14 day interval). The average weight of the steers during this interval was used to determine NE_m requirement from the formula $NE_m = 43\ W^{.75}$, where $W^{.75}$ is the metabolic size of the animal. The net energy efficiency of producing body protein and fat was calculated using the formulas previously described.

Discussion

Much variation existed in the energy efficiency ratios obtained by this method. A typical example is shown in Figure 1, which shows the energy efficiency for the Simmental cross (SxAH) steers fed both feeding programs in 1976–77. Data for the other breed crosses in other years are very similar in the amount of variability. If cattle were marketed when there was an apparent decrease in energy efficiency the cattle probably would not have been at the same compositional end point. Also, as is exemplified in Figure 1, the steers

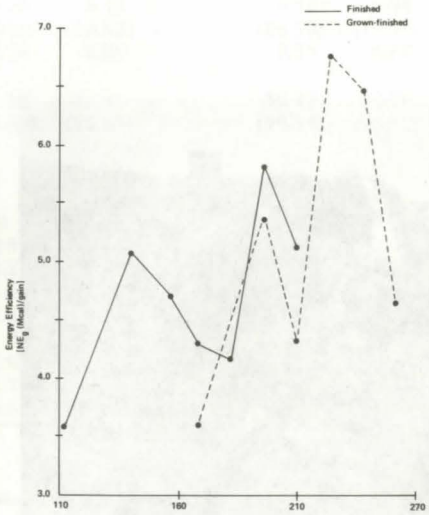

Figure 1. Typical variability in energy efficiency of feedlot steers.

returned to an increased efficiency level in a subsequent weigh period. Thus, it seems as if these fluctuations in energy efficiency cannot effectively be used to determine the slaughter point of feedlot cattle.

To determine the slaughter point for this experiment, data on weight, days on feed, feed consumption and subjective determination of "readiness" were considered. The final energy efficiency levels for the different breed types fed the different programs during the study would also indicate that a decrease in efficiency had not been reached at the time the steers were slaughtered. The energy efficiency levels for the final weigh period are shown in Table 2. With little exception, the magnitude of the efficiency ratios is quite acceptable. The exception (AxH, 1975–76, both feed systems) can be partially explained by extremely hot weather during that weigh interval, fill differences and it also would be expected to return to an increased efficiency based on the variability as shown in Figure 1.

Although the net energy system has many uses in the feedlot industry, it appears that energy efficiency determination of slaughter has limited usefulness on a practical basis. This limitation is partly due to the difficulty in measuring energy efficiency and fill differences. The youngness of the cattle when they were slaughtered may also be a partial explanation. Mature cattle placed on similar rations may respond to the concept of decreased energy efficiency. Feed consumption, ration composition and gain data are needed over relatively short time periods (weekly). Possibly, as more data are accumulated on other factors affecting metabolic efficiency, such as genetic background, form of diet, climate, age of cattle and nutrient balance, a system such as net energy efficiency can be used to assist in evaluating "finished" cattle.

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Wheat Straw in Growing Rations

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Three million acres of wheat produce about three million tons each of grain and straw annually in Nebraska. Although the straw is relatively low in energy it does offer a large quantity of available feed and needs to be considered as a possible energy source in growing ruminant rations.

Chemical treatment of wheat straw is effective in increasing its digestibility and energy value according to results of one lamb digestion and growth trial and several cattle trials. NaOH also appears to be more effective than $Ca(OH)_2$ as a chemical treatment.

Four percent NaOH treated wheat straw improved average daily gain and feed utilization over untreated wheat straw fed at the same rate. Minerals balanced for high sodium intakes on treated wheat straw rations improved performance. More research is needed before this process can be applied successfully to large scale operations.

Previous Nebraska research has shown that chemical treatment is effective in improving energy utilization in corn crop residues, however, little is known about its effect on wheat straw. A lamb digestion and growth trial, and three cattle growth trials were conducted to evaluate the use of untreated and treated wheat straw for growing ruminants.

Lamb Trials

In the digestion trial, 24 crossbred wethers weighing 80 lb (36 kg) initially were allotted to six treatments. The following treatment combinations of NaOH (sodium hydroxide) and $Ca(OH)_2$ (calcium hydroxide) were added as a percent of the straw dry matter: 4:0, 4:1, 3:2, 3:1, 1:3, 0:0 (units chemical/units straw dry matter). The chemical was added in solution to ground straw and then water was added to increase the moisture content to 60 percent. The straw then was allowed to react for a minimum of five days before feeding. A ration containing 75% wheat straw and 25% brewers dried grain-urea based

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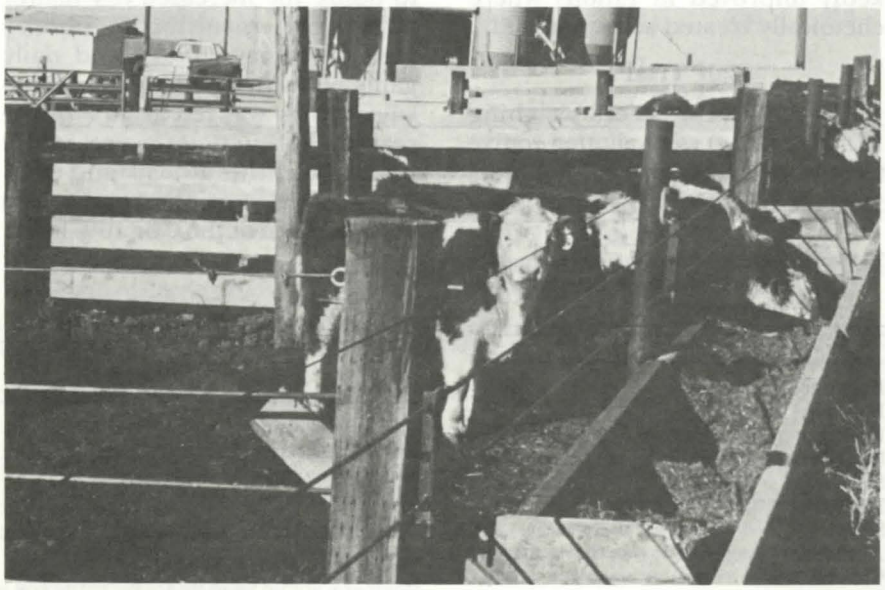

Weaning calves wintered on treated and untreated wheat straw.

Wheat Straw

(continued from page 17)

supplement (Table 1) was fed at 85% the level consumed before the trial started.

Digestibility of wheat straw was calculated by difference, assuming the supplement to be 66% digestible. All chemical treatments had improved digestibility over the control (Table 2). Treatment with the 1:3–Na:Ca ratio increased digestibility by 4.9 percentage units; while the 4:0 treatment increased digestibility by as much as 10 percentage units over the untreated wheat straw.

A lamb growth trial also was conducted with the previously listed chemical treatments. Thirty-six lambs weighing 66 lb (30 kg) initially were individually fed 75% wheat straw and 25% brewers dried grain-urea based supplement (Table 1) in a 61 day growth trial.

Lambs on the untreated straw ration did not consume enough straw to maintain their own weight (Table 2). All chemical treatments performed far superior to the untreated straw, with lambs fed the 4:0 ratio gaining .346 lb (.16 kg)/hd/day. Daily dry matter intake increased 125% over the control when lambs were fed 3% NaOH and 2% $Ca(OH)_2$ treated wheat straw. Feed efficiencies were markedly improved in rations where chemically treated straw was fed.

Calf Trial I

In trial I, 100 steers weighing 533 lb (242 kg) were allotted to five rations in an 81 day trial. Calves were fed: 0, 10, 20, 30 or 40% ground wheat straw with corn silage, soybean meal and dicalcium phosphate making up the remaining portion of a balanced ration (Table 3).

As level of wheat straw increased in the ration, average daily gain decreased (Table 4). Steers receiving no wheat straw performed much better than the cattle on the straw rations. Daily dry matter intake was highest for calves on the 30% wheat straw ration. This higher intake had no apparent advantage as the calves were unable to utilize the increased dry matter effectively, resulting in poorer feed efficiency. Intake and daily gains both dropped sharply when wheat straw was fed as 40% of the ration. Efficiencies were much poorer for the 20, 30 and 40% wheat straw rations than when straw was fed at the 0 or 10% level.

Calf Trial II

Trial II was conducted to evaluate the use of 4% NaOH treated and untreated wheat straw fed at two different levels in growing calf rations. One hundred steers weighing 656 lb (298 kg) initially were randomly allotted to five rations in a 114-day growth trial. Cattle were fed rations containing 0% wheat straw; 30% treated, 30% untreated; 60% treated or 60% untreated wheat straw. Corn silage, soybean meal and dicalcium phosphate were also fed in the rations balanced for 11.5% crude protein (Table 5).

Cattle on the treated wheat straw rations performed better than those on the untreated straw (Table 6). Steers fed 30% treated wheat straw gained 12.6% faster and 5.0% more efficiently than those fed 30% untreated wheat

Table 1. Composition of supplements used in the lamb digestion and growth trial.

	% DM
Brewers dried grains	78.37
Molasses	12.00
Urea	4.88
Dicalcium phosphate	2.86
Salt	1.2
Limestone	.328
Sulfur	.228
Antibiotics	.08
Vitamin ADE	.04
Trace minerals	.12

Table 2. Treatment of wheat straw with different ratios of sodium and calcium hydroxide digestibility and rate and efficiency of gain of lambs.

Treatments	% Digestibility[a]	Daily gain[b] lb	Daily gain[b] (kg)	Daily feed[c] lb	Daily feed[c] (kg)	Gain/feed
4 NaOH:O $Ca(OH)_2$	65.5	.346	(.157)	2.15	(.98)	.157
4 NaOH:1 $Ca(OH)_2$	64.0	.333	(.151)	2.14	(.97)	.151
3 NaOH:2 $Ca(OH)_2$	63.1	.320	(.137)	2.26	(1.03)	.135
3 NaOH:1 $Ca(OH)_2$	60.6	.278	(.126)	1.94	(.88)	.144
1 NaOH:3 $Ca(OH)_2$	60.4	.225	(.102)	1.83	(.83)	.123
Control	55.5	–.042	(–.019)	1.00	(.45)	–.142

[a]Rations fed to four individually penned lambs/treatment. Organic matter digestibilities calculated by difference assuming the supplement to be 66% digestible.

[b]Rations fed *ad libitum* to six lambs/treatment for 61 days.

[c]Dry matter basis.

Table 3. Composition of rations used in cattle growth trial I.

Ration	% Dry matter: Wheat straw	Corn silage	Soybean meal	Dicalcium phosphate	Limestone
0% Wheat straw	0	91.19	8.53	.19	.09
10% Wheat straw	10	80.02	9.64	.24	.10
20% Wheat straw	20	68.86	10.74	.30	.11
30% Wheat straw	30	57.69	11.84	.35	.12
40% Wheat straw	40	46.52	12.94	.41	.13

Table 4. The level of wheat straw on rate and efficiency of gain of steers trial I[a].

Treatments	Daily gain[b] lb	Daily gain[b] (kg)	Daily feed[c] lb	Daily feed[c] (kg)	Feed/gain
0% Wheat straw	2.46	(1.12)	17.6	(8.0)	7.15
10% Wheat straw	2.15	(.98)	16.7	(7.6)	7.77
20% Wheat straw	1.99	(.90)	18.0	(8.2)	9.05
30% Wheat straw	1.91	(.87)	18.7	(8.5)	9.79
40% Wheat straw	1,70	(.77)	15.9	(7.2)	9.35

[a]Twenty steers per treatment fed 81 days.

[b]Steers were weighed full on the 81st day and the final weight was adjusted with a 4% shrink.

[c]Dry matter basis.

Table 5. Composition of rations used in cattle growth trial II.

Ration	% Dry matter			
	Wheat straw	Corn silage	Soybean meal	Dicalcium Phosphate
0% Wheat straw	0	91.14	8.53	.34
30% Treated wheat straw	30	57.60	11.84	.56
30% Untreated wheat straw	30	57.60	11.84	.56
60% Treated wheat straw	60	24.08	15.15	.77
60% Untreated wheat straw	60	24.08	15.15	.77

Table 6. Level and treatment of wheat straw on rate and efficiency of gain of steers trial II[a].

Treatments[b]	Daily gain[c]		Daily feed[c]		Feed/gain
	lb	(kg)	lb	(kg)	
0% Wheat straw	2.13	(.97)	21.9	(10.0)	10.27
30% Treated wheat straw	1.79	(.81)	26.3	(12.0)	14.67
30% Untreated wheat straw	1.59	(.72)	24.5	(11.1)	15.40
60% Treated wheat straw	1.43	(.65)	21.1	(9.6)	14.76
60% Untreated wheat straw	1.14	(.52)	21.4	(9.7)	18.86

[a]Twenty steers per treatment for 114 days.

[b]Wheat straw was treated with four parts NaOH per 100 parts wheat straw dry matter.

[c]Steers were weighed after an overnight shrink on day 114. Steers were fed an equal amount of standard corn silage ration on days 110 through 113.

[d]Dry matter basis.

straw. On the 60% wheat straw rations, chemical treatment of straw improved average daily gain 25.4% and feed efficiency 27.8% over the untreated wheat straw ration. Efficiencies were poor for all straw rations. Steers receiving no wheat straw performed better than cattle on the straw containing diets. Dry matter intake was greatest on the 30% wheat straw rations.

Calf Trial III

Trial III was conducted to evaluate treated and untreated wheat straw and the effect of balancing minerals for high sodium intakes on treated straw rations. One hundred-twenty steers weighing 442 lb (201 kg) initially were randomly allotted to five rations in a 109-day growth trial. Steers were fed rations containing corn silage and: 0% wheat straw; 50% untreated straw; 50% treated wheat straw plus mineral additions; 80% treated wheat straw with no mineral additions; or 78% treated wheat straw plus mineral additions.

All rations were balanced for 11.5% crude protein and the minimum mineral requirements (Table 7). The rations with the mineral additions were balanced for the following mineral ratios: Na:K, 1:1; Na:Cl, 1.7:1, Na:Ca, 2:1, and Na:Mg, 6:1. These ratios were used to obtain a more favorable mineral balance for the steers on the NaOH treated wheat straw rations.

Cattle receiving no wheat straw performed far better than steers on the straw rations (Table 8). Chemical treatment again improved performance over the untreated straw ration. Steers fed 50% treated wheat straw had 18.7% greater average daily gain and were 12.7% more efficient than those fed 50% untreated wheat straw. Mineral additions to treated straw rations improved performance over similar rations without mineral additions. Cattle fed the high level of treated wheat straw plus minerals gained 20.2% faster and 18.8% more efficiently than those on the treated wheat straw without minerals. Dry matter intake was greatest for cattle receiving no wheat straw [13.5 lb (6.1 kg)/hd/day] and least for the cattle fed 80% treated wheat straw without minerals [11.7 lb (5.3 kg)/hd/day].

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[1]Gary Lesoing is a graduate assistant, Ivan Rush is District Extension Specialist (Livestock), Terry Klopfenstein and John Ward are professors of Ruminant Nutrition.

Table 7. Composition of rations used in calf growth trial III.

Ration	% Dry matter					
	Wheat straw	Corn silage	Soybean meal	Dicalcium Phosphate	$CaCl_2$	MgO
0% Wheat straw	–	91.14	8.53	.34	–	–
50% Untreated wheat straw	50.00	34.02	15.27	.71	–	–
50% Treated wheat straw + minerals	50.00	32.23	15.47	.98	.285	.038
80% Treated wheat straw – minerals	79.81	–	19.28	.91	–	–
78% Treated wheat straw + minerals	78.22	–	19.36	1.03	1.17	.22

Table 8. Effect of treatment of wheat straw and balancing minerals for high sodium intake on treated wheat straw rations, on rate of efficiency of gain of steers.[a]

Treatment[b]	Daily gain[c]		Daily feed[d]		Feed/gain
	lb	(kg)	lb	(kg)	
0% Wheat straw	2.33	(1.06)	13.5	(6.1)	5.79
50% Untreated wheat straw	1.34	(.61)	12.2	(5.5)	9.05
50% Treated wheat straw + minerals	1.59	(.72)	12.8	(5.8)	8.04
80% Treated wheat straw – minerals	1.19	(.54)	11.7	(5.3)	9.94
78% Treated wheat straw + minerals	1.43	(.65)	12.1	(5.5)	8.44

[a]Twenty-four steers per treatment for 109 days.

[b]Wheat straw was treated with 3.15 parts NaOH and 1.19 parts of KOH per 100 parts of wheat straw dry matter.

[c]Steers were weighed after an overnight shrink on day 109. Steers were fed an equal amount of a standard corn silage ration on days 103 through 108.

[d]Dry matter basis.

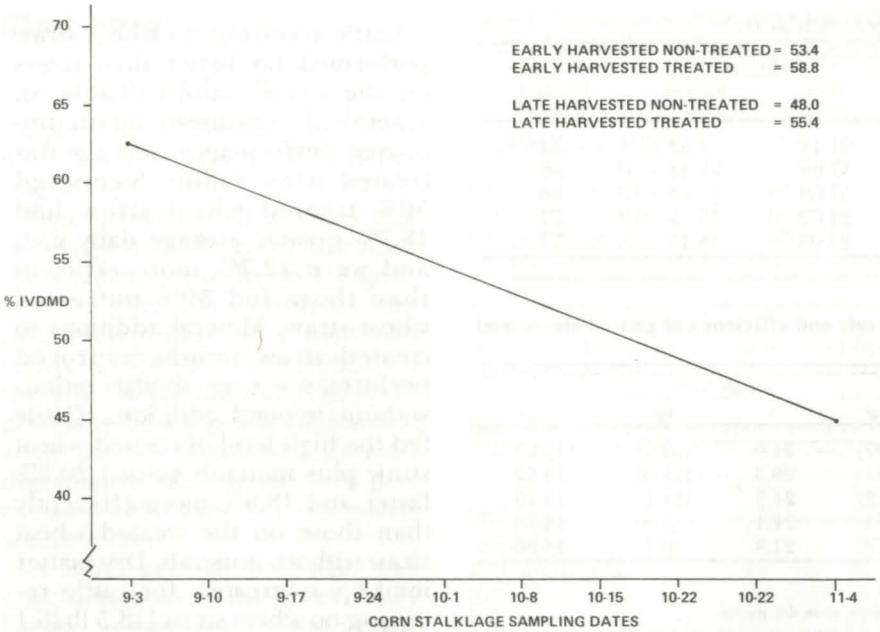


Figure 1. ***In vitro*** **dry matter disappearance of corn stalks harvested over time (1976).**

Crop Residues

Harvest Date, Chemical Treatment

John Paterson
Larry Berger
Terry Klopfenstein[1]

With more corn being harvested and stored as high moisture grain, the accessibility to cornstalks for harvest comes earlier than usual. If left unharvested for a prolonged period after the grain has been harvested, feeding value of the stalk may decrease.

Laboratory analysis (artificial rumen digestibility) of cornstalks showed an almost linear decrease in digestibility over time (Figure 1). Weekly samples were collected from three weeks before high moisture grain harvest until five weeks after the grain had been combined. Harvest occurred the last week of September through the first week of October, when the grain was about 25% moisture.

Growth trials at Nebraska have shown that the chemical treatment of crop residues improves feeding quality. Steer calves and lambs fed chemically treated corn cobs or stalks increased average daily gains and improved feed to live weight gain conversions.

Trials with steer calves were conducted to compare the effects of harvesting cornstalks shortly after grain harvest with harvesting the stalks several weeks later, and effects of treating the stalks with either a combination of sodium and calcium hydroxide [NaOH or $Ca(OH)_2$] or with NaOH alone.

Trial 1. This trial compared steers fed stalklage harvested 3 to 10 days after high moisture grain harvest to steers fed stalklage left in the field four weeks before being harvested. Stalks from both periods were harvested with a John Deere 5400 chopper with a stalker head.

Water was added to increase moisture level to 60% and stalks either were ensiled directly in bunker silos, or were treated with a combination of three parts NaOH to one part $Ca(OH)_2$ at a rate of four parts of the mixture to 100 parts of stalk dry matter and then ensiled.

The four stalklage rations were fed (dry matter basis) at the rate of 78% stalks and 22% supplement (Table 1). Rations were formulated for 12% crude protein such that half of the supplemental protein equivalent came from the brewers grains and half from the urea. The four stalklage plus corn silage rations were formulated (dry matter basis) to be 41.4% stalks, 41.4% corn silage and 17.2% supplement. A corn silage treatment was added as a comparison to the stalklage and stalklage plus corn silage treatments.

Harvest Date Important

Cattle fed the early harvested untreated stalks (EHUT) gained .45 lb (.20 kg) per day more than those fed the late harvested untreated stalks (LHUT) and were 32.7% more efficient in converting feed to live weight gains (Table 2). Steers fed corn silage alone gained .33 lb (.15 kg) and .78 lb (.35 kg) per day more and were 12.9 and 49.9% more efficient in producing these gains than the EHUT or LHUT fed steers, respectively.

Adding corn silage to EHUT stalks did not cause any improve-

Table 1. Composition of supplements used in steer growth trials.[a]

	Trial 1		Trial 2		
Ingredient	Stalks	Corn silage	Untreated stalks	Treated stalks	Corn silage
Brewers dry grains, %	68.1	83.3	30.5	25.7	24.1
Blood meal, %	–	–	30.5	25.7	24.1
Meat meal, %	–	–	30.5	25.7	24.1
Molasses, %	18.6	–	–	–	–
Urea, %	7.3	4.4	5.9	5.0	3.2
Animal fat, %	2.3	3.0	–	–	–
Dicalcium phosphate, %	2.3	4.2	–	–	19.4
Limestone, %	–	1.4	–	5.7	–
Potassium chloride, %	–	–	–	10.7	–
Magnesium oxide, %	–	–	–	1.4	–
Salt, %	1.4	3.5	2.3	–	4.5
Trace minerals, %	.04	.10	.10	.10	.2
Vitamin premix, %	.09	.11	.20	.20	.3
Rumensin, mg/hd/day	–	–	200.0	200.0	200.0

[a]Dry matter basis.

Table 2. The effect of chemical treatment, harvest date and the addition of corn silage to stalklage rations on rate and efficiency of gain on steers.[a,b]

	EH[c] stalklage		LH stalklage		EH stalklage + CS		LH stalklage + CS		
	Un-treated	3 NaOH: 1 Ca(OH)₂	Un-treated	3 NaOH: 1 ca(OH)₂	Un-treated	3 NaOH: 1 Ca(OH)₂	Un-treated	3 NaOH: 1 Ca(OH)₂	CS
Daily gain, lb	1.38 (.63)	1.29 (.59)	.93 (.42)	1.41 (.64)	1.36 (.62)	1.34 (.61)	1.11 (.50)	1.29 (.59)	1.71 (.78)
Daily feed[d], lb	14.90 (6.76)	17.70 (8.30)	13.80 (6.26)	15.30 (6.94)	14.80 (6.71)	16.30 (7.39)	14.20 (6.44)	14.50 (6.58)	16.66 (7.56)
Feed/gain	11.00	13.80	14.60	11.30	10.84	12.49	12.28	11.78	9.74

[a]Numbers in parentheses expressed in kilograms.

[b]Trial length 113 days with 18 steers per treatment, average initial weight of 580 pounds. corn silage rations contained 41.4% stalks, 41.4% corn silage and 17.2% supplement; sup-

[c]EH = early harvest, LH = late harvest, CS = corn silage.

[d]Dry matter basis, stalklage rations contained 78% stalks, 22% supplement; stalklage + plement based on brewers grains and urea.

ment in daily gains, but an improvement of .18 lb (.08 kg) per day was measured when silage was added to LHUT stalks. EHUT plus corn silage-fed steers gained .25 lb (.11 kg) per day more and were 13% more efficient than were the LHUT plus corn silage-fed steers. Cattle fed only corn silage gained .35 lb (.16 kg) and .60 lb (.27 kg) per day more than EHUT plus corn silage- or LHUT plus corn silage-fed cattle, with corresponding improvements in feed efficiency of 11.3 and 26.1%, respectively.

Average daily gains of early harvested-treated (EHT) and EHUT fed steers were similar. However, the EHT-fed steers consumed more dry matter causing a 25.5% depression in feed efficiency (13.8 *vs* 11.0). The chemical treatment of the late harvested stalks (LHT) improved daily gains [1.41 lb (.64 kg) *vs* .93 lb (.42 kg)] and improved feed efficiency by 29% over the LHUT-fed cattle (11.3 *vs* 14.6). No differences in daily gain were measured between EHUT plus corn silage fed steers and EHT plus corn silage fed steers [1.36 lb (.62 kg) *vs* 1.34 lb (.61 kg)]. Feed efficiencies followed the same trend as steers fed the all-stalklage rations. Cattle fed LHT plus corn silage rations had improved daily gain of .18 lb (.08 kg) and feed efficiency of 4.2% over the LHUT plus corn silage-fed steers.

Trial 2. This trial compared performance of steers fed stalklage harvested within a day after high moisture corn was combined with those fed stalklage that had been left in the field three weeks after the grain harvest. A John Deere chopper again was used for both collections. Stalks from the early harvest were sufficiently high in moisture to allow direct ensiling. The EHT were treated with NaOH to provide 4 lb (1.8 kg) of hydroxide to 100 lb (45.4 kg) of stalk dry matter. Stalks from the late harvest had water added to increase their moisture level to 60 percent. These stalks either were ensiled directly or were treated with NaOH at the same rate as EHT stalks. All stalks were ensiled in Eberhart Silo-Press bags. A corn silage treatment again was added as a comparison to the stalklage treatments.

Steers were implanted with 36 mg Ralgro at the beginning of the trial and again after 63 days. Supplementation for all rations was formulated so that 25% of the supplemental crude protein equivalent came from urea and the remaining 75% from equal dry matter weights of brewers grains, blood meal and meat meal (Table 1). Rumensin was added to the supplements to provide 200 mg/hd/day. To help reduce the effects of sodium on animal mineral balance, all treated rations had potassium chloride, magnesium oxide and calcium carbonate added.

Results – Trial 2. Cattle fed EHUT stalk rations gained .32 lb (.15 kg) per day more than LHUT-fed cattle and were 7% more efficient (Table 3). Steers fed the corn silage gained .96 lb (.44 kg) and 1.28 lb (.58 kg) per day more and were 26 and 35% more efficient than the EHUT- or LHUT-fed steers, respectively. The addition of 4% NaOH to the early harvested stalks improved daily gain .45 lb. (.20 kg) and feed efficiency 24% over the EHUT fed steers. Chemical treatment of late harvested material increased daily gain .20 lb (.09 kg) and feed efficiency 5.6%.

Conclusions

Results from two steer growth trials show a decrease in the feeding value of cornstalks harvested several weeks after high moisture grain had been combined. This late harvest is similar to the time

(continued on next page)

Table 3. The effect of harvest date of cornstalks and treatment with sodium hydroxide on rate and efficiency of gain of feeder steers.[a,b]

	Early harvested stalks		Late harvested stalks		
	Untreated	4% NaOH[c]	Untreated	4% NaOH[b]	Corn silage
Initial wt., lb	527 (239)	500 (227)	526 (239)	527 (239)	530 (240)
Daily gain, lb	1.48 (.67)	1.93 (.88)	1.16 (.53)	1.36 (.62)	2.44 (1.11)
Daily feed[d], lb	13.58 (6.16)	14.23 (6.45)	11.41 (5.18)	12.67 (5.74)	17.74 (8.05)
Feed/gain	9.17	7.37	9.84	9.32	7.27

[a]Numbers in parentheses expressed in kilograms.

[b]Trial length, 120 days, 25 calves/treatment; rations were supplemented with brewers grains, blood meal, meat meal and urea.

[c]Treated stalk rations had potassium chloride, magnesium oxide and calcium carbonate added to provide the following ratios: 1 Na:1 K, 2 Na:1 Ca, 6 Na:1 Mg and 2 Na:1 Cl. Phosphorus levels were .30% for all rations.

[d]Dry matter basis.

(continued from page 21)

when stalks can be stacked and stored dry. Steers fed EHUT stalklage gained .38 lb (.17 kg) per day more and were 20.5% more efficient in converting feed to gain than steers fed LHUT stalklage (Table 4). The corn silage-fed cattle gained .65 lb (.29 kg) and 1.03 lb (.47 kg) a day more and were 20.4 and 45.1% more efficient than EHUT- or LHUT-fed cattle, respectively. The slower gains of the stalklage-fed cattle may be compensated for when these cattle are switched to higher concentrate finishing rations. Data will be collected from trial 2 steers (in progress) in an attempt to measure any compensatory gains once the stalklage steers have completed the finishing phase.

The use of EHUT stalk rations compared to conventional corn silage is best suited when the price of corn is relatively expensive. At a corn price of $3.00/bushel EHUT rations have a feed cost savings of $14.96 per 100 lb gain at $120/ton supplement cost and $11.72 savings at $200/ton supplement cost (Table 5). Because of the slower daily gain of the EHUT-fed steers, non-feed costs reduce the savings to $8.14 and $4.90 for $120/ton and $200/ton supplement costs, respectively. However, these higher non-feed costs may not be important because of the potential compensatory gain in the stalk fed calves.

Table 5. Total cost per 100 pounds gain for trials 1 and 2.

	Corn silage $2/bu corn	Corn silage $3/bu corn	EHUT	LHUT
$120.00/ton supplement				
Corn silage[a]	18.82	27.31	–	–
Cornstalks[b]	–	–	7.49	9.02
Supplement[c]	5.41	5.41	10.70	12.91
Subtotal	24.23	32.72	18.19	21.93
Nonfeed costs[d]	15.00	15.00	21.82	29.72
Total costs	39.23	47.72	40.01	51.65
$200.00/ton supplement				
Corn silage	18.82	27.31	–	–
Cornstalks	–	–	7.49	9.02
Supplement	9.02	9.02	17.82	21.52
Subtotal	27.84	36.33	25.31	30.54
Nonfeed costs	15.00	15.00	21.82	29.72
Total costs	42.84	51.33	47.13	60.26

[a]$50.62 and $73.44 per ton of dry matter for $2 and 3/bu corn respectively from Guyer, Paul. 1975. Estimating Grain Sorghum or Corn Silage Value. Nebraska NebGuide G74-99.

[b]$18 per ton of dry matter from Ayers, G.E. 1975. Large Package Forage Machinery Costs. Proceedings — An Industry Week, July 7–11, 1975, Iowa State University, Extension Bull. AS–408.

[c]Supplement at 92% dry matter.

[d]Nonfeed costs include labor, facilities, interest and taxes. Goodrich, R. and J. C. Meiske. 1975. Proceedings of 9th Annual Thompson-Hayward Beef Swine Seminar, Spetember 4, 1975, Des Moines, Iowa.

The feeding of EHUT stalklage rations probably will not be justified when corn costs are much below $2.00/bushel. With inexpensive supplement, feed costs of stalk-fed calves was $6.47 less than the corn silage ration. Non-feed costs would reduce any advantage to feeding the stalks ($38.80 *vs* $39.15 for corn silage and EHUT, respectively) but the calves do have more compensatory gain. Since supplement costs are about 55 to 70% of the stalklage ration feed cost, an expensive supplement ($200/ton) would shift preference to the corn silage ration.

Steer response to chemically treated stalks proved variable with zero to 30% increase in efficiency measured in one trial and 6 to 24% response noted with the second trial. More research with chemically treated cornstalks is needed before any definite recommendations can be made for its use.

John Paterson and Larry Berger are graduate assistants. Terry Klopfenstein is Professor, Ruminant Nutrition.

Table 4. Average performance data for trials 1 and 2.[a]

Item	Corn silage		EHUT		LHUT	
No. steers	79		43		43	
Initial wt., lb	555	(252)	554	(251)	553	(251)
Final wt., lb	798	(362)	721	(327)	675	(306)
Daily gain, lb	2.08	(.94)	1.43	(.65)	1.05	(.48)
Total gain, lb	243	(110)	167	(76)	122	(55)
Daily feed intake, lb						
Corn silage	15.48	(7.02)	–	–	–	–
Cornstalks	–	–	11.89	(5.39)	10.52	(4.77)
Supplement	1.72	(.78)	2.35	(1.07)	2.08	(.94)
Total	17.20	(7.80)	14.24	(6.46)	12.60	(5.71)
Feed/100 units gain						
Corn silage	744		–		–	
Cornstalks	–		832		1002	
Supplement	83		164		198	
Total	827		996		1200	

[a]Numbers in parentheses expressed in kilograms

Harvesting corn stalklage.

Finishing Young Bulls

Ralgro Implants And Dietary Fat

S. D. Farlin
V. H. Arthaud
W. W. Steen[1]

Implanting young bulls with 72 mg Ralgro and feeding 5% fat in the ration altered some carcass measurements in young finished bulls slaughtered at about 16 months of age.

Twenty Angus and 20 Hereford X Angus contemporary crossbred bull calves weighing about 640 lb (290 kg) and 730 lb (331 kg), respectively, were used in a 173 day trial designed to test the effect of Ralgro implants and supplemental fat on growth and carcass characteristics of young bulls.

Half of each breed was implanted with 72 mg Ralgro. Half of each breed of bulls was fed a ration containing 5% fat. The ration on a dry matter basis consisted of 10% hay, 79% high moisture corn, 5% dry supplement and 6% liquid supplement. Fat was added at the expense of high moisture corn.

The crossbred bulls were heavier at the beginning and end of the trial, however, there was no difference in the rate of gain of Angus and Hereford X Angus bulls during the trial. At slaughter Angus bulls had larger ribeye areas and less fat over the 12th rib than Hereford X Angus bulls.

The 72 mg Ralgro implant resulted in slightly faster gains [2.86 lb (1.30 kg) *vs* 2.74 lb (1.24 kg)] but gains were not statistically different for the implant treatment. Except for the Hereford X Angus bulls receiving no fat, Ralgro implants in all other treatment groups produced improvements in gain.

The Ralgro implant did result in more fat over the 12th rib [.61] in (1.55 cm) *vs* .50 in (1.27 cm)]. Accompanying the increased fat cover was an increase in marbling score from 9.8 for nonimplants to 11.1 for implanted bulls. Although the increase in marbling was accompanied by a very slight advantage in quality grade, there was no statistical difference.

Inclusion of 5% fat in the ration tended to produce lower rates of gain when no implants were used. When implants were used in combination with dietary fat, gains were not depressed by the fat. Fat in the ration reduced fat cover over the 12th rib. A lower marbling score was associated with feeding fat and was reflected in a slightly lower quality grade. The estimated yield grade for bulls receiving fat was better (2.8 *vs* 3.2) than for bulls without fat in the ration.

The largest increase in marbling and quality grade obtained with implants was associated with bulls that were not fed fat in the ration, whereas feeding fat in combination with Ralgro implants tended to nullify the effects of the implant on marbling and quality grade.

Feed efficiency for the various treatments could not be determined. Observations on feed intake indicated that bulls fed 5% fat in their ration consumed 6% less feed. This may account for the slightly lower gains and carcass changes observed when fat was fed.

The results indicate that Ralgro implants used at high levels (72 mg) may be beneficial in improving growth rate. Changes in carcass quality of young bulls fed fat or implanted with Ralgro can likely be explained by the trend toward slower or faster gains with treatments.

[1]S. D. Farlin is Associate Professor, Beef Nutrition. V. H. Arthaud is Professor, Beef Production (retired). W. W. Steen is Graduate Assistant.

Table 1. Growth and carcass desirability of young bulls implanted with Ralgro and fed fat in the ration.[a]

	Angus				Angus X Hereford			
	No fat		Fat		No fat		Fat	
	0	72 mg	0	72 mg	0	72 mg	0	72 mg
No. animals	5	5	5	5	5	5	5	5
Initial wt, lb	598	651	650	674	762	688	745	719
	(272)	(296)	(296)	(306)	(346)	(313)	(339)	(327)
Final wt, lb	1072	1159	1105	1184	1279	1167	1196	1195
	(487)	(527)	(502)	(538)	(581)	(530)	(544)	(543)
ADG[b], lb	2.74	2.94	2.63	2.95	2.99	2.77	2.61	2.75
	(1.24)	(1.34)	(1.20)	(1.34)	(1.36)	(1.26)	(1.19)	(1.25)
Carcass wt, lb	681	737	702	752	813	742	761	760
	(310)	(335)	(319)	(342)	(370)	(337)	(346)	(345)
Ribeye, sq in	13.38	14.00	14.38	13.44	13.70	12.46	13.12	13.20
	(86.32)	(90.32)	(92.77)	(86.71)	(88.39)	(80.39)	(84.64)	(84.00)
Fat thickness, in	.44	.49	.39	.48	.67	.84	.52	.62
	(1.12)	(1.24)	(.99)	(1.22)	(1.70)	(2.13)	(1.32)	(1.57)
Marbling[c]	9.8	11.0	9.4	9.6	10.2	14.4	9.8	9.4
Quality grade[d]	10.6	11.0	10.4	10.4	10.4	11.6	10.6	10.2
Yield grade[e]	2.5	2.6	2.1	2.8	3.5	4.1	3.0	3.3

[a]Number in parentheses is in metric system.
[b]Final weight adjusted to 64% dress from hot carcass weight.
[c]9 = slight; 10 = slight plus; 11 = small minus.
[d]10 = average good; 11 = low choice.
[e]1 most desirable; 5 least desirable.

Wood, Cane Molasses Compared

Adding experimental hemicellulose extract molasses products to the ration.

C. Doxon
S. D. Farlin[1]

The nutritive value of two hemicellulose extracts (wood molasses) were compared to cane molasses in a finishing trial. Hemicellulose extracts and cane molasses produced similar gain, efficiency and carcass traits when fed at 5 and 10% levels in finishing rations for yearling steers.

The two hemicellulose extracts used were derived from hardwoods by a process which included: (1) steaming hardwood chips at elevated temperatures and pressures, (2) neutralizing the aqueous hydrolysate with either calcium hydroxide or sodium hydroxide to a pH of seven, (3) removing the lignin degradation products and (4) evaporating the clarified hydrolysate. Composition of the two hemicellulose extracts produced by this process is shown in Table 1.

In the finishing trial 120 steers of mixed breeds were fed one of the two hemicellulose extracts or cane molasses at either 5 or 10% of the ration on an as fed basis. Rations were formulated using cane molasses. The wood molasses was substituted for cane molasses without any other ration adjustments. The rations contained 10% alfalfa with dry corn and dry supplement (urea was protein source) in addition to molasses. No antibiotic was included in the ration. Steers were implanted with Synovex at the beginning of the trial. The trial lasted 144 days and at its end cattle were slaughtered and carcass data were recorded.

Results showed that type of molasses had little effect on live or carcass measurements (Table 2). However, for each type of molasses the 10% level showed a significantly improved feed efficiency over the 5% level. These observations indicate that the hemicellulose extracts tested have about the same nutritive value as cane molasses at 5 and 10% level in the ration of finishing steers.

Table 1. Composition of hemicellulose extracts.[a,b]

Item	Hemicellulose extract neutralized with calcium	Hemicellulose extract neutralized with sodium
Brix[c]	69	73
Solids, %	64.4	68.3
Ash, %	8.8	11.8
Ca., %	2.5	0.2
Na, %	2.7	4.6
Fat, %	0.04	0.03
Fiber, %	0.2	0.3
Protein, %	0.7	0.8
Carbohydrates,%	55	55

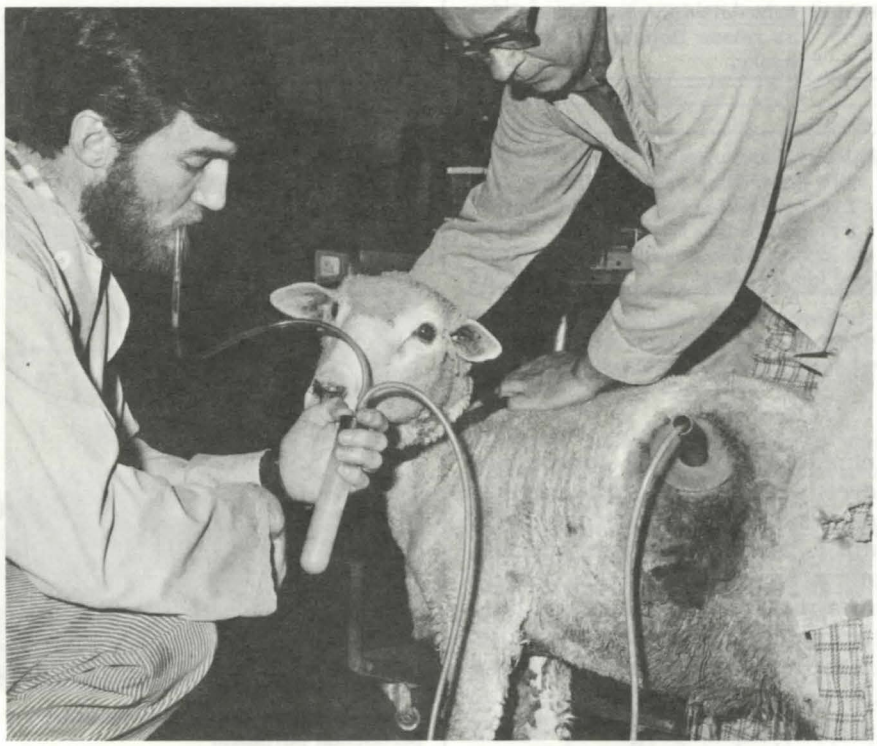
[a]International Paper Company Experimental Hemicellulose Extract.
[b]Wet basis.
[c]Indicates relative level of sugar present. Cane molasses has Brix of approximately 79.5.

[1]C. Doxon is Graduate Assistant. S. D. Farlin is Associate Professor, Beef Nutrition.

Table 2. The effect of wood molasses in steer finishing rations.[a,b]

	Cane				Hemicellulose extracts							
					Calcium neutralized				Sodium neutralized			
Item	5%		10%		5%		10%		5%		10%	
Initial wt., lb	651	(295)	655	(297)	656	(298)	658	(298)	664	(301)	682	(309)
Daily gain[c], lb	2.69	(1.22)	2.66	(1.21)	2.52	(1.14)	2.57	(1.17)	2.51	(1.14)	2.59	(1.17)
Daily feed, DM lb	19.5	(8.85)	18.5	(8.39)	19.6	(8.89)	19.0	(8.62)	20.5	(9.30)	19.5	(8.85)
Feed/gain	7.25		6.95		7.78		7.39		8.17		7.53	
Carcass wt., lb	643	(292)	643	(292)	629	(285)	638	(289)	636	(288)	657	(298)
Marbling[d]	11.19		13.57		11.15		11.67		12.38		11.65	
Quality grade[e]	11.15		12.23		11.23		11.71		11.79		11.54	
Abscessed livers, %	30		10		25		40		20		20	

[a]Numbers in parentheses expressed in kilograms.
[b]Twenty steers per treatment.
[c]Final weight adjusted to 62% from hot carcass weight.
[d]11 = small minus; 12 = small.
[e]11 = high good; 12 = low choice.



Obtaining rumen fluid.

Lactic Acid Aids Adjustment To High Concentrate Rations

G. Huntington
R. Britton[1]

Lactic acid added to hay (5% by weight) aided in adjusting sheep to a high grain ration by favorably affecting lactate (the form in which it exists in the living animal) utilization in the rumen. Consumption of lactic acid treated hay "primed" the microbes and resulted in lower rumen lactate levels as level of concentrate in the ration was subsequently increased from 50 to 90%.

Switching feedlot ruminants (cattle and sheep) from a high forage to a high grain ration causes stress. During this time animals can go "off feed" and have acidosis. Acidosis results from excessive production of lactate during grain fermentation in the rumen. Lactate then passes into the bloodstream and upsets blood acid-base balance of the animal. There are two forms of lactate (D and L). The D form is especially a problem because ruminants cannot use D-lactate for energy after it is absorbed so it must be excreted in the urine.

Changes in rumen microbial population are an important part of adjustment to high grain rations. These changes include decreased numbers of protozoa and cellulose-digesting bacteria and increased numbers of starch-digesting and lactate-utilizing bacteria. Some starch-digesting bacteria produce lactate and presence of lactate promotes increased numbers of lactate-utilizing bacteria.

Wethers with permanent rumen fistulas were allotted to two treatments, hay (five sheep) or hay plus 5% lactic acid (six sheep). Unneutralized lactic acid was added to the hay on a weight to weight basis. Water was added to the control hay (mature brome) to equalize percent dry matter of the two rations. The sheep received these treatments for 20 days. After 20 days, all sheep received in sequence a 50, 70 and 90% concentrate ration for 5, 5 and 10 days, respectively. All rations were calculated to contain 12% crude protein, .5% calcium and .3% phosphorus (Table 1). Wethers were full fed once daily during the concentrate feeding phase.

Rumen fluid samples were taken from each sheep 22 hours after feeding throughout the experiment. Additional samples were

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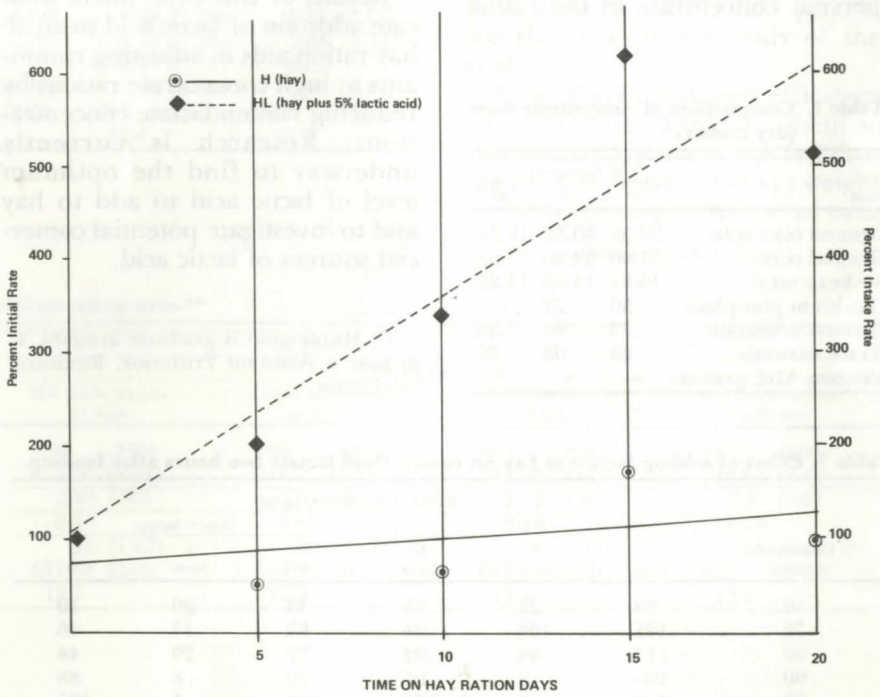


Figure 1. *In vitro* lactate disappearance (data are pooled L and D lactate).

Feeding Lactic Acid

(continued from page 25)

taken two hours after feeding during the concentrate feeding phase. Rumen fluid collected 22 hours after feeding was used to conduct *in vitro* lactate disappearance studies. These studies determine how rapidly rumen microbes use lactate and if there is any difference in rate of utilization between D and L lactate.

Averages of all concentrate levels show adding lactic acid to the hay resulted in lower rumen fluid lactate two hours after feeding (Table 2). Total lactate for sheep fed lactate treated hay was 58% that of the control hay. Both D and L forms of lactate were lower for sheep fed treated hay. There was no difference in feed intake during the concentrate feeding phase and only a slight difference in rumen lactate levels occurred 22 hours postfeeding. No gross symptoms of acidosis were seen in any sheep during adjustment to high concentrate rations.

Rumen fluid lactate levels for each concentrate level are shown in Table 3. Lactate level tended to increase for both treatments as the percent concentrate in the ration increased, but at all concentrate levels wethers fed lactate hay had less total lactate than controls. D and L lactate levels were variable, but a large increase in relative amounts of D lactate in both treatments occurred five days after feeding the 90% concentrate ration began.

In vitro disappearance of lactate during the hay feeding phase was enhanced by addition of lactic acid to the hay (Figure 1). Maximum disappearance was reached after 15 days. *In vitro* D and L lactate disappeared from the preparations at similar rates during the concentrate feeding phase indicating that the advantage of adding lactate to hay sheep was not sustained.

Results of this experiment indicate addition of lactic acid to an all hay ration aids in adjusting ruminants to high concentrate rations by reducing rumen lactate concentrations. Research is currently underway to find the optimum level of lactic acid to add to hay and to investigate potential comercial sources of lactic acid.

[1]G. Huntington is graduate assistant. R. Britton is Assistant Professor, Ruminant Biochemist.

Table 1. Composition of concentrate diets (dry matter).

Item	% Concentrate 50	70	90
Ground corn cobs	50.50	30.52	10.24
Ground corn	31.40	54.16	77.25
Soybean meal	16.84	14.06	11.25
Dicalcium phosphate	.50	.28	–
Ground limestone	.73	.95	1.23
Trace minerals	.03	.03	.03
Vitamin ADE premix	+	+	+

Table 2. Effect of adding lactic acid to hay on rumen fluid lactate and feed intake.

Item	Hay	Hay + lactic acid
Rumen lactate, ug/ml		
2 hr postfeeding total	130	75[a]
2 hr postfeeding L	38	16[b]
2 hr postfeeding D	92	59[a]
22 hr postfeeding total	50	46
Feed intake, g/day[c]	1335	1335

[a]Significantly different from H (P<.05).
[b]Significantly different from H (P<.01).
[c]Full feed intake during concentrate feeding phase.

Table 3. Effect of adding lactate to hay on rumen fluid lactate two hours after feeding.

% Concentrate in ration	Rumen fluid lactate, ug/ml: Hay Total	Hay L form	Hay D form	Hay + lactate Total	Hay + lactate L form	Hay + lactate D form
50	58	23	35	30	20	10
70	198	103	95	63	17	46
90	111	49	62	77	29	48
90	105	8	97	96	8	88
90	180	6	174	111	5	106

Plastic bags containing high moisture corn for experimental purposes.

For High Moisture Corn Rations

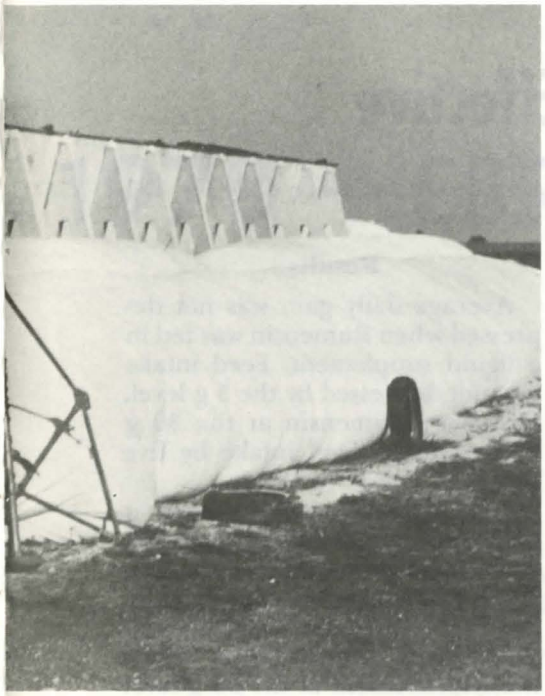
Urea Good Source of

G. Schindler
S. D. Farlin
V. Krause
R. Britton[1]

Results of three trials support the use of urea as the source of supplemental protein for high moisture (25%) corn rations fed to finishing cattle. Although not required for maximum gain and efficiency, formulating to 12% protein in the ration with urea did not impair performance of yearling steers fed a finishing ration based on high moisture corn.

A high moisture corn ration supplemented with either soybean meal or urea was fed to 194 mixed yearling steers for 142 days in trial I. The treatments included; (1) 11% crude protein using soybean meal, (2) 11% crude protein using urea, (3) 11% crude protein for the 56 days using urea and (4) 12% crude protein using urea.

Cattle were fed Rumensin (30 g/ton of air dry ration) and implanted with Synovex-S. The ration contained 80-85% high moisture corn, 10% hay, 5% dry sup-



Supplemental Protein

Table 1. Urea vs. soybean meal for supplementing high moisture corn rations.[a,b]

Item	Treatments: Soybean meal, 11 % Crude protein, 142 days	Urea, 11% Crude protein, 1–56 days[c]	Urea, 11% Crude protein, 142 days	Urea, 12% Crude protein, 142 days
Initial weight, lb	712 (324)	710 (323)	710 (323)	707 (321)
Daily feed (DM), lb	19.85 (9.02)	19.54 (8.88)	18.89 (8.59)	19.17 (8.71)
Daily gain, lb[d]	2.90 (1.32)	2.81 (1.28)	2.78 (1.26)	2.88 (1.31)
Feed/gain (DM)	6.84	6.95	6.80	6.65
Fat thickness, in	.60 (1.52)	.55 (1.40)	.54 (1.88)	.56 (1.42)
Carcass wt., lb	697 (317)	688 (313)	684 (311)	692 (315)
Quality grade[e]	12.5	12.5	12.4	12.5

[a]Numbers in parentheses expressed in metric units.
[b]Forty-nine animals per treatment.
[c]Urea withdrawn after 56 days.
[d]Final weight adjusted to 62% dress from hot carcass weight.
[e]12 = low choice; 13 = average choice.

Table 3. Value of urea for high moisture or dry corn rations[a,b]

Item	12% Crude protein (urea supplemented): High moisture corn	1/2 high moisture 1/2 dry corn	Dry corn
Initial wt., lb	756 (343)	748 (339)	737 (334)
Daily feed, lb (DM)	20.57 (9.33)	21.38 (9.70)	20.25 (9.19)
Daily gain, lb[c]	2.43 (1.10)	2.48 (1.12)	2.26 (1.03)
Feed/gain (DM)	8.46	8.62	8.90
Fat thickness, in	.43 (1.09)	.46 (1.17)	.42 (1.07)
Hot carcass wt., lb	669 (303.5)	668 (303)	644 (292)
Quality grade[d]	12.3	12.6	12.0

[a]Numbers in parentheses expressed in metric units.
[b]Twenty-two animals per treatment.
[c]Final weight adjusted to 62% dress from hot carcass weight.
[d]12 = low choice; 13 = average choice.

plement and the remainder was liquid urea supplement when a protein supplement was fed.

Soybean meal was not a better source of supplemental protein than urea for finishing cattle fed high moisture corn. (Table 1).

No significant differences occurred in rate of gain, feed intake, or feed efficiency because of source of supplemental protein. Providing 11% crude protein for the first 56 days, at which time the supplemental urea was withdrawn from the ration, produced nearly the same results as feeding 11% crude protein for the entire 142 days. The addition of urea to raise crude protein to 12% for the entire trial did not significantly improve or depress cattle performance compared to either soybean meal or urea at 11% crude protein. However, 12% protein with urea produced slightly more efficient gains. Yearling steers were fed for 98 days in a similar study of urea level in trial II. The cattle were fed 30 g Rumensin per ton of ration and implanted with Synovex-S. The rations were formulated with urea the same as in trial I. Treatments in trial II included (1) no supplemental protein, (2) 11% protein, (3) 11% protein for the first 70 days only of the trial, (4) 12% protein and (5) 12% protein for the first 70 days only of the trial.

Rate of gain and feed efficiency were reduced (Table 2) when no supplemental protein was fed during the test [880 lb (399 kg) weight at the beginning]. The use of urea

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Table 2. Protein level for high moisture corn rations using urea.[a,b]

Item	Treatment: No protein 98 days	Urea supplemented: 11% crude protein 98 days	11% crude protein 1st 70 days	12% crude protein 98 days	12% crude protein 1st 70 days
Initial wt., lb	885 (402)	870 (395)	869 (395)	897 (404)	881 (400)
Daily feed, lb (DM)	19.13 (8.70)	18.50 (8.41)	18.71 (8.51)	18.92 (8.60)	18.64 (8.47)
Daily gain[c]	1.96 (.89)	2.19 (.99)	2.07 (.94)	2.12 (1.00)	2.17 (.98)
Feed/gain (DM)	9.75	8.49	9.05	8.97	8.63
Fat thickness, in	.59 (1.5)	.56 (1.42)	.56 (1.42)	.60 (1.52)	.58 (1.47)
Carcass wt., lb	672 (305)	677 (308)	668 (304)	689 (313)	683 (310)
Quality grade[d]	13.2	12.7	12.9	12.9	12.8

[a]Numbers in parentheses expressed in metric units.
[b]Twenty-four animals per treatment.
[c]Final weight adjusted to 62% dress from hot carcass weight.
[d]12 = low choice; 13 = average choice.

Urea Supplementation

(continued from page 27)

as a protein source improved cattle performance equally at both levels of crude protein.

Withdrawing urea during the last four weeks did not cause a significant reduction in gain or efficiency. The response to withdrawal was somewhat variable. Cattle in one treatment did show a slight affect of withdrawal while the other treatment showed none. As in trial I, using urea to raise protein to 12% did not depress cattle performance compared to 11%.

Feedlot results were compared when urea was used as the supplemental protein for rations containing 12% crude protein when dry or high moisture corn was fed. Sixty-five head of mixed yearling steers were fed in trial III for 133 days. Rumensin was fed at 30 g/ton of ration and cattle were implanted with Synovex-S. Rations were formulated the same as in trial I on a dry matter basis. Ration treatments consisted of (1) high moisture corn, (2) ½ high moisture corn and ½ dry corn, and (3) dry corn.

Cattle gained 7.5% more rapidly with high moisture corn and 10% more rapidly with the combination of high moisture and dry corn than with dry corn (Table 3). Animals receiving high moisture corn or dry corn consumed dry matter at about the same rate. Those getting the mixture of dry and high moisture corn consumed more than with either dry or high moisture corn alone. There was an increased improvement in feed efficiency as the high moisture corn level increased. Cattle consuming the all high moisture corn ration were 4.9% more efficient than the steers getting dry corn. Performance of cattle fed high moisture corn was not depressed by urea as compared to dry corn and urea.

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[1]G. Schindler is Research Technician. S. D. Farlin is Associate Professor, Beef Nutrition. V. Krause is Assistant Professor, Animal Science. R. Britton is Assistant Professor, Ruminant Biochemist.

For Liquid Supplement

Rumensin Is Effective

S. D. Farlin
G. Schindler[1]

Rumensin is a feed additive cleared by FDA for use in dry supplements only. The use of Rumensin in widespread feeding situations emphasized the need to determine whether Rumensin was effective when carried in a liquid supplement.

The conclusion from this study in which Rumensin was mixed in a liquid molasses based protein supplement and fed to yearling finishing cattle was that Rumensin is effective when carried in a liquid supplement. This adds yet more versatility for use of Rumensin in cattle production.

Experimental Designs

Two hundred eighty-six yearling steers were fed either 0, 5 or 30 g Rumensin per ton of air dry ration consisting [dry matter (DM) basis] of 83% rolled corn, 10% corn silage, 5% dry mineral and vitamin supplement and 2% liquid supplement carrying Rumensin. The liquid supplement consisted of (DM basis) 74.46% cane molasses, 6.09% ammonium polyphosphate, 19.19% urea solution, .23% trace mineral and .03% vitamin premix.

The liquid supplement was recirculated before each feeding and cattle were fed twice daily for 131 days.

Results

Average daily gain was not depressed when Rumensin was fed in a liquid supplement. Feed intake was not depressed by the 5 g level. However, Rumensin at the 30 g level reduced feed intake by five percent.

Feed efficiency was improved at both levels of Rumensin when fed in the liquid supplement. The 5 g level improved feed efficiency nearly 5% while the 30 g level produced 6.1% improvement. While the improvement at the 30 g level is not quite as large as the improvement seen in many previous trials when Rumensin was fed in a dry supplement, the results of this trial do demonstrate that the effect on feed efficiency is obtained when Rumensin is fed in a liquid supplement.

Carcass characteristics observed at time of slaughter were not affected by feeding Rumensin.

This trial suggests that Rumensin when fed in a liquid supplement will produce results similar to those reported when Rumensin was fed in dry supplements.

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[1]S. D. Farlin is an Associate Professor of Ruminant Nutrition. G. Schindler is a Research Technician.

Table 1. Rumensin in liquid supplement.[a,b]

Item	Rumensin level (g/ton) 0		5		30	
No. steers	108		71		107	
Initial wt., lb	661	(300)	665	(302)	661	(300)
Avg daily dry matter consumed, lb	22.1	(6.19)	21.7	(9.84)	21.0	(9.53)
Avg daily gain, lb[c]	3.21	(1.46)	3.32	(1.51)	3.24	(1.47)
Feed required/lb gain, lb	6.90		6.54		6.48	
Hot carcass wt., lb	670.5	(304)	681.5	(309)	673.5	(305.5)
Fat thickness, in	.52	(1.32)	.56	(1.42)	.48	(1.22)
USDA quality grade[d]	12.0		12.3		12.0	
Abscessed liver,[e] %	16.8	[7.5]	23.9	[14.1]	19.6	[6.5]

[a]Cattle fed for 131 days.
[b]Number in parentheses expressed in metric units.
[c]Final weight adjusted to 62% dress based on hot carcass weight.
[d]12 = low choice; 13 = average choice.
[e]Number in brackets is the percent of livers with 2 or more severe liver abscesses.