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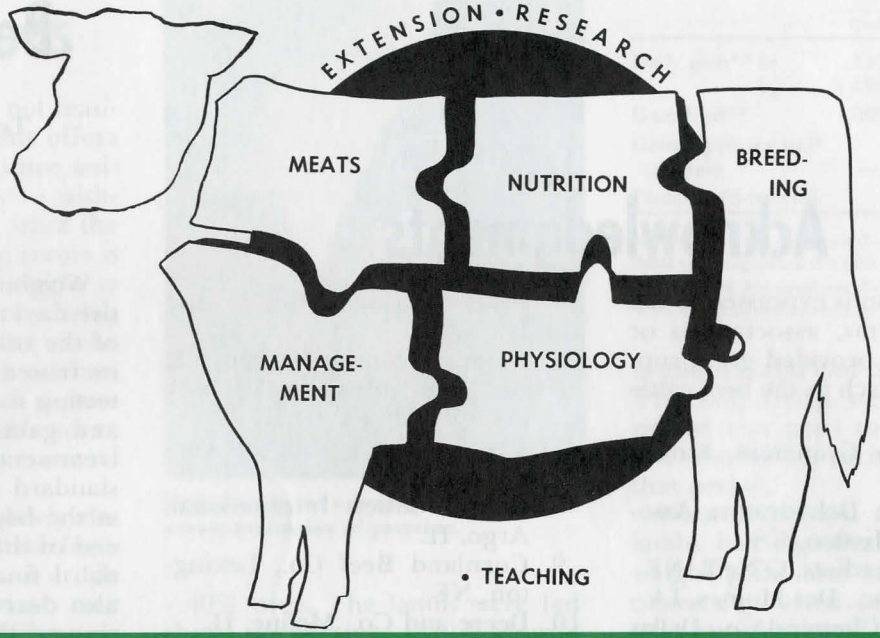

1980 BEEF CATTLE REPORT

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Refined Research Better Evaluation

Rick Stock
Terry Klopfenstein
Steve Lowry
Dave Rock
Dennis Brink
Mary Poos[1]

Weighing steers three consecutive days at the beginning and end of the trial reduced variation and increased the probability of detecting a difference in daily gain and gain/protein ratios between treatments when compared to a standard weighing method (once at the beginning and once at the end of the trial). Regressing 1 initial, 1 final and 11 weekly weights also decreased variation and increased the probability of detecting treatment differences compared to the standard method, but was more variable than using three weights at the beginning and end of the trial.

Young, growing steers and lambs supplemented with natural protein sources gained significantly faster than those fed urea. The relative values of blood meal (BM) compared with soybean meal (SBM) for the lamb and steer trials were 252% and 281% respectively.

Introduction

A refinement of techniques may be necessary to detect significant treatment differences when evaluating slowly degraded proteins (proteins resistant to microbial breakdown in the rumen). Weighing errors may cause more variation than any other factor. These errors are mainly the result of differences in gut fill. With the use of individually fed animals, fewer animals are necessary to test differences among protein sources.

Little research has been done to study weighing errors and their effect on variation among individually fed animals. With penfed animals, increasing the number of animals per pen will help reduce weighing variation; however, with

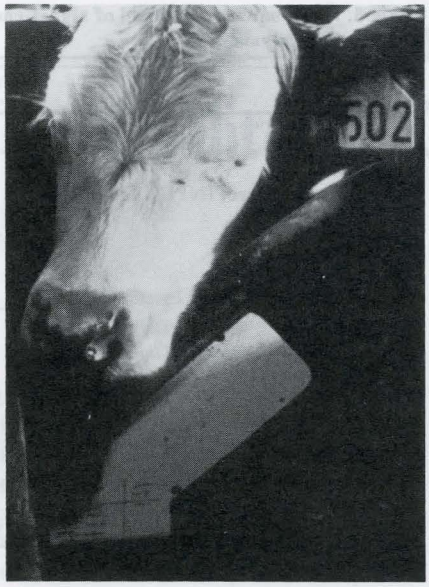
Techniques Give of Protein Needs

individual feeding this is not feasible. Use of shrunk weights offers only a slight advantage since animals respond differently to withholding feed and water. Since the variation due to weighing errors is largest when using one weight at the beginning and end of a trial, using multiple day weights at the beginning and end of a trial or weighing periodically and regressing over time may provide more accurate information about animal performance.

In previous studies, slowly degraded protein sources have been substituted for SBM on a crude protein basis. This approach may not fully evaluate the differences among protein sources. Research conducted at the Institute of Agriculture and Natural Resources has shown it took only half the amount of BM to give the same performance as a given amount of SBM. Since all rations have been balanced to meet NRC requirements using crude protein values of the respective protein sources, those rations containing BM may have exceeded the animals' protein requirement. The protein content of the ration must be below the animals' requirement to accurately evaluate protein sources. By feeding various levels of protein, the proper level of protein supplementation can be determined. If a lower level of dietary protein will meet the animals protein requirements, the cost of supplementation will be reduced.

Lamb Growth Trial

A lamb growth trial was conducted to evaluate SBM and BM as supplemental protein sources. Twenty-four lambs averaging 53.5 lb (24.3 kg) were allotted to three treatments with eight lambs per treatment. Treatments consisted of different sources of supplemental protein: (1) all urea; (2) 60% SBM - 40% urea; (3) 60% BM - 40% urea. The lambs were fed their respective supplemental protein sources for three consecutive periods (21 days/period; 63 total days).



Individually fed calves are essential to accurate evaluation of proteins.

Rations (Table 1) were balanced for 14% CPE and about 73% TDN. All lambs were fed the urea diet during a seven-day adjustment period and then were fed their appropriate rations. Lambs were individually fed twice daily so that their daily "as fed" intake was equivalent to 3% of their body weight. Lambs were weighed at the beginning and end of each period. The beginning weight of each period was used to calcualte "as fed" intake for each lamb during that period.

Table 1. Composition of rations fed in lamb growth trial.

	Rations[a]		
Ingredient	Urea	Soybean meal-urea	Blood meal-urea
Ground corn cobs	32.00	32.00	32.00
Cracked corn	42.50	42.50	42.50
Cane molasses	15.00	15.00	15.00
Soybean meal		8.35	
Blood meal			5.02
Urea	2.60	1.04	1.04
Corn starch	6.57		3.26
Dicalcium phosphate	.65	.34	.54
Limestone	.36	.45	.32
Salt	.25	.25	.25
Trace mineral mix[b]	.05	.05	.05
Vitamin premix[c]	.02	.02	.02

[a]Percent on a dry matter basis.
[b]10% Mn, 10% Zn, 1% Cu, .3% I, .1% Co.
[c]32,000 IU vitamin A and 8,000 IU vitamin D_2 per gram premix.

Table 2. Daily gain, feed and protein efficiency of lambs fed urea, SBM-urea and BM-urea.

	Treatment		
	Urea	SBM	BM
Daily gain[a,b] lb	.117	.162	.234
kg	(.053)	(.074)	(.106)
Gain/feed[c,d]	.095	.129	.180
Gain/supplemental[d] protein	—	.798	2.013
Protein efficiency%		100	252

[a]Urea vs SBM, BM significant (P<.025).
[b]SBM vs BM significant (P<.025).
[c]Urea vs SBM, BM significant (P<.01).
[d]SBM vs BM significant (P<.01).

Natural protein supplemented lambs had significantly increased weight gains and improved feed conversion when compared with urea supplemented lambs. Lambs supplemented with BM-urea had improved daily gain (P<.025) and feed efficiency (P<.01) compared with SBM-urea supplemental lambs (Table 2). Protein efficiency value for the BM supplemented lambs was 252% of the value for SBM supplemented lambs (P<.01)

Steer Growth Trial

Forty nine Hereford X Angus steers averaging 576 lb (261 kg) were randomly allotted to treatments in an 86-day trial. Animals were housed in an open front barn with a gutter flush system. Steers were fed individually using electronically controlled gates. Daily intake of basal ration and supplement was monitored and the actual intake of each component was calculated for each animal.

Basal rations contained 60% corn silage, 30% cornstalks (after 43 days cornstalk quality deteriorated and stalks were replaced by corncobs) and 10% supplemental protein and minerals. Rations contained about 63% TDN and 11.5% CP. Supplemental protein sources were: 100% urea; 100%, 80%, 60%, 40%, 20% SBM; or 50%, 40%, 30%, 20%, 10% BM with the urea supplement making up the differences.

(continued on next page)

Protein Needs . . .

(continued from page 3)

These treatments allowed evaluation of protein sources, level of protein and the interaction of source and level of protein.

Previous research (Nebraska Beef Cattle Report, 1979) demonstrated that animals weighing approximately 495 lb (255 kg) would consume 12.1 lb (5.4 kg) dry matter. To better evaluate each natural protein source, the amount of natural protein fed to each animal was held constant throughout the trial. Animals were then fed to compensate for any differences in maintenance requirement (above or below 495 lb (225 kg) by addition or subtraction of the basal ration and urea supplement. For example, a calf receiving the 60% SBM treatment and weighing 495 lb (225 kg) would be fed 10.8 lb (4.90 kg) DM from the basal ration, .48 lb (.22 kg) DM from urea supplement and .72 lb (.33 kg) DM from the SBM supplement. If this calf weighed 525 lb (238 kg) it would be fed 11 lb (4.99 kg) DM of basal ration, .50 lb (.23 kg) DM from the urea supplement and .72 lb (.33 kg) DM from the SBM supplement.

Animals were weighed on three consecutive days at the beginning and end of the trial with interim weekly weights also taken. Corrections for maintenance needs were also made weekly.

Table 3. Mean square and level of significance for protein efficiency using three methods of analysis.[a]

Source	Degree of freedom	Mean square	Level of significance
	1 initial weight and 1 final weight		
SBM *vs* BM	1	.00905	.0073
Natural protein level (NPL)	4	.00101	.4610
Treatment × NPL	4	.00048	.7797
Error	39	.00109	
	Average of 3 initial weights and 3 final weights		
SBM *vs* BM	1	.01272	.0002
Natural protein level (NPL)	4	.00122	.1788
Treatment × NPL	4	.00065	.4765
Error	39	.00072	
	Regression of weekly weights		
SMB *vs* BM	1	.01075	.0015
Natural protein level (NPL)	4	.00258	.0356
Treatment × NPL	4	.00501	.2449
Error	39	.00087	

[a]1 Degree of freedom lost for covariance of initial weight.

Table 4. Daily gain and protein efficiency using an average of three initial and three final weights.

Level of natural protein in supplement, %	Number of animals	Daily gain lb (kg)	Protein efficiency (gain/protein)	Relative value of protein, %
Urea-100	9	1.05 (.48)	—	—
SBM 20-Urea 80	3	1.15 (.52)	.85	100[a]
SBM 40-Urea 60	4	1.17 (.53)	.45	100[b]
SBM 60-Urea 40	4	1.28 (.58)	.61	100[c]
SBM 80-Urea 20	4	1.39 (.63)	.68	100[d]
SBM-100	4	1.41 (.64)	.55	100[e]
BM 10-Urea 90	5	1.22 (.55)	2.75	324[a]
BM 20-Urea 80	4	1.23 (.56)	1.47	327[b]
BM 30-Urea 70	4	1.46 (.66)	2.17	356[c]
BM 40-Urea 60	4	1.39 (.63)	1.36	200[d]
BM 50-Urea 50	4	1.38 (.63)	1.07	195[e]

[a,b,c,d,e]Same superscript indicates BM, SBM levels compared.

Increased Weighing Helps

Weighing steers for three consecutive days at the beginning and end of the trial decreased the mean square error for gain and protein efficiency while increasing the probability of detecting significant differences (Table 3). Using 1 initial weight, 1 final weight and 11 weekly weights and regressing them over time also reduced the mean square error for gain and protein efficiency while increasing the probability of detecting significant difference. Animal variation is usually considered the reason that treatment differences are not detected, however the ability to make accurate measurements may be as important as animal variation. This trial indicates that the ability to detect treatment differences was increased by improving the accuracy of weight measurements. The additional weighings at the beginning and end of the trial not only provided greater

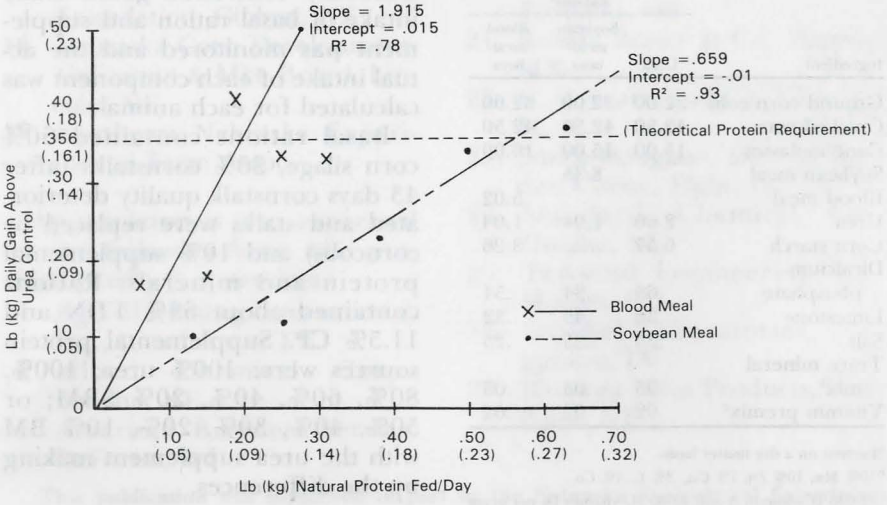


Figure 1. Natural protein fed/day vs daily gain above urea control.

statistical precision than use of weekly weights, but also required less labor.

Steers supplemented with natural protein gained significantly faster than steers supplemented with urea (Table 4). Since BM was assumed to be 2.0 times the value of SBM and fed at half the amount of SBM at each level of protein, there was no significant difference between the levels of natural protein fed. Daily gain of the SBM fed steers increased as level of natural protein fed increased up to 80% (Table 4, Figure 1) and then leveled off. Daily gain of the BM fed steers increased as level of natural protein fed increased to 30% and then leveled off. The leveling off of daily gain would indicate that the animal's protein requirement had been met and any further increase in natural protein fed would be an excess and thus poorly utilized. Therefore, steers fed 100% SBM, 40% BM and 50% BM probably were overfed protein.

Steers supplemented with BM had superior protein efficiency when compared to SBM fed animals. When SBM was assigned a relative value of 100%, an average value across all levels of BM was calculated to be 281%, which is much greater than previous Nebraska research has indicated. When comparing 20%, 40% and 60% SBM to 10%, 20% and 30% BM the relative value is greater than 320%, suggesting that when BM and SBM are both fed below the animal's requirement, the value of 281% for BM may actually be too low. Thus, when slowly degraded proteins are fed at the same rate as SBM or even at our presently assigned values, we may be overfeeding protein. The value of these slowly degraded proteins may be greater than previously estimated. Overfeeding protein will result in unnecessarily high costs of protein supplementation.

[1]Rick Stock and Dave Rock are Graduate Assistants. Terry Klopfenstein is Professor, Ruminant Nutrition. Steve Lowry is Assistant Professor, Animal Science and Consultant Biometrics and Information System Center. Dennis Brink is Assistant Professor, Ruminant Nutrition and Mary Poos is a Post Doctorate.

Time of Harvest Affects Quality of Cornstalks Fed

Michael McDonnell
John Paterson
Terry Klopfenstein[1]

Cornstalk quality decreases after the grain reaches physiological maturity. Most of this decline is due to a reduction in cell solubles as the potentially digestible cell wall remains constant. The rate of digestion of the potentially digestible cell wall is constant over time but may vary between varieties and cultural practices.

Cornstalks harvested at the time of corn silage harvest were 91% as digestible by lambs as corn silage. Stalks harvested at the time of high moisture grain harvest were 79% as digestible, while those harvested when dry were only 55% as digestible as corn silage.

Introduction

Previous work at Nebraska (1978 Nebraska Beef Cattle Report) has shown that corn stalklage harvested early gave calf performance equal to 80% of corn silage value. However, this response has not been consistent among years. One reason for this are changes in the corn plant at and after physiological maturity. Another reason may be variation in grain yield. Nebraska work in 1973 and 1974 showed a decrease in grain yield of 25 bushels per acre was accompanied by an increase of 10 percentage units in stalk digestibility.

More corn is being harvested as high moisture grain because of the increased cost of drying, thus making more of the higher quality stalks available for harvest. These stalks usually are 30 to 40% dry matter and ensile readily. The stalks can be harvested with conventional silage harvesting equipment.

Trials on the effect of harvest dates after physiological maturity on digestibility were conducted. In 1977 one corn variety on irrigated land was harvested at 0, 1, 3, 7, 14, 35 and 63 days post-physiological maturity. Physiological maturity was determined by black layer formation in the grain. In 1978 two different varieties (A & B), at 23,000 plants per acre, were planted on irrigated land, while one of the varieties (B) was planted at 18,000 plants per acre on dry land. The 1978 corn crop was sampled on 0, 5, 12, 20, 26, 34, 40, 50, 56 and 61 days post-physiological maturity. The samples were analyzed to determine cell solubles, cell walls (CW), in

(continued on next page)

Table 1. Lamb digestion trial conducted with 1977 corn plant.

	Days post maturity	Dry matter intake		Dry matter digest.	IVDMD[a]
		(lb)	(g)	%	%
Earlage	0	1.37	(622)	73.85	88.60
Corn silage	0	2.47	(1122)	67.41	73.10
Stalklage	0	1.96	(890)	61.85	66.32
Stalklage	35	1.33	(605)	53.02	56.41
Stalklage	63	.40	(181)	36.91	47.99

[a]In vitro dry matter disappearance.

Table 2. Distribution of corn plant components in the dry matter.

Year	Variety	%Grain	%Stalk	%Cob	%Husk
1977		42	46	8	3
1978	Irrigated A	59	30	8	3
	Irrigated B	58	32	7	3
	Dryland B	53	37	7	3

Cornstalk Quality . . .

(continued from page 5)

vitro dry matter disappearance (IVDMD), CW digestibility, and rate of CW digestibility.

Lamb Digestion Trial

A lamb digestion trial was performed to compare earlage (high moisture ear corn), corn silage, stalklage at physiological maturity, stalklage at 35 days post maturity (at high moisture grain harvest) and stalklage at 63 days post maturity (harvested after dry grain harvest). All feedstuffs were ensiled in plastic-bag-lined steel drums and allowed to ferment before being fed. Rations were balanced to meet the National Research Council requirements for sheep.

Digestibility of stalklage harvested at physiological maturity was slightly less than that of corn silage (Table 1). Earlage had the highest dry matter digestibility. Ration digestibility decreased as corn grain concentration in the diet decreased. Stalklage harvested 63 days post-maturity did not ferment well when ensiled and was unpalatable. The laboratory prediction of digestibility (IVDMD) predicted the actual digestibility in sheep with a high degree of accuracy. For this reason only IVDMD was used in 1978 to estimate digestibility.

Distribution of corn plant components (Table 2) varied between the two years. While cob and husk remained constant, the ratio of grain to stalk varied considerably. In 1977 (a dry and poor grain production year) the grain was only 42% of the total plant dry matter. In 1978 (a wet, high grain production year) the grain was 58-59% of the whole plant dry matter on irrigated land and 53% on dry land.

IVDMD Plotted

When IVDMD was plotted over time of harvest (Figure 1) the two years have different initial digestibilities (intercepts) and rates of decline (slopes). The difference in grain stalk ratios may be part of the reason for this. The 1977 stalks had more cell solubles (CW + cell solubles = 100%) than the 1978 stalks. When less grain is produced by the plant, less soluble sugars are convertd to starch and stored in the grain. If less sugars are removed from the stalks and leaves, because of decreased grain yield, and photosynthesis continues, the soluble sugars will accumulate in larger concentrations in the plant. This increase in cell solubles, which are rapidly and efficiently utilized by the animal will cause an increase in digestibility. Because of the influence of cell solubles on IVDMD, the decline in cell solubles causes a decline in IVDMD.

After photosynthesis stops the cell soluble level declines rapidly to some equilibrium point with the cell wall. When the cell solubles are higher, as in 1977, their rate of decline will be more rapid because of the higher origin point and a common end point. There was no difference (IVDMD) between va-

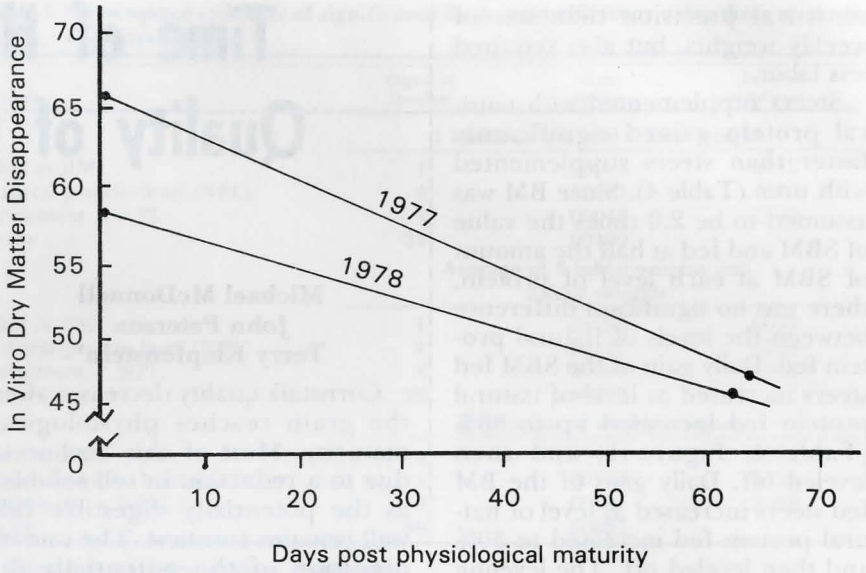


Figure 1. In vitro dry matter disappearance of cornstalks harvested over time.

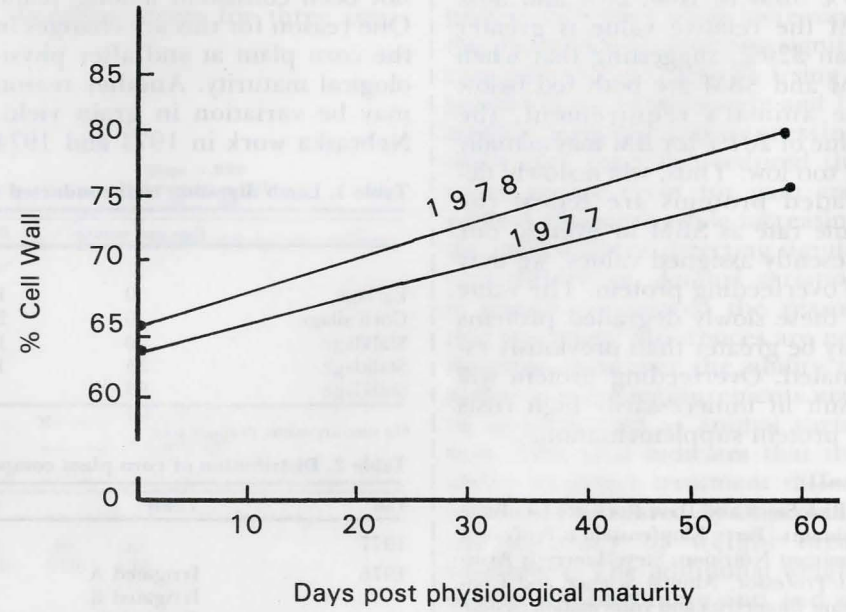


Figure 2. Cell wall concentration in cornstalks harvested over time.

Table 3. Cell wall levels and digestibilities in vitro.

Year and variety	Days post maturity	%CW[a]	Digestibility of CW[a,b]	Potentially digestible CW% of whole stalk
1977	0	64	59.7	38.2
	35	65.8	46.6	30.7
	63	75.54	44.2	33.4
1978				
Irrigated A	0	68.7	59.2	40.7
	26	76.1	52.1	39.6
	61	78.7	51.8	40.8
Irrigated B	0	64.8	57.4	37.2
	26	71.6	41.0	33.7
	61	75.0	50.1	37.6
Dryland B	0	63.5	60.1	38.2
	26	80.2	54.7	43.9
	61	80.2	56.6	45.4

[a]Cell Wall.
[b]96 hr. digestibility.

rieties in 1978, or whether the variety was irrigated, however, the dryland stalks were more variable, and seemed to be more affected by climatic conditions. The decrease in IVDMD was accompanied by increases in CW (decreases in cell solubles) (Figure 2). When IVDMD and cell solubles were compared, the loss of cell solubles accounted for 75% of the change in the IVDMD. This is because the absolute amount of digestible CW remained relatively constant in the stalk, and thus the loss of cell solubles was the main reason for the decline in IVDMD.

The percent of CW increased with maturity (Table 3) and the digestibility of the CW decreased with maturity. However, these changes offset each other so that the potentially digestible CW, when expressed as a percent of the whole stalk remained constant for the 1978 stalks. If potentially digestible CW remains constant, rate of digestion becomes more important. If the rate is faster, intake will increase because the CW will disappear from the rumen faster. In these trials the rate of cell wall digestion did not change after physiological maturity. There did appear to be a difference between varieties as one variety was digested faster than a comparable variety at 63 days post maturity ($P<.05$). Cultural practices may also affect rate of digestion as irrigated stalks seemed to have a faster rate of digestion than dryland.

Table 4. Rate of cell wall digestion of cornstalks harvested over time (% hr).

Year	Variety	Days post maturity 0	26-35	61-63
1977		4.82	4.58	4.64
1978	Irrigated A	4.98	4.97	4.52
	Irrigated B	5.31	5.18	5.26
	Dryland B	5.03	4.75	4.87

Stalks Make Excellent Feed

The quality of cornstalks decreases after physiological maturity. When there is a lower grain yield, the stalks are of higher quality. With lower grain yields, the stalklage has nearly the same feeding value as corn silage. However, in excellent grain producing years, the feeding value of the stalk is lower. The amount of cell wall increases and the digestibility of that cell wall decreases with time. The potentially digestible cell wall, as a percent of whole stalk, remained constant in 1978 but showed a decline in 1977. The rate of cell wall digestion remained constant over time, but varied with varieties.

Cornstalks, harvested soon after physiological maturity, are an excellent quality feed. If stalks are being used, this increased quality can be obtained with an earlier harvest date. This presents some mechanical, labor and management problems with simultaneous grain and forage harvest.

[1]Michael McDonnell is a Graduate Assistant. John Paterson is Assistant Professor, Animal Science, Univ. of Missouri, Columbia, Mo. Terry Klopfenstein is Professor, Ruminant Nutrition.

One implant lasts the lifetime of the animal.

For Suckling Steers

Estradiol Implant Increases Gains

S.D. Farlin
J.C. Parrott[1]

Suckling calves weighing 179 lb (81 kg) implanted with an estradiol removable implant gained 7% more during a 452-day suckling growing and finishing trial. Results indicate that one implant during the lifetime of the steer is effective in improving gain.

One-hundred twenty suckling steer calves weighing 179 lb (81 kg) were selected for the study. Calves were predominantly ¾ Angus, ¼ Brown Swiss breeding. They were assigned to six treatments including no implant, 1.0 inch (2.5 cm) solid implant and 0.25 inch (.63 cm), 0.5 inch (1.25 cm), 1.0 inch (2.5 cm) or 1.5 inch (3.75 cm) coated implant. The trial was divided into three phases.

Suckling Phase

The suckling phase was started May 16 and ended November 1 (169 days). Cows and calves had access to native range and improved pastures. All steers were equally divided into two pastures with each pasture serving as one replicate with all treatments equally represented.

Growing Phase

Calves were weaned November

(continued on next page)

Lifetime Implant

(continued from page 7)

1. Steers grazed native range and were supplemented with 4 to 6 lb (1.8 to 2.73 kg) of corn and 6 to 8 lb (2.73 to 3.64 kg) of an alfalfa-oat hay mixture. All treatments were equally represented in two pastures. The growing phase lasted 175 days.

Finishing Phase

The finishing phase lasted 98 days. Steers were fed in a barn open to the south with a flush-flume concrete floor. The steers from each pasture were separated by treatment. Treatment groups were then allotted to pens in the confinement facility.

The steers were fed a starting ration for eight days. The final ration was fed for 90 days and consisted of 73.65% corn, 19.46% corn silage, 3.78% dry supplement containing salt, mineral, and vitamins and 3.11% liquid protein supplement. Steers were weighed every 28 days. Carcass measurement were obtained at slaughter.

Results

Suckling Phase — Implanted steers gained 6% more rapidly than controls (Table 1). The greatest gain response (9%) was obtained with the 1.5 inch (3.75 cm) coated implant. One inch (2.5 cm) solid or coated implant gave an 8% faster rate of gain.

Growing Phase — Gain during the growing phase was not improved for cattle with implants. There was a reduction in gains of 5 and 4 percent for the 0.25 inch (.63 cm) and 1.50 inch (3.75 cm) implant treatment groups during the growing phase.

Table 2. Effect of Estradiol implants during the finishing phase.[a,b,c]

Implant Length inches	Implant Type S/C[d]	Initial Wt. Lb	ADG Lb	ADF Lb	F/G
1.00 (2.5)	Control	767 (349)	1.80 (.82)	15.60 (7.09)	8.62
1.00 (2.5)	S	793 (360)	2.11 (.96)	18.93 (8.60)	8.97
0.25 (.63)	C	755 (343)	1.91 (.87)	17.76 (8.07)	9.30
0.50 (1.25)	C	783 (356)	2.07 (.94)	17.46 (7.94)	8.44
1.00 (2.5)	C	804 (365)	2.05 (.93)	18.05 (8.20)	8.88
1.50 (3.75)	C	792 (360)	2.08 (.95)	17.82 (8.10)	8.60

[a]Includes days 345 through 452 after implanting, 98 days total in the finishing phase.
[b]2 reps/treatment; 10 steers/rep; total 20 steers/treatment.
[c]Numbers in parenthesis in metric units.
[d]s = solid; c = coated.

Table 1. Effect of Estradiol implants on average daily gain.[a,b]

Length inch	Type S/C[c]	Suckling (S) 169	Growing (G) 175	Finishing (F) 98	S+G 344	G+F 273	S+F+G 442
1.00 (2.5)	Control	1.85 (.84)	1.60 (.82)	1.80 (.78)	1.72 (.78)	1.67 (.76)	1.74 (.79)
1.00 (2.5)	S	2.00 (.91) [+8]	1.59 (.72) [−1]	2.11 (.96) [+17]	1.79 (.81) [+4]	1.78 (.81) [+7]	1.86 (.85) [+7]
0.25 (.63)	C	1.86 (.85) [+1]	1.52 (.69) [−5]	1.91 (.87) [+6]	1.69 (.77) [−2]	1.66 (.75) [−1]	1.74 (.79) [0]
0.50 (1.25)	C	1.92 (.87) [+4]	1.59 (.72) [−1]	2.07 (.94) [+15]	1.76 (.80) [+2]	1.76 (.80) [+5]	1.83 (.83) [+5]
1.00 (2.5)	C	1.99 (.90) [+8]	1.60 (.73) [0]	2.05 (.93) [+14]	1.79 (.81) [+4]	1.76 (.80) [+5]	1.85 (.84) [+6]
1.50 (3.75)	C	2.01 (.91) [+9]	1.54 (.70) [−4]	2.08 (.95) [+16]	1.77 (.80) [+3]	1.73 (.84) [+4]	1.84 (.84) [+6]

[a]Number in parenthesis is metric unit.
[b]Number brackets are percent change from control treatment.
[c]S = Solid; C= Coated.

Finishing Phase — Daily gain during the finishing phase was improved 14% (Table 2) above the non-implanted steers. The 1.0 inch (2.5 cm) solid implant improved daily gain 17% during the finishing phase. All implant treatments increased feed consumption during the finishing period. Feed efficiency was not improved with implant treatments.

Carcass measurements were similar for all treatments, however, there was a slight increase in ribeye area for implanted groups. A slightly higher cutability was also observed with implanted steers. All estradiol implants improved daily gain for the combined suckling and growing phase (Table 1).

The growing and finishing phases combined resulted in 4 to 7% faster gains for implanted cattle. Estradiol implants 0.50 inch (1.25 cm) or longer improved gain 6% with the 1.0 inch (2.5 cm) solid implant causing a 7% improvement in gain. The 0.25 inch (.63 cm) implant had no effect on gain over the entire 452-day trial. Results indicate that maximum improvement in gain can be achieved by estradiol implants at least 1.00 inch (2.5 cm) long.

Implanting suckling calves with no subsequent implants gave improved performance during the lifetime of the steer.

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Cows on native winter range.

For Beef Cows

Winter Nutritional Programs

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

Alfalfa hay and brome-orchardgrass hay are equal to soybean meal protein when fed on a protein equivalent basis to cows on native winter range. Generally 2.5 to 3 lb (1.14 to 1.36 kg) of hay equals 1 lb (.45 kg) of 40% protein supplement made from soybean meal.

Cows perform as well or better when wintered on cornstalks and alfalfa stubble without supplement as those wintered on native range with supplement. The carrying capacity is 2.5 times greater, also.

Protein is the first limiting nutrient in a native winter range grazing system. The cost of protein supplement is a major expense in the system. Increased irrigation allows the rancher to use alfalfa or cool-season grass hay as a protein supplement.

Three experiments conducted during 1974-75, 1975-76, and 1976-77 at the Sandhills Agricultural Laboratory near Tryon, Nebraska (1) compared soybean meal and/or corn based supplements with alfalfa or brome-orchardgrass hay fed for a protein supplement to mature cows wintering on native range and (2) compared the performance of cows wintered on native range with protein supplement and cows wintered on cornstalk pasture. Each four groups of 25 cows were placed in one of four similar 120 acre (48.6 ha) pastures from mid-November until early March. A fifth group of cows was wintered in a pasture of 40% cornstalks, 50% alfalfa stubble and 10% native range with no supplementation. Carrying capacity was .83 AUM/A (2.05 AUM/ha) or 5A/cow (2 ha/cow) on native range for all three trials. The corn-stalk-alfalfa stubble had a carrying capacity of 2 AUM/A (4.94 AUM/ha) or 2 A/cow (.8 ha/cow) in the first experiment and 2.64 AUM/A (6.52 AUM/ha) or 1.5 A/cow (.6 ha/cow) in the last two experiments.

Calving season was from March 15 until May 5 each year. Cows received a full feed of alfalfa hay from the start of calving until they went to summer pasture. The cows were bred artificially the first 30 days of the breeding season followed by 20 days with clean up bulls.

First Experiment

In 1974-75 2 lb (.92 kg) of a 40% all natural protein supplement was compared with 6 lb (2.75 kg) of third cutting alfalfa hay containing 17% crude protein fed to cows on

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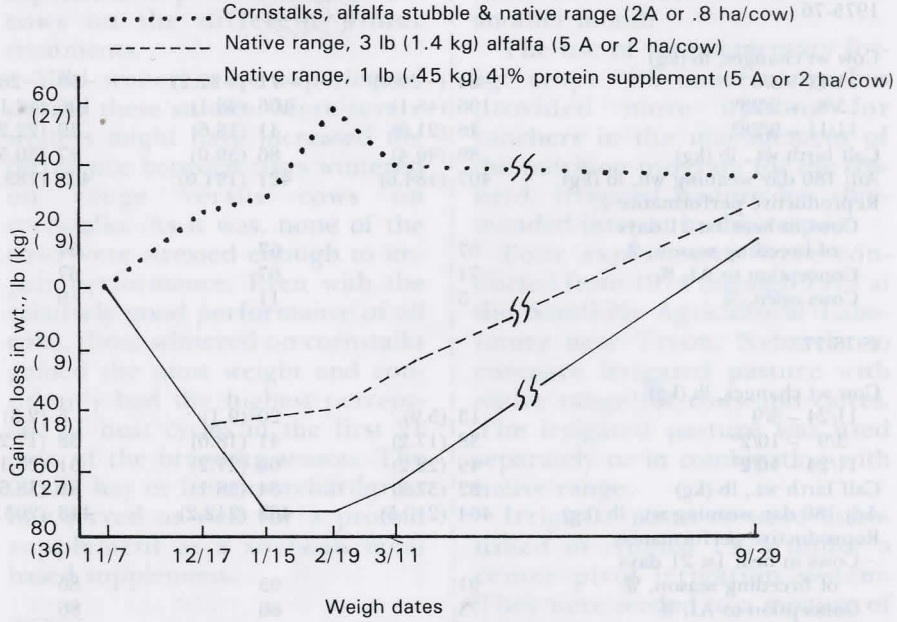

Figure 1. Weight change of cows wintered on native range with an alfalfa or 40% protein supplement and on cornstalks and alfalfa stubble (1974-75). Supplementation started December 17 and stopped March 11.

Winter Nutrition

(continued from page 9)

native range. Supplements were fed every other day. Two groups of 25 cows each were fed each supplement. The performance of cows wintered on the range with supplement was compared to a fifth group on cornstalk-alfalfa stubble with no supplement.

The cows were placed in pastures on November 7, 1974 and supplemental feeding started December 17, 1974. The native pastures had not been grazed during the summer and fall of 1974. No hay or other source of energy besides the protein supplement was fed to any group.

Cows that received no supplement on the cornstalks-alfalfa stubble pasture gained 39 lb (17.7 kg) between November 7, 1974 and March 11, 1975 compared to a loss of 48 lb (21.8 kg) for cows on native range during the same time span (Figure 1). The major weight loss for cows on range was from November 7 to December 17 before supplementation.

The average weight change of cows on native range between December 17, 1974 and March 11, 1975, the period they received supplement, was a loss of 20 lb (9.1 kg) for those fed a 40% protein supplement and a gain of 18 lb (8.2 kg) for those fed alfalfa hay (Figure 1).

There was little difference in reproductive performance of the cows, although cows fed the 40% protein supplement on native pasture had the poorest performance (Table 1). They also weaned the lightest calves (Table 1).

Table 1. Calf performance and reproductive performance of cows wintered on different programs (1974-75).

	2 lb (.9 kg)[a] 40% protein	6 lb (2.73 kg)[a] alfalfa hay	Cornstalks, alfalfa stubble
Birth weight, lb (kg)	76 (35)	76 (35)	75 (34)
Adj 180 day weaning weight, lb (kg)	380 (173)	394 (179)	393 (179)
Cows in heat 1st 21 days of breeding season, %	83	86	91
Cows open, %	15	7	13

[a]Amount fed per head every other day.

Second and Third Experiments

In 1975-76 and 1976-77 four supplements were fed on native winter range. The two experiments were identical as far as supplements were concerned. There were 25 cows allotted to each treatment each year. The four supplements fed on an every other day basis were: (1) 2 lb (.91 kg) 40% natural protein, (2) 4 lb (1.82 kg) 20% natural protein, (3) 5.0 lb (2.27 kg) alfalfa hay, and (4) 5.0 lb (2.27 kg) brome-orchardgrass hay taken from an irrigated pasture. A fifth group on cornstalks and alfalfa stubble did not receive a supplement.

In 1975 the cows were placed on winter pasture November 11 and started receiving supplements on December 4. Supplementation was discontinued on March 8, 1976 when the cows were taken to the calving area. In 1976 the cows

Table 2. Calf performance and reproductive performance of cows fed different protein supplements on winter range (1975-76 & 1976-77).

	2 lb (.9 kg)[a] 40% protein supplement	4 lb (1.8 kg)[a] 20% protein supplement	5 lb (2.28 kg)[a] alfalfa hay	5 lb (2.28 kg)[a] brome-orchardgrass hay	Cornstalks alfalfa-stubble
1975-76					
Cow wt changes, lb (kg)					
11/11 – 3/8	−64 (−29.0)	−71 (−32.2)	−58 (−26.3)	−56 (−25.4)	10 (4.5)
3/8 – 9/28[b]	106 (48.1)	106 (48.1)	106 (48.1)	97 (44.0)	29 (13.2)
11/11 – 9/28[b]	48 (21.8)	41 (18.6)	49 (22.2)	34 (15.4)	45 (20.4)
Calf birth wt., lb (kg)	89 (40.4)	86 (39.0)	87 (39.5)	87 (39.5)	83 (37.6)
Adj 180 day weaning wt., lb (kg)	407 (184.6)	421 (191.0)	405 (183.7)	425 (192.8)	428 (194.1)
Reproductive performance					
Cows in heat 1st 21 days of breeding season, %	67	67	64	71	77
Conception to AI, %	71	67	67	75	65
Cows open, %	5	11	9	8	8
1976-77					
Cow wt changes, lb (kg)					
11/24 – 3/9	13 (5.9)	20 (9.1)	5 (2.3)	−5 (−2.3)	86 (39.0)
3/9 – 10/2[b]	38 (17.2)	41 (18.6)	38 (17.2)	42 (19.1)	−18 (−8.2)
11/24 – 10/2[b]	49 (22.2)	60 (27.2)	51 (23.1)	51 (23.1)	74 (33.6)
Calf birth wt., lb (kg)	82 (37.2)	84 (38.1)	85 (38.6)	82 (37.2)	83 (37.6)
Adj 180 day weaning wt., lb (kg)	464 (210.5)	468 (212.2)	448 (203.2)	481 (218.2)	458 (207.7)
Reproductive performance					
Cows in heat 1st 21 days of breeding season, %	91	95	86	90	100
Conception to AI, %	73	86	86	86	88
Cows open, %	4	4	0	0	0

[a]Amount fed per head every other day.

[b]The data from cows not weaning calves were dropped as of the March weights.

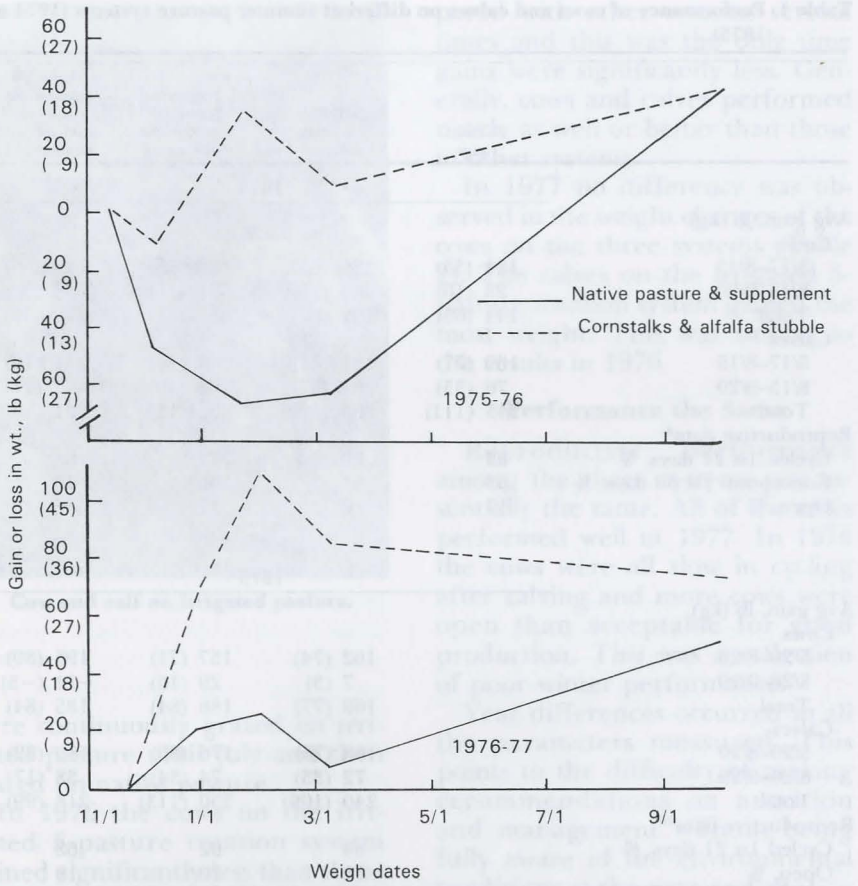

Figure 2. Weight change of cows wintered on native range with a supplement or on cornstalks and alfalfa stubble (1975-76 & 1976-77).

were placed in the winter pastures on November 24 and supplementation started immediately. They were held out of the pastures longer than in previous years because lack of moisture in 1976 prevented maximum forage growth, thus a shorter total winter season but a longer supplementation period. Supplementation was discontinued on March 9, 1977.

The average cow weight changes between November and March were not greatly different for the four groups of cows receiving supplements on native range (Table 2), however, those that were on cornstalks and alfalfa stubble gained significantly more (Table 2 and Figure 2). Cows wintered on native pasture gained more during the summer than cows wintered on cornstalks (Table 2). This is an expression of compensatory gain by the cows losing the most weight during the winter.

There were no differences between winter treatments in birth weights or 180-day adjusted weaning weights (Table 2). Similarly, there were no differences in reproductive performance of the cows on the different winter treatments.

Mild winters were experienced during these studies. More severe winters might have increased the difference between cows wintered on range versus cows on cornstalks. As it was, none of the cows were stressed enough to impair performance. Even with the relatively good performance of all cows, those wintered on cornstalks gained the most weight and consistently had the highest percentage of heat cycles in the first 21 days of the breeding season. The alfalfa hay or brome-orchardgrass hay served as well for a protein supplement as a soybean meal based supplement.

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Cow and calf on native range.

Cow-Calf Summer Management Systems

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

Irrigated pasture can be used quite flexibly in combination with native range pasture. Cows and calves rotated on irrigated pasture, rotated on irrigated pasture and native pasture, or grazed continuously on irrigated pasture until mid-July then on native pasture performed similarly. Calves weaned in mid-August and placed on irrigated pasture gained less than calves left on the cows another month.

The use of complementary forage crops with native range has provided more options for ranchers in the management of the nutrition program for the cow herd. Irrigated pasture has commanded interest in this respect.

Four experiments were conducted from 1974 through 1977 at the Sandhills Agricultural Laboratory near Tryon, Nebraska to compare irrigated pasture with native range for cows and calves. The irrigated pasture was used separately or in combination with native range.

Irrigated pastures were established in August 1973 under a center pivot irrigation system. They were seeded to a mixture of 7 lb (3.2 kg) and 10 lb (4.5 kg) pure live seed per acre (.4 ha) of

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Summer Management

(continued from page 11)

orchardgrass and smooth bromegrass, respectively. In one 25 acre (10.1 ha) area, divided into five equal sized pastures for rotational grazing, three additional grasses were seeded to determine adaptability to sandy soils and compatability in mixtures with bromegrass and orchardgrass. The seeding rate of bromegrass and orchardgrass was reduced by one-third and meadow brome, intermediate wheatgrass and Garrison creeping foxtail were cross-seeded in separate pastures.

The native range was in good condition and managed in a deferred system so no pasture was grazed in early summer year after year. It was stocked at the rate of .6 AUM/A (1.5 AUM/ha). The irrigated pasture was stocked at the rate of 12 AUM/A (26.6 AUM/ha).

Systems Compared

In the first experiment (1974) four systems were compared: (1) twenty-five acres (10.1 ha) of irrigated pasture grazed in a 5-pasture rotation starting May 17; (2) fifteen acres (6.1 ha) of irrigated pasture in 3 pastures and 340 acres (138 ha) of native range in 1 pasture used in a rotation system starting May 17, (3) twenty acres (8.1 ha) of irrigated pasture continuously grazed from May 17 until July 17 followed by native range with the calves weaned on August 15 and put back in the irrigated pasture; and (4) native range continuously grazed. There were 35 cow-calf pairs in each system.

In the second experiment (1975) the first three systems were again compared. The fourth system was not repeated because the results in 1974 were similar to those obtained at the North Platte Station when irrigated pasture was compared with native range over a five-year period. The same cows were used in 1975, however, they were reassigned to the three systems. There were 37 pairs per system in 1975.

In the first experiment, cows and calves on irrigated pasture gained more than those on native range (Table 1). In addition, there were fewer open cows on irrigated pasture at the end of a 50-day breeding season. Cows on the irrigated pasture-native range rotation did not perform as well in 1974 as in 1975. This may have been a result of the way the cattle were rotated from irrigated pasture to range or it may have been a yearly difference due to climate, etc. In 1975 the cows were retained on irrigated pasture during most of the artificial insemination period.

The poor weight gain of the calves weaned early and their mothers between August 15 and September 20 caused the total weight gain for the summer to be low compared to the other groups. The reason, although not documented here, for the poorer weight gains of the early weaned calves and their mothers is that both cows and calves lose weight for several days following weaning. When this time period is included in the five week period, the gain appears less than those that were not weaned until later. This same loss of weight in cows and calves has been observed following weaning regardless of weaning date.

In 1974 the early weaned calves received only irrigated pasture forage between their weaning date and the weaning date of the other calves. In 1975 they were fed three pounds (1.36 kg) of corn per head per day during this period in an effort to improve gains. In either case, they did not gain as well between mid-August and late September as calves that were not weaned early.

In the third (1976) and fourth (1977) experiments the same summer management systems were used as in the second experiment except the calves were not weaned early in the group that

Table 1. Performance of cows and calves on different summer pasture systems (1974 and 1975).

	Native range	Irrigated 5-pasture rotation	Irrigated 3-pasture rotation with native range	Irrigated continuous grazed until mid-July and weaned early
		1974		
Avg gain, lb (kg)				
Cows				
5/17–8/15	121 (55)	139 (63)	123 (56)	129 (59)
8/15–9/20	23 (10)	53 (24)	33 (15)	0 (0)
Total	144 (65)	192 (87)	156 (71)	129 (59)
Calves				
5/17–8/15	169 (77)	184 (84)	164 (74)	174 (79)
8/15–9/20	76 (35)	81 (37)	88 (40)	47 (21)
Total	245 (111)	265 (120)	252 (114)	221 (100)
Reproductive data[a]				
Cycled 1st 21 days, %	83	89	77	83
Conception 1st 30 days, %	63	57	60	49
Open, %	17	9	17	6
		1975		
Avg gain, lb (kg)				
Cows				
5/20–8/20		162 (74)	157 (71)	196 (89)
8/20–9/29		7 (3)	29 (13)	−11 (−5)
Total		169 (77)	186 (84)	185 (84)
Calves				
5/20–8/20		168 (76)	176 (80)	180 (82)
8/20–9/29		72 (33)	74 (34)	38 (17)
Total		240 (109)	250 (113)	218 (99)
Reproductive data[ab]				
Cycled 1st 21 days, %		84	92	68
Open, %		10	10	10

[a]The breeding season consisted of 30 days of artificial insemination (AI) followed by 20 days with clean up bulls.

[b]Conception rate the 1st 30 days could not be determined because older cows were culled in the fall following pregnancy examination.

Cow and calf on irrigated pasture.

were continuously grazed on irrigated pasture until July and then placed on native pasture.

In 1976 the cows on the irrigated 5-pasture rotation system gained significantly less than those on the other two systems but their calves gained significantly more (Table 2). The irrigated 5-pasture rotation system has been compared with other systems several times and this was the only time gains were significantly less. Generally, cows and calves performed nearly as well or better than those in other systems.

In 1977 no difference was observed in the weight changes of the cows on the three systems (Table 2). The calves on the irrigated 5-pasture rotation system gained the most weight. This was similar to the results in 1976.

Performance the Same

Reproductive performance among the three systems was essentially the same. All of the cows performed well in 1977. In 1976 the cows were all slow in cycling after calving and more cows were open than acceptable for good production. This was a reflection of poor winter performance.

Year differences occurred in all the parameters measured. This points to the difficulty of making recommendations on nutrition and management without being fully aware of the environmental conditions at the time and site.

[1]D.C. Clanton is Professor, Animal Science (Beef) and L. L. Berger and M. E. England are Research Assistants.

Table 2. Performance of cows and calves on different summer pastures systems (1976 and 1977).

	Irrigated 5-pasture rotation	Irrigated 3-pasture rotation with native range	Irrigated continuous grazed until mid-July then native range
	1976 (May 13 – Sept 28)		
Avg gain, lb (kg)			
Cows	127 (58)	184 (84)	163 (74)
Calves	292 (133)	263 (119)	271 (123)
Reproductive data[a]			
Cycled 1st 21 days breeding season, %	68	63	73
Conception, %			
AI	68	61	70
Clean up bulls	24	28	22
Open, %	8	11	8
	1977 (May 4 – Oct 3)		
Avg gain, lb (kg)			
Cows	150 (68)	145 (66)	147 (67)
Calves	315 (143)	301 (137)	308 (140)
Reproductive data[a]			
Cycled 1st 21 days breeding season, %	97	89	91
Conception, %			
AI	84	85	86
Clean up bulls	16	13	11
Open, %	0	2	3

[a]The breeding season consisted of 30 days of artificial insemination (AI) followed by 20 days with clean up bulls.

Young cows with their calves used in the slow release urea experiment.

Range Supplements

Slow Release Urea

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

Bred yearling and 2-year-old heifers wintered on native range and fed 1.75 lb (.8 kg) per head per day of 40% protein supplement containing 50% of the protein equivalence from regular urea or coated urea[2] gained less weight during the winter than those fed a supplement containing 40% natural protein. They gained similarly to those fed the same amount of a supplement containing 20% all natural protein. There was no difference in weight gains following calving and during the summer. The heifers that gained the least during the winter compensated and gained the most during the summer. There was no difference in reproductive or calf performance.

Ammonia Release

Developing procedures by which the rate of ammonia release from urea in the rumen can be controlled to provide for more complete utilization of the urea nitrogen is needed. Oklahoma studies have shown slower nitrogen release from the coated urea.

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Slow Release Urea

(continued from page 13)

Twelve bred yearling and 2-year-old heifers were fed one of four supplements while being wintered on native range at the Sandhills Agricultural Laboratory. There were equal numbers of each age group across the four treatment groups. The heifers were corralled every day and each individually fed her assigned supplement for 112 days during the winter of 1977-78, using a stall feeding arrangement. The remainder of the day the heifers were together in a common pasture.

The four supplements were 1.75 lb (.8 kg) per head per day of:

(1) 40% all natural protein.

(2) 20% all natural protein.

(3) 40% crude protein equivalent with 50% of the nitrogen from urea.

(4) 40% crude protein equivalent with 50% of the nitrogen from coated urea (slow release).

The supplements (Table 1) were formulated, mixed and pelleted in ¾ inch (1.9 cm) pellets except for supplement 4 which was not pelleted because the process was breaking down the coating. They were balanced and equalized for minerals and vitamin A.

Table 2. Performance of heifers fed supplements containing different sources of nitrogen while grazing winter range.

	Supplement			
	Natural protein N 100%	Natural protein N 100%	Regular urea N 50%	Coated urea N 50%
Protein in supplements, %	40	20	40	40
Avg cow weights, lb (kg)				
Initial	816 (369)	809 (368)	812 (369)	820 (373)
Gain Oct – Feb (112 days)	72 (33)	53 (24)	53 (24)	55 (25)
Gain May – Sept	155 (70)	168 (76)	192 (87)	182 (83)
Final	911 (414)	903 (410)	945 (430)	936 (425)
Avg calf weights, lb (kg)				
Birth	77 (35)	76 (35)	75 (34)	75 (34)
Age adj weaning wt	451 (205)	434 (197)	445 (202)	454 (206)
Reproductive performance, %				
Cycled 1st 21 days breeding	56	64	73	90
Pregnant 60 day breeding	89	64	91	100

During calving the heifers received a full feed of alfalfa and 2 lb (.91 kg) of 13% protein pellets. Following calving until May 8, 1978 when they were placed on irrigated pasture they received 3 to 5 lb (1.36 to 2.27 kg) of dry rolled corn in place of the pellets with the alfalfa hay. They continued to receive the corn for three weeks after going to irrigated pasture where they spent the summer.

Gained Weight

The heifers that received the 40% all natural protein supplement gained significantly more weight during the 112-day winter period than the other three groups of heifers (Table 2). Their average gains were 72 lb (33 kg), whereas the two groups that received the supplements containing 50% of the nitrogen from either regular or coated urea gained 53 lb (24 kg) and 55 lb (25 kg), respectively. This was similar to the group that received 20% natural protein supplement which gained 53 lb (24 kg). This could be interpreted to mean that there was little if any benefit from putting the urea in the supplements. There was no benefit from the coated urea as compared to the regular urea. The cows that gained the least during the winter gained the most the following summer which was the normal expression of compensatory gain.

There were no differences in calf weights or in reproductive performance of the cows (Table 2). This may not be surprising because it is necessary to have 25 or more cows per treatment to measure small but significant differences in these traits. This is because individual animal variation is quite large for these traits. Even though not significant, the group of heifers that received the 20% protein supplement had a poor conception rate.

Table 1. Composition of supplements fed to heifers grazing native winter range.

	Supplement			
Ingredient, %	Natural protein N 100%	Natural protein N 100%	Regular urea N 50%	Coated urea N 50%
Soybean meal[a]	70.0	—	—	—
Soybean meal[b]	15.3	35.0	34.5	35.0
Corn	—	47.4	48.1	45.5
Molasses	5.0	5.0	5.0	5.0
Urea	—	—	7.0	—
Coated urea	—	—	—	9.1
Wood shavings[c]	7.0	7.0	—	—
Dicalcium phosphate	2.0	3.2	3.0	3.0
Potassium chloride	—	1.7	1.7	1.7
Sulfur	.3	.3	.3	.3
Trace mineral mix	.3	.3	.3	.3
Vitamin A, premix[d]	.1	.1	.1	.1
Protein, %	40.0	20.0	40.0	40.0
Phosphorus, %	1.0	1.0	1.0	1.0
Calcium, %	1.0	1.0	1.0	1.0
Potassium, %	2.0	2.0	2.0	2.0

[a]49% protein

[b]44% protein

[c]Used to equalize energy

[d]To provide 20,000 IU/head per day.

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[1]D. C. Clanton is Professor, Animal Science (Beef) and L. L. Berger and M. E. England are Research Assistants.

[2]Coated urea developed by Nipak Corporation, Pryor, Oklahoma.

Cows preferred treated straw bales.

Treating Wheat Straw for Cows

John Paterson
Terry Klopfenstein
John Ward[1]

Mature gestating beef cows given a choice between untreated or sodium hydroxide (NaOH) treated wheat straw in round bales, consumed six times more NaOH treated straw. When given a choice between untreated or liquid protein supplement treated straw bales, cows consumed about five times more supplement treated straw. In both comparisons cows were supplemented with seven lb (3.2 kg) of alfalfa hay per head per day.

NaOH treatment increased *in vitro* dry matter digestibility and decreased cell wall content of the straw. Treatment with liquid protein supplement slightly increased *in vitro* dry matter digestibility and raised the crude protein content of the straw from 3.3 to 8.6%.

Wheat Straw—Energy

Each year over three million tons of wheat straw are produced in Nebraska. Although the straw is not used extensively as a feedstuff, it could serve as an energy source for ruminants. The relatively low digestible energy value of wheat straw has restricted its use as a feedstuff to maintenance diets for gestating cows or as a roughage source in finishing rations. The use of straw in lactation or growing rations has been limited because energy density is low and cattle will not consume enough to meet their energy needs. Research reported in the 1979 Nebraska Beef Report showed that young cows fed wheat straw free choice from big bales plus seven lb (3.2 kg) of alfalfa hay daily while on winter pasture would not consume adequate amounts to maintain body weight.

Mature gestating cows fed chopped wheat straw mixed with alfalfa in a 2:1 ratio gained about .5 lb (.23 kg) daily during a 100-day winter trial (1979 Beef Cattle Report). The alfalfa (about 7 lb, 3.2 kg) was sufficient to meet the protein needs of the cow.

NaOH treatment of crop residues improves *in vitro* dry matter disappearance and dry matter intake. Wheat straw has a low protein content (3-5%) and therefore may be enhanced by treating with liquid protein supplement. As part of an ongoing project, different systems of straw utilization and chemical treatment are being evaluated (see 1977, 1978, 1979 Nebraska Beef Cattle Reports).

The objectives of this study were to: (1) estimate daily dry matter intake and preference of cows offered untreated, NaOH treated, or liquid protein supplement treated wheat straw and (2) to determine the effect of NaOH and liquid protein supplement on straw digestibility *in vitro*.

Procedure

After wheat harvest in July the remaining straw was windrowed and about 800 lb (362 kg) round bales produced.

Treatment 1 consisted of untreated control straw.

Treatment 2 consisted of NaOH treatment and was accomplished by spraying a NaOH solution on the straw windrow just before baling. The NaOH solution (20 units NaOH/80 units water) was carried in two 150 gallon (68 liter) saddle tanks mounted on the tractor. An adjustable electric sprayer, also mounted on the tractor, applied the NaOH to the straw at a rate of 4 units NaOH/100 units dry straw.

Treatment 3 consisted of spraying the straw windrow with a liquid protein supplement (urea-molasses base, 51% crude protein) just before baling. The electric sprayer was adjusted to apply enough supplement so as to increase the protein content of the straw from 4 to about 10%.

After treatment, all bales were removed from the field and stored in a hay barn until the palatability trial began in January. Straw samples were analyzed for *in vitro* dry matter disappearance, neutral detergent fiber (cell walls) and crude protein.

The cow palatability trial was conducted in January and February with 15 mature gestating cows averaging 1030 lb (467 kg). Trial 1 of the experiment compared cow preference for either untreated or NaOH treated straw. Trial 2 of the experiment compared cow preference for either untreated or liquid protein supplement treated straw. Cows were offered a choice of straw fed in two round bale feeders and after about 80% of one of the bales had been consumed, both bales were removed and another replication with fresh bales begun. Each trial utilized three treated bales and three untreated bales. Cows were

(continued on next page)

Table 1. Estimated cow dry matter intake, *in vitro* digestibility and laboratory analyses of straw.

	Trial 1		Trial 2	
	Untreated	NaOH	Untreated	Liquid supplement
Estimated daily intake, lb (kg)	2.3 (1.04)	13.3 (6.03)	2.5 (1.13)	12.1 (5.49)
In vitro digestibility	37.6	46.7	37.6	41.1
Neutral detergent fiber (cell walls), %	87.7	82.0	87.7	86.0
Crude protein, %	3.3	4.5	3.3	8.6

Treating Wheat Straw

(continued from page 15)

supplemented with seven lb (3.2 kg) alfalfa hay per head per day. Bales were weighed before being offered, but the amount remaining was visually estimated due to the difficulty of moving broken bales and contamination with manure and snow.

Results

Results of trials 1 and 2 are given in Table 1. When cows were given a choice between untreated or NaOH treated straw, it was estimated that daily intake of the untreated straw was 2.3 lb (1.04 kg) and 13.3 lb (6.03 kg) for the NaOH treated straw. Similarly in trial 2, when cows were given a choice between untreated or liquid supplement treated straw, daily intake of untreated straw was estimated to be 2.5 lb (1.13 kg) and 12.1 lb (5.49 kg) for liquid protein supplement treated straw.

Sodium hydroxide increased the *in vitro* digestibility of the straw from 37.6 to 46.7% (24.2% improvement) and decreased the amount of cell walls from 87.7 to 82.0% (a 6.5% decrease). This increase was observed in samples from the middle ⅓ of the length of the bale due to the problem of getting sufficient NaOH solution on the outer portions of the windrow.

Liquid supplement treatment of straw improved *in vitro* digestibility protein from 37.6 to 41.1% (9.3% improvement). Crude protein content was raised from 3.3 to 8.6% through the addition of liquid supplement. This increase, however, was found only for samples taken from the middle ⅓ of the length of the bale due to problems of application already mentioned. Cow intake might have been greater if a more uniform spray of either NaOH or liquid supplement had been applied to the windrow.

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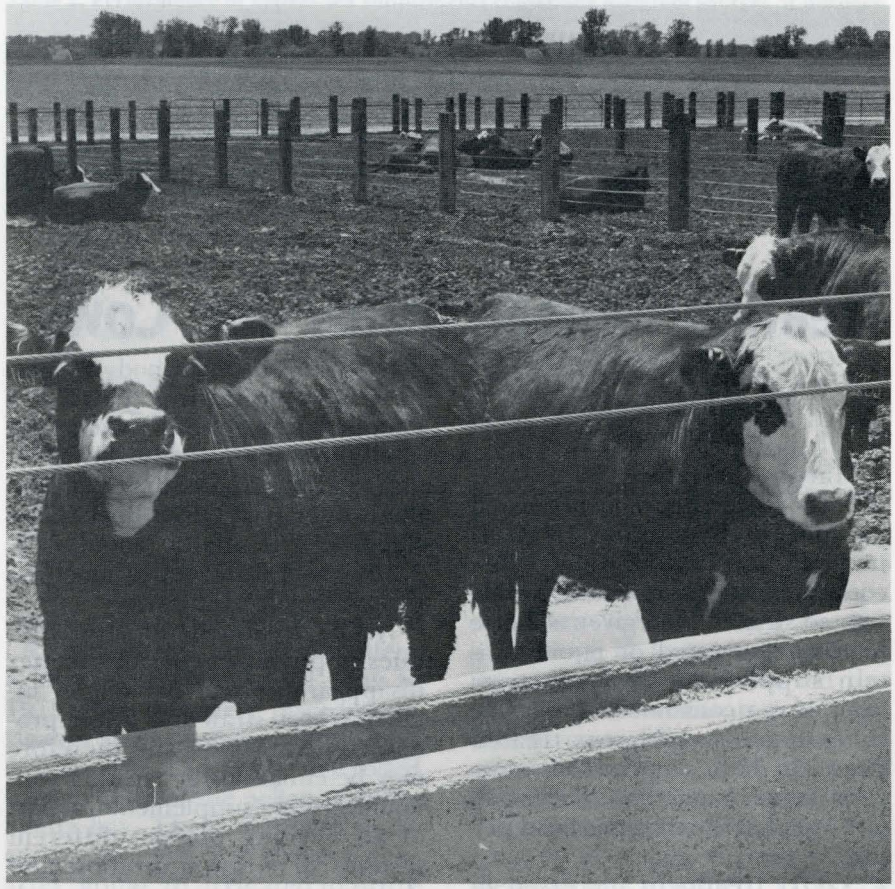

Hereford-Angus steers on test at Meat Animal Research Center.

Breed Groups, Cycle II

Carcass Evaluation

Robert M. Koch[1]

Palatability differences of beef from animals of similar age and raised under similar feeding and management were small regardless of breed combinations used in Cycle II of studies at the Roman L. Hruska U. S. Meat Animal Research Center. While slight differences in tenderness were detected in taste panel evaluation, all breed combinations were scored in the range of moderately tender.

Breed crosses differed significantly in growth rate of fat, lean, and bone. The estimated live weight at which breed groups reached marbling equivalent to USDA Choice grade was 829 lb (377 kg) for straightbred Angus, 984 lb (447 kg) for Red Poll crosses, 1004 lb (456 kg) for Hereford-Angus crosses, 1141 lb (519 kg) for straightbred Hereford, 1153 lb (524 kg) for Brown Swiss crosses, 1212 lb (551 kg) for Maine Anjou crosses, 1244 lb (565 kg) for Gelbvieh crosses, and 1386 lb (630 kg) for Chianina crosses.

At an equal amount of fat trim there were small but significant differences among breed groups in amount of marbling. Straightbred Angus had the highest and straightbred Hereford had the lowest average marbling scores of breed groups compared. At an equal fat trim percentage the difference between extremes was about one degree of marbling.

Procedures

Steer carcasses obtained from matings of Gelbvieh, Maine Anjou, Chianina, Brown Swiss, Red Poll, Hereford, and Angus sires to Hereford and Angus cows were

Table 1. Breed group means adjusted to a common (1) age, (2) carcass weight, (3) fat thickness, (4) fat trim percentage, or (5) marbling end point.

Item	Breed group[a]	(1)[b] Age	(2)[b] Carcass weight	(3)[b] Fat thickness	(4)[b] Fat trim %	(5)[b] Marbling
Final weight, lb (kg)	AA	967 (439.6)	1003 (455.8)	910 (413.5)	879 (399.7)	829 (376.9)
	HH	970 (440.9)	1020 (463.6)	922 (419.0)	965 (438.6)	1141 (518.5)
	HAX	990 (449.9)	1014 (461.0)	898 (407.8)	919 (417.9)	1004 (456.5)
	RX	961 (436.9)	1012 (460.2)	968 (440.4)	915 (415.9)	984 (447.4)
	BX	1058 (480.8)	1024 (465.3)	1177 (535.2)	1151 (523.3)	1153 (524.0)
	GX	1071 (487.0)	1023 (465.1)	1225 (556.9)	1179 (536.1)	1244 (565.3)
	MX	1085 (493.0)	1013 (460.3)	1248 (567.4)	1241 (564.1)	1212 (551.0)
	CX	1059 (481.3)	1008 (458.0)	1308 (494.7)	1453 (660.5)	1386 (629.9)
Carcass weight, lb (kg)	AA	609 (276.7)	635 (288.0)	569 (258.5)	547 (248.8)	512 (232.9)
	HH	600 (272.5)	635 (288.0)	566 (257.4)	596 (270.9)	717 (325.7)
	HAX	617 (280.3)	635 (288.0)	553 (251.2)	568 (258.2)	627 (284.9)
	RX	598 (271.9)	635 (288.0)	603 (274.3)	566 (257.4)	614 (279.2)
	BX	657 (298.7)	635 (288.0)	740 (336.2)	722 (328.0)	723 (328.5)
	GX	667 (303.2)	635 (288.0)	773 (351.5)	741 (337.0)	786 (357.3)
	MX	684 (311.0)	635 (288.0)	799 (363.0)	794 (360.7)	774 (351.6)
	CX	670 (304.4)	635 (288.0)	845 (384.0)	946 (430.2)	899 (408.7)
Ribeye area in² (cm²)	AA	10.4 (67.3)	10.6 (68.2)	10.2 (65.8)	10.1 (65.1)	9.9 (63.8)
	HH	10.0 (64.7)	10.2 (65.9)	9.8 (63.5)	10.0 (64.6)	10.7 (68.8)
	HAX	10.2 (66.0)	10.3 (66.6)	9.9 (63.8)	10.0 (64.3)	10.3 (66.3)
	RX	10.4 (66.9)	10.6 (68.2)	10.4 (67.1)	10.2 (65.7)	10.4 (67.4)
	BX	11.4 (73.6)	11.3 (72.7)	11.9 (76.6)	11.8 (75.9)	11.6 (76.0)
	GX	11.7 (75.5)	11.5 (74.2)	12.3 (79.4)	12.1 (78.2)	12.4 (79.8)
	MX	12.0 (77.3)	11.7 (75.4)	12.6 (81.5)	12.6 (81.3)	12.5 (80.5)
	CX	12.2 (78.4)	11.9 (77.0)	13.2 (85.0)	13.8 (88.9)	13.5 (87.1)
Fat thickness, in. (mm)	AA	.6 (14.6)	.6 (15.9)	.5 (12.5)	.4 (11.4)	.4 (9.6)
	HH	.6 (14.2)	.6 (15.9)	.5 (12.5)	.6 (14.0)	.8 (20.6)
	HAX	.6 (16.1)	.7 (17.1)	.5 (12.5)	.5 (13.4)	.7 (16.7)
	RX	.5 (12.3)	.5 (13.8)	.5 (12.5)	.4 (10.9)	.5 (13.0)
	BX	.4 (9.8)	.4 (9.1)	.5 (12.5)	.5 (11.9)	.5 (12.0)
	GX	.4 (9.3)	.3 (8.3)	.5 (12.5)	.5 (11.5)	.5 (12.9)
	MX	.4 (9.2)	.3 (7.7)	.5 (12.5)	.5 (12.4)	.5 (11.8)
	CX	.3 (8.0)	.3 (7.1)	.5 (12.5)	.5 (15.1)	.5 (13.9)
Yield grade	AA	3.7	3.9	3.4	3.3	3.1
	HH	3.5	3.7	3.3	3.5	4.3
	HAX	3.7	3.8	3.3	3.4	3.8
	RX	3.1	3.8	3.6	3.4	3.7
	BX	3.1	3.0	3.6	3.5	3.5
	GX	3.0	2.9	3.6	3.5	3.7
	MX	2.7	2.7	3.5	3.5	3.4
	CX	3.2	2.5	3.5	3.9	3.7

[a]A = Angus; H = Hereford; R = Red Poll; B = Brown Swiss; G = Gelbvieh; M = Maine Anjou; C = Chianina; HAX = ½(HA + AH); RX = ½(RH + RA); et cetera . . .
[b]End points: (1) = 473 days of Age; (2) = Carcass weight of 635 lb (288 kg); (3) = Fat thickness of .5 in (12.5 mm); (4) = Fat trim of 19%; (5) = Small marbling

compared after adjustment to equal (1) age, (2) weight, (3) fat thickness, (4) fat trim, and (5) marbling end points. These breed groups form Cycle II of the germ plasm evaluation program.

A total of 775 steers, born in 1973 and 1974, were evaluated. The steers averaged about 225 days of age at the start of the feeding period. Steers were divided into three or four slaughter dates each year to provide a measure of progressive change in breed group characteristics with time on feed. The change over time on feed served as a basis to adjust breed group means to alternative end points.

Steers were slaughtered at a commercial packing plant. After a 24-hour chill, carcasses were evaluated for conformation, maturity, marbling, color, texture, firmness, and USDA quality and yield grades. The right side of each carcass was transported to Kansas State University for detailed cutout and taste panel evaluation.

The side was separated into wholesale cuts which were processed into closely trimmed, boneless roasts and steaks and lean trim, except for a small amount of bone left in the short loin and rib roasts. No more than .3 inch (8 mm) of fat was left on the surface of retail cuts. Weights of retail product, fat trim and bone were determined for each wholesale cut. Lean from all wholesale cuts was trimmed to contain 25% fat. Retail product was the sum of roast and steak meat plus lean trim. Steaks at the 10th rib from four representative carcasses of each breed group at each slaughter date were used in a taste panel evaluation of tenderness, flavor, and juiciness.

Alternative End Points. Means

(continued on next page)

Carcass Evaluation

(continued from page 17)

adjusted to a common age of 473 days reflect differences in average growth or development rates for the breed groups. Breed of sire groups were averaged over the Hereford and Angus dams to simplify presentation. However, half the difference between straightbred Hereford compared to straightbred Angus could be used to approximate a specific breed of sire and breed of dam combination. The end point of 635 lb (288 kg) was used because it was close to the average carcass weight and was the constant carcass weight used to compare breed groups in Cycle I (see 1976 Nebraska Beef Cattle Report, EC 76-218). A fat thickness of .5 inch (12.5 mm) at the 12th rib section was selected because it approximated the fat condition often recommended as a compromise between yield and quality grades. The average fat trim for breed groups at .5 inch (12.5 mm) fat thickness was 19% of carcass weight. A marbling end point of "small" is the first degree of marbling within the USDA Choice grade. While weights and scores shown here may not be typical of other feed and management situations, the relative differences between breed groups likely typify those expected under a fairly wide range of feed and management situations.

Table 2. Breed group means adjusted to a common (1) age, (2) carcass weight, (3) fat thickness, (4) fat trim percentage, or (5) marbling end point.

Item	Breed group[a]	(1)[b] Age	(2)[b] C.wt.	(3)[b] F.Thick.	(4)[b] R.Trim %	(5)[b] Marb.
Retail product, %	AA	66.9	66.1	68.3	68.9	70.2
	HH	68.4	67.4	69.4	68.4	64.8
	HAX	67.2	66.6	69.3	68.8	66.8
	RX	67.4	66.2	67.2	68.4	66.9
	BX	70.0	70.5	67.9	68.4	68.3
	GX	70.7	71.5	68.2	68.9	67.8
	MX	71.0	72.2	68.5	68.6	69.1
	CX	73.8	74.4	70.8	69.0	69.8
Fat trim, %	AA	21.5	22.6	19.8	19.0	17.4
	HH	19.0	20.4	17.7	19.0	23.6
	HAX	20.9	21.6	18.3	19.0	21.3
	RX	20.2	21.7	20.4	19.0	20.9
	BX	16.8	16.1	19.5	19.0	18.9
	GX	16.6	15.5	19.9	19.0	20.3
	MX	15.7	14.3	19.0	19.0	18.3
	CX	12.3	11.4	16.4	19.0	17.7
Bone, %	AA	11.5	11.3	11.9	12.1	12.4
	HH	12.5	12.2	12.8	12.6	11.5
	HAX	11.9	11.8	12.5	12.3	11.8
	RX	12.4	12.1	12.3	12.7	12.2
	BX	13.2	13.4	12.6	12.7	12.7
	GX	12.7	13.0	12.0	12.2	11.9
	MX	13.2	13.6	12.4	12.5	12.6
	CX	14.0	14.2	12.8	12.1	12.4
Kidney and pelvic fat, %	AA	4.6	4.7	4.4	4.3	4.1
	HH	3.5	3.6	3.3	3.4	3.9
	HAX	4.2	4.3	3.9	4.0	4.3
	RX	5.4	5.6	5.4	5.2	5.5
	BX	4.3	4.2	4.7	4.6	4.6
	GX	4.8	4.6	5.3	5.1	5.3
	MX	4.4	4.1	4.8	4.8	4.7
	CX	4.0	3.9	4.7	5.1	4.9
Marbling score[c]	AA	13.3	13.9	12.3	11.8	11.0
	HH	9.1	9.6	8.5	9.0	11.0
	HAX	10.8	11.1	9.6	9.9	11.0
	RX	10.7	11.4	10.8	10.1	11.0
	BX	9.9	9.5	11.3	11.0	11.0
	GX	9.2	8.7	10.8	10.3	11.0
	MX	9.6	8.9	11.4	11.3	11.0
	CX	8.0	7.5	10.3	11.6	11.0

[a]A = Angus; H = Hereford; R = Red Poll; B = Brown Swiss; G = Gelbvieh; M = Maine Anjou; C = Chianina; HAX = ½(HA + AH); RX = ½(RH + RA); et cetera.

[b]End Points: (1) = 473 days of Age; (2) = Carcass weight of 635 lb (288 kg); (3) = Fat thickness of .5 in (12.5 mm); (4) = Fat trim of 19% (5) = small marbling.

[c]Marbling scores: Slight = 7, 8, 9; small = 10, 11, 12; modest = 13, 14, 15.

Results

Final Weight and Carcass Weight. Comparison of the means at a common age, (1) in Table 1, indicates sizable differences in growth rate among breed groups. Hereford-Angus and Red Poll crossbreds were similar in weight, but both groups were significantly lighter than Brown Swiss, Gelbvieh, Maine Anjou, and Chianina crossbreds. The weight at which breed groups reached an equal fat trim percentage, or choice marbling, columns (4) and (5), differed markedly. Among crossbred groups, Red Poll and Hereford-Angus attained choice marbling at the lightest carcass weights, 614 and 627 lb (279 and 285 kg), respectively, and Chianina crosses at the heaviest carcass weights, 899 lb (409 kg), column (5). The Chianina crosses required adjustment beyond their heaviest slaughter group average. Because linear adjustment was used, this may overstate the magnitude of the contrast. However, their ranking would not be expected to change.

At a common carcass weight of 635 lb (288 kg), the largest difference in dressing percentage was only 1.3%. Straightbred Angus and Chianina crosses had the highest dressing percentages, 63.3 and 63.0; straightbred Hereford, Gelbvieh and Brown Swiss crosses had the lowest dressing percentages, 62.3, 62.1, and 62.0, respectively. As an animal fattens dressing percentage increases. However, relative fatness of breed groups did not seem to be a major factor affecting dressing percentage.

Hide weight, expressed as a percentage of the common carcass

weight of 635 lb (288 kg), was 10.7 for Angus, 11.3 for Red Poll crosses, 11.6 for Maine Anjou crosses, 12.2 for Chianina crosses, 12.4 for Hereford-Angus crosses and Brown Swiss crosses, 12.7 for Gelbvieh crosses, and 13.6 for Hereford.

Ribeye Area, Fat Thickness, and Yield Grade. There were significant differences in ribeye area even at a constant carcass weight, column (2) Table 1. Age constant means for fat thickness indicated significant differences in rate of external fat deposition, column (1) Table 1. Contrasts among breed groups were largest at a constant weight and smallest at a constant fat trim percentage, columns (2) and (4) Table 1. Although fat thickness is closely related to fat trim percentage, some breed groups differed significantly in fat thickness when compared at a constant fat trim percentage. Differences in seam fat or kidney and pelvic fat reduce the accuracy of fat thickness as a predictor of total fat trim percentage.

Yield grades were lower for Chianina crosses than for any other breed group, on an age or weight constant basis. However, for all practical purposes, breed groups could be divided into two classes. (1) Chianina, Maine Anjou, Gelbvieh, and Brown Swiss crosses; and (2) Angus, Hereford, Hereford-Angus crosses and Red Poll crosses.

Carcass Composition and Marbling Scores. Retail product percentage of breed groups differed significantly when compared at a constant age, column (1), Table 2. Differences in composition were greatest at a constant carcass weight, column (2). This end point maximizes differences in maturity. At a constant carcass weight, Chianina crosses had the highest and Angus and Red Poll crosses had the lowest percentage of retail product. At a constant fat trim percentage, column (4), Table 2, the small variation in retail product suggests breed groups did not differ significantly in muscle-to-bone ratio.

When compared at a constant fat thickness or marbling score, columns (3) and (5), Table 2, differences in average fat trim percentage among breed groups were greatly reduced; even so, significant differences remained because of breed variation in subcutaneous, seam, and kidney fat.

In these data, "bone" included major tendons, and excised ligaments. Breed group differences in bone percentage at a constant age were much smaller than those in retail product or fat trim but were large enough to be economically important. At age or weight constant end points Chianina crosses had the highest and Angus and Hereford-Angus crosses had the lowest bone percentages.

Kidney and pelvic fat was included in total fat trim. At a constant fat trim percentage, Red Poll crosses had the highest and Hereford had the lowest percentage kidney and pelvic fat.

USDA quality grade is determined primarily by amount of intramuscular fat as evaluated by marbling score. At age and weight constant end points, columns (1) and (2), Table 2, Angus, Hereford-Angus, and Red Poll crosses had the highest marbling scores. Chianina crosses had the lowest marbling scores. At a constant fat trim percentage, column (4), Angus and Chianina crosses had the highest marbling scores. Hereford, Hereford-Angus, and Red Poll crosses had lowest marbling scores. However, the difference of 2.8 scores between extremes is less than one degree of marbling. There is one degree of marbling in the Good grade and three degrees of marbling in Choice and Prime grades. The results suggest small differences between breeds in rate of intramuscular fat deposition relative to total fat.

The percentage of carcasses with Choice marbling at a constant age was 85 for Angus, 64 for Hereford-Angus, 59 for Red Poll, 53 for Brown Swiss, 48 for Maine Anjou, 39 for Hereford and Gelbvieh, and 21 for Chianina.

Taste Panel Evaluation. There were small differences among breed group taste panel tenderness scores, Table 3. All groups were in the moderately tender range. Taste panel tenderness means were closely related to means for marbling scores. However, in the combined data from Cycles I and II, a three degree change in marbling, (nine units of marbling on our scale and equivalent to the range from Good to Prime) would only increase taste panel tenderness score by .7. That, of course, raises the question of how much attention should be placed on marbling in beef quality evaluation.

Juiciness scores tended to follow the direction of tenderness scores, but differences in juiciness were only about half as large as differences in tenderness. Essentially no differences were observed among breed groups in average flavor scores.

Differences in meat palatability are apparently small among breed groups where aminals are of similar age and have been raised under similar feed and management conditions.

Table 3. Breed group means of taste panel evaluation adjusted to a common age.

Breed group[a]	Taste panel scores[b]		
	Tender	Juicy	Flavor
AA	7.7	7.5	7.5
HH	6.8	7.3	7.4
HAX	7.4	7.4	7.3
RX	7.4	7.2	7.4
BX	7.3	7.4	7.5
GX	7.0	7.3	7.4
MX	7.2	7.3	7.3
CX	7.0	7.3	7.3

[a]Breed group abbreviations are given in footnote "a", Table 1 and 2.

[b]Scores: 9 = extremely tender, juicy, or flavorful, . . . 1 = extremely tough, dry, or bland.

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[1]Robert M. Koch is Research Geneticist, University of Nebraska, located at the Roman L. Hruska U. S. Meat Animal Research Center, Clay Center, Nebraska. The cooperation of Kansas State University, Manhattan, is acknowledged. Results presented here were taken from "Characterization of biological types of cattle, Cycle II: III. Carcass composition, quality and palatability," by R. M. Koch, M. E. Dikeman, R. Jerry Lipsey, D. M. Allen, and J. D. Crouse, published in the Journal of Animal Science 49(2):448. 1979.

Contaminating face flies with IBR virus before release into screened pens of cattle.

Economically Important

The Face Fly

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Face flies caused mechanical injury to eye tissue of cattle during a 33-day exposure period. Exposure of cattle to face flies contaminated with pinkeye causing bacterium, Moraxella bovis, and/or IBR Virus, resulted in eye infections indicating that the face fly can be a vector of eye pathogens. Yearling steers that developed pinkeye on irrigated pasture did not gain appreciably slower than those without pinkeye.

The face fly, *Musca autumnalis* De Geer, immigrated from Europe to Canada and subsequently to the U. S. in the early 1950s. It has since spread across both countries and south into the Southeastern states and Oklahoma. This fly is very similar to the house fly in appearance but quite different in habits. It breeds in fresh manure and the egg to adult time span is about three weeks. This time span determines where it can exist. In Nebraska, it is found in the eastern third of the state where rainfall is ample. It is found along riverways, canyon pastures, or irrigated pastures in the rest of the state. The sandhill pastures and short grass pastures do not support development of the face fly because the manure dries before the fly can complete its life cycle.

Attracted to Animals

The face fly is attracted to animals where it feeds on body exudate, particularly around the eyes and nostrils. It has sponging type mouthparts so it does not penetrate the skin to feed but still causes considerable annoyance to animals because of its persistent feeding around the eyes.

Although considerable research has been done on the ecology and biology of this fly, little has been done on its effect on animal performance. The fly is so difficult to control that comparisons between treated and untreated animals have not been possible.

This study was to determine 1) if the feeding by the face fly around the eyes caused injury to the eye tissue, which would make the animal susceptible to eye pathogens, 2) if the fly could transmit IBR virus (infectious bovine rhinotracheitis) and *Moraxella bovis,* generally considered the bacterium causing pinkeye (bovine infectious keratoconjunctivitis), 3) the effect on cattle when the flies were contaminated with both organisms and 4) the effect of pinkeye on weight gain performance of yearling steers being pastured on irrigated grass.

For the first phase of this study, 12 yearling heifers (6 Hereford and 6 Charolais × Angus or Hereford) were placed in each of two fly-screened feedlot pens. Face flies were released into one of the pens and not the other. Each of the 24 animals had been carefully examined for any sign of eye abnormality before it was included in the trial.

Flies Released

Flies were released at five different times at about five day intervals with a total of 10,800 flies released. Flies on each animal were counted each day and the amount of eye lacrimation was indicated by an eye score from 0-3. This eye score was converted to an eye index score which was the percentage of the total observed lacrimation eye score divided by the total possible lacrimation eye score.

At the end of the 33-day trial, the eye lacrimation score for cattle in the fly pen averaged 1.7 while the pen of fly-free calves averaged only 0.03. There were observable petichial lesions and swelling of the ventral conjunctival margins of the eyes of 75 percent of the animals in the fly pen and none on the fly-free animals.

Histopathological examination of the surgically removed eyes (one eye from two animals of each breed in each pen) showed ulcerations and conjunctivitis in three of the four eyes exposed to flies and none in the tissue of the eyes not exposed to flies.

Damage Caused

These results clearly indicate that face fly feeding does cause mechanical damage to eye tissue of cattle. Although the number of flies released per animal seems rather high (about 900), fly counts on the animals averaged less than 1/eye/count. No difference in the number of flies on the Herefords

and Charolais-crossbreds were observed, but the average eye lacrimation eye score for the Herefords was 2.56, while only 0.84 for the Charolais-crossbreds. This difference was statistically significant at the 0.05 level of probability.

In the second phase, pathogen contaminated face flies were released into three pens of cattle. IBR virus contaminated flies were released into one pen of eight animals (two of each breed with prior face fly exposure and two of each breed with no prior face fly feeding). Flies contaminated with *Moraxella bovis* were released into the second pen which contained eight animals exposed to face fly feeding the same as those in the first pen. Flies contaminated with both IBR virus and *Moraxella bovis* were released into a pen of seven animals none of which had prior exposure to face fly feeding.

Cattle in each of the three pens exhibited signs indicating the IBR or *Moraxella bovis* infection. The most severe reactions were exhibited by cattle in pen three where both organisms had been used to contaminate the flies.

This data indicates that the face fly can be a vector of eye pathogens. This fact, combined with the data from the first phase of the study, is strong evidence that the face fly is an important factor in spreading eye diseases of cattle.

In the third phase, weight gain comparisons were made between yearling steers with pinkeye and others that had no eye problems. This evaluation included data on 120 yearling steers grazing irrigated pastures in two different seasons. Steers with pinkeye gained 0.04 lb/day (0.018 kg) less than those without pinkeye. This difference is not significant.

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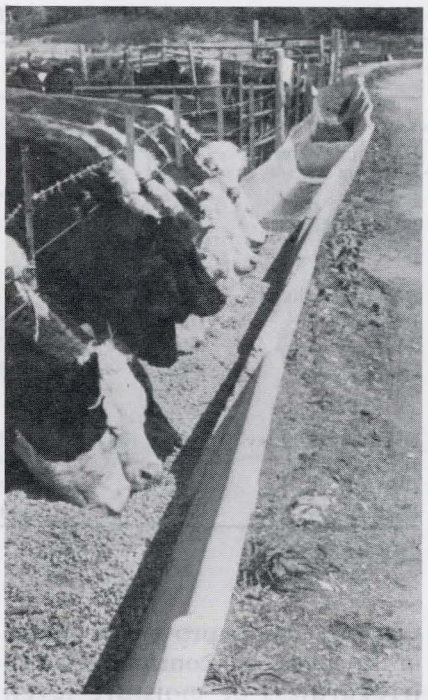

Calves fed control corn cobs.

Crop Residues

Calcium Hydroxide Treatment

John Paterson
Rick Stock
Terry Klopfenstein[1]

Moisture level influences the effectiveness of calcium hydroxide $Ca(OH)_2$ treatment of corn cobs and wheat straw. Forty percent moisture with 5% $Ca(OH)_2$ treatment showed the greatest DM intake and digestibility when compared to 20% or 60% moisture levels.

However, when corn stalks were treated in a similar manner, DM intake was greatest at the highest moisture level but digestibility was improved at lower moisture levels. Treated residues with 60% moisture appeared to ferment while treated residues with 20% moisture appeared to have much of the $Ca(OH)_2$ unreacted because of the dustiness of the diets. Even though 40% moisture level increased DM intakes and digestibilities, the treated residues showed signs of molding by seven days.

In an *in vitro* study cobs treated with 5% $Ca(OH)_2$ reached maximal *in vitro* digestibility by day ten but cobs treated with either 1% NaOH; 4% $Ca(OH)_2$ or 2% NaOH; 3% CaOH reached maximal *in vitro* digestibility between days two and five.

Introduction

NaOH treatment of residues has consistently increased *in vitro* digestibility (IVDMD) and dry matter intakes however, rate and efficiency of gains have not improved as much as expected. While NaOH is the most effective chemical in solubilizing the residue cell wall, previous research (1979 Nebraska Beef Cattle Report) has shown that it also increases rate of fiber passage from the rumen, decreases rumen fermentation time and appears to negatively affect animal mineral balance. NaOH also places an undesirable residue back on the soil through the manure. Since calcium is not metabolized in the same manner as sodium, $Ca(OH)_2$ may not be as detrimental as NaOH.

$Ca(OH)_2$, which is a weaker base than NaOH, reacts with the cell wall fraction of the residue at a much slower rate than does NaOH. Since $Ca(OH)_2$ is a weaker base, moisture level may affect the value of $Ca(OH)_2$. Instead of a rapid increase in solubilization of the cell wall, fermentation at higher moisture levels may partially neutralize the $Ca(OH)_2$. This partial neutralization would inhibit the increased potential digestibility of the treated residue from being expressed.

Research emphasis has been: the effect of $Ca(OH)_2$ treatment and moisture level on changes in digestibility of corn cobs, cornstalks and wheat straw; and, the effect of combining NaOH and $Ca(OH)_2$ on *in vitro* digestibility of corn cobs over time.

Effect of $Ca(OH)_2$ Treatment

Three lamb digestion trials were conducted to evaluate diges-

(continued on next page)

Crop Residues

(continued from page 21)

tibilities of corn cobs, cornstalks, and wheat straw treated with 5% $Ca(OH)_2$, 5 units $Ca(OH)_2$/100 units residue DM, and reaction at three moisture levels. The treatments for the trials were: (1) untreated residue, 60% moisture; (2) 5% $Ca(OH)_2$ residue, 60% moisture, (3) 5% $Ca(OH)_2$ residue, 40% moisture; and (4) 5% $Ca(OH)_2$ residue, 20% moisture. Residues were allowed to react for at least 15 days before being fed. Six lambs were assigned to each treatment and were pre-fed the diets for 10 days with feed leftovers and feces samples collected for the next seven days. All lambs were fed *ad libitum*. The diets were 85% residue and 15% soybean meal supplement which balanced crude protein (11%) vitamin and mineral requirements.

Lambs fed $Ca(OH)_2$ treated corn cobs with 40% moisture consumed more dry matter and had greater ration digestibilities (DMD), cell wall digestibilities (CWD) and IVDMD compared to lambs fed treated cobs with 60 or 20% moisture and lambs fed untreated control rations (Table 1). Cobs with 60% moisture appeared to ferment while cobs with 20 or 40% moisture did not. The 20% moisture level appeared to have much of the $Ca(OH)_2$ unreacted due to the dustiness of the cobs, while the 40% moisture level cobs showed signs of molding after 7 to 10 days.

Lambs fed $Ca(OH)_2$ treated cornstalks did not show a consistent response to any one treatment. Lamb ration DMD and stalk CWD were greatest for 20% moisture level, but IVDMD was greatest for 40%moisture level.

Table 1. Dry matter intakes and digestibilities for Experiment 1.

	Untreated	5% $Ca(OH)_2$		
	60% Moisture	20%	40%	60%
		Corn cobs		
DM intake, lb/day[a]	2.41 (1095)[a]	2.12 (967)	3.38 (1533)	2.64 (1199)
DMD, %	54.9	45.1	70.8	58.9
CWD, %	56.5	45.7	71.8	58.9
IVDMD, %	60.8	60.4	67.3	62.5
		Corn stalks		
DM intake, lb/day	1.92 (869)	2.18 (990)	2.31 (1049)	2.39 (1082)
DMD, %	48.7	53.9	48.5	43.8
CWD, %	45.3	53.7	49.5	37.0
IVDMD, %	52.8	48.9	48.6	57.1
		Wheat straw		
DM intake, lb/day	1.41 (641)	1.92 (869)	2.87 (1304)	2.08 (944)
DMD, %	51.0	50.9	62.2	46.8
CWD, %	51.2	52.9	71.5	60.4
IVDMD, %	57.4	51.0	52.3	57.1

[a](grams)

$Ca(OH)_2$ did improve DM intake of the stalks over control fed lambs irregardless of moisture level. Small increases in digestibility of the treated stalks may be due to the increased intakes compared to lambs fed control. Stalks with 60% moisture appeared to ferment, while 40% moisture stalks appeared partially fermented but showed signs of molding. The 20% moisture level again showed that $Ca(OH)_2$ did not completely react with the stalks.

Lambs fed $Ca(OH)_2$ treated wheat straw with 40% moisture had increased intakes, ration DMD and CWD compared to other treatments. The IVDMD values were greatest for the 60% moisture level for 5% $Ca(OH)_2$ treatments. Lambs fed $Ca(OH)_2$ treated straw consumed more dry matter than lambs fed the untreated straw.

Results indicate that $Ca(OH)_2$ treatment increases intake of residues. The interaction of $Ca(OH)_2$ treatment and reaction at 40% moisture also appears to give an increase in intake and digestibility over treatment with 20 or 60% moisture. Treated cornstalks may not react the same way with moisture and treatment as do cobs or wheat straw.

$Ca(OH)_2$ × Moisture Level

The previous experiments showed that maximum increases in intake and digestibility for $Ca(OH)_2$ treated residues was between 20 and 60% moisture level. This experiment was conducted to more closely define the optimum moisture level for $Ca(OH)_2$ treatment. The treatments for this experiment were: (1) untreated stalks, 45% moisture; (2) 5% $Ca(OH)_2$ stalks, 45% moisture; (3) 5% $Ca(OH)_2$ stalks, 40% moisture; (4) 5% $Ca(OH)_2$ stalks, 35% moisture; (5) 5% $Ca(OH)_2$ stalks, 30% moisture; and (6) 5% $Ca(OH)_2$ stalks, 25% moisture. Stalks were allowed to react 15 days before being fed. There were four lambs per treatment. Lambs were prefed the diets for nine days to determine *ad libitum* intakes. Feed, ort and feces samples were collected for days 10 through 18.

Table 2. Dry matter intakes and digestibilites for Experiment 2.

	Untreated	5% $Ca(OH)_2$ Stalks				
	45% Moisture	25	30	35	40	45
DM intake, lb/day	1.26 (570)[a]	.83 (375)	1.66 (753)	1.61 (733)	1.42 (644)	2.25 (1020)
DMD, %	55.15	51.64	46.43	50.83	49.67	52.04
CWD, %	61.52	65.39	52.91	61.77	61.65	59.83
IVDMD, %	44.21	52.90	48.70	49.83	48.66	48.20

[a](grams)

Lambs fed stalks containing 5% $Ca(OH)_2$ and 45% moisture consumed 79% more DM per day than lambs fed the 45% moisture untreated stalks (Table 2). There was no apparent improvement in either DMD or CWD for the lambs fed treated stalks over the lambs fed untreated stalks, however, the large increase in intake (with an expected faster rate of passage) may partially explain the lack of improvement. The lamb DMD intake values indicated that 35 to 45% moisture was optimum, however, the 25% moisture level appears to give the largest increase in IVDMD and CWD, but DM intake of these stalks was found to be the least probable due to the dustiness of the treated stalks. With increasing moisture levels the $Ca(OH)_2$ adheres much better to the residue than at lower moisture levels.

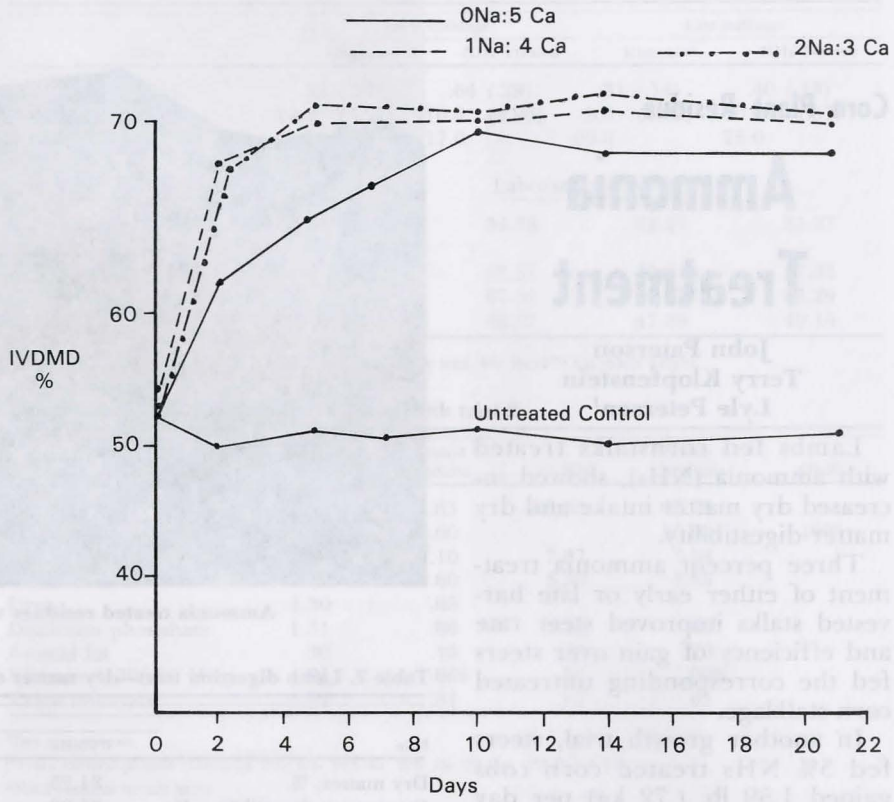

Figure 1. In vitro dry matter disappearance for cobs with different combinations of NaOH and $Ca(OH)_2$.

NaOH and $Ca(OH)_2$ Combinations

A laboratory trial was conducted to evaluate IVDMD over time of corn cobs treated with different combinations of NaOH and $Ca(OH)_2$. The treatments were: (1) untreated cobs; (2) 5% $Ca(OH)_2$ treated cobs; (3) 1% NaOH:4% $Ca(OH)_2$ treated cobs; and (4) 2% NaOH:3% $Ca(OH)_2$ treated cobs. Cobs were raised to 40% moisture, hydroxides added and then placed in air tight silos. Samples were taken days 0, 2, 5, 7, 10, 14 and 21, freeze dried and ground through a 1 mm screen and *in vitro* digestibilities determined.

Cobs treated with 5% $Ca(OH)_2$ showed increased digestibility almost linearly from 52% to a maximum of 68% after 10 days reaction time, while cobs treated with either 1 or 2% NaOH reached maximum digestibility between days two and five (Figure 1). No further improvement in IVDMD was measured for 5% $Ca(OH)_2$ treated cobs after day 10 and similarly no improvement for Na:Ca combinations were reached after day 5. These data indicate that NaOH addition caused a faster increase in IVDMD (shorter reaction time) than for cobs with only $Ca(OH)_2$ addition. One percent NaOH + 4% $Ca(OH)_2$ treatment showed almost identical results to 2% NaOH:3% $Ca(OH)_2$ treatment.

Moisture Affects DM Intake

Results of this research indicate that increases in DM intake and digestibility due to $Ca(OH)_2$ treatment are affected by the amount of moisture in the residue. For treated cobs and straw 40% moisture level appears to give a more positive response than does treatment at 20 or 60% moisture level. The acceptance of treated cobs or straw at 20% moisture may be affected by the dustiness of the ration since the majority of the added $Ca(OH)_2$ appears unreacted or unattached to the residue. At 60% moisture level the residues appeared fermented but the acid produced during fermentation may partially neutralize the caustic effect of $Ca(OH)_2$ and prevent the potential *in vitro* digestibility of the treated cell wall from being expressed. While 40% moisture level may appear optimum for $Ca(OH)_2$ treatment, problems due to molding may limit its usefulness. It would seem that if only $Ca(OH)_2$ were used to increase digestibility of the residue cell wall a moisture level between 20 and 40% is necessary. The residue needs to be wet enough so that $Ca(OH)_2$ can adhere to the fiber but dry enough to prevent fermentation.

The laboratory data showed that maximal *in vitro* digestion of corn cobs treated with 5% $Ca(OH)_2$ was reached by day 10. However, at 40% moisture molding may also be a problem by day 10. With the addition of 1 or 2% NaOH maximal digestion was reduced to day five. If the residues were treated with a combination of hydroxides and fed within five to eight days, mold may be limited.

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Corn Plant Residue

Ammonia Treatment

John Paterson
Terry Klopfenstein
Lyle Petersen[1]

Lambs fed cornstalks treated with ammonia (NH_3), showed increased dry matter intake and dry matter digestibility.

Three percent ammonia treatment of either early or late harvested stalks improved steer rate and efficiency of gain over steers fed the corresponding untreated corn stalklage.

In another growth trial, steers fed 3% NH_3 treated corn cobs gained 1.59 lb. (.72 kg) per day while steers fed untreated cobs gained .86 lb (.39 kg) per day. Dry matter intake was increased from 9.30 lb (4.22 kg) per day for steers fed untreated cobs to 15.80 lb (7.17 kg) per day for steers fed 3% NH_3 treated cobs.

Introduction

Ammonia treatment either in anhydrous or aqueous form increases the feeding quality of crop residues. Advantages of using ammonia are: (1) increasing cell wall digestibility by partial solubilization of hemicellulose and delignification; (2) supplying a nonprotein nitrogen source which could lower ration feed costs, and (3) using a chemical treatment which does not have the problems of a pollutant such as does sodium hydroxide.

Table 1. Ration compositions[a]—digestion trial.

Ingredient	Untreated	NH_3
Corn stalks	95.06	94.46
Blood meal	3.30	4.90
Urea	1.00	
Sodium phosphate monobasic	.63	.63
Vitamin A 30,000 IU/g[b]	.01	.01
Trace minerals	.02	.02

[a]Dry matter basis.
[b]Trace mineral premix contained 10% Mn, 10% Fe, 10% Zn, 1% Cu, .3% I, .1% Co.

Ammonia treated residues were stored in silo press bags.

Table 2. Lamb digestion trial—dry matter digestibility and dry matter intake.

Item	Treatment 0%NH_3	2%NH_3	3%NH_3	4%NH_3
Dry matter, %	81.25	79.73	78.21	76.70
Dry matter digestibility, %	36.82	46.96	45.80	46.65
Dry matter intake, g	398	698	777	997

Major disadvantages of ammonia are: (1) a slower reaction rate than sodium hydroxide since it is a weaker base; (2) a closed reaction chamber (air tight silo) is necessary to minimize volatile ammonia loss, and (3) intake of ammonia treated residues may be depressed if not aerated or mixed with a fermented forage.

Research was conducted to: (1) evaluate different levels of ammonia treatment of corn stalks; (2) evaluate time and treatment effects of corn stalks harvested at two different times relative to high moisture grain harvest, and (3) evaluate ammonia treatment of corn cobs.

Effect of level of NH_3

Twenty-four mature cross-bred wether sheep were fed *ad libitum* either: (1) untreated corn stalk ration; (2) 2% NH_3 corn stalk ration; (3) 3% NH_3 corn stalk ration, or (4) 4% NH_3 corn stalk ration (Table 1). The 75% dry matter, chopped stalks were placed in air tight, plastic lined, steel drum silos and anyhdrous NH_3 added at a rate of 2, 3 or 4 units NH_3/100 units dry stalks. The drum silos were sealed to minimize NH_3 loss and the stalks were allowed to react for at least 21 days before being fed. Stalks were then aerated 24 hours before being fed.

At *ad libitum* intakes the dry matter digestibility of the stalks

Table 3. Ration composition—steer growth trial 1[a]. Harvest date and ammonia treatment.

Ingredient	Ration Untreated	Ammonia treated
Corn stalks	71.24	72.59
Alfalfa, dehy mn 17 protein	20.00	20.00
Molasses		6.34
Liquid supplement[b]	7.92	
Dicalcium phosphate	.59	.81
Salt	.25	.25
Trace minerals[c]	.01	.01

[a]Dry matter basis.
[b]Liquid supplement (dry basis); 51.2% crude protein, 81.8% molasses, .65% phosphorus.
[c]Trace minerals premix contained: 10% Mn, 10% Fe, 10% Zn, 1% Cu, .3% I, .1% Co.

was increased from 36.8% for sheep fed untreated stalks to 47.0% for sheep fed stalks with 2% NH_3 addition. The addition of 3 or 4% NH_3 did not further improve digestibility (Table 2). The intake of the aerated stalks increased from .88 lb (398 g) per day to 2.20 lb (997 g) per day for lambs fed untreated and 4% NH_3 stalks, respectively.

Harvest Date × Ammonia Treatment of Stalks

Mixed steers averaging 483 lb (219 kg) were allotted to 16 pens to compare performance when fed four corn stalk rations: (1) early harvest untreated cornstalks; (2) early harvested NH_3 treated stalks; (3) late harvest untreated stalks; and (4) late harvested NH_3 treated stalks (Table 3). The early harvested stalks were collected one to three days after high moisture grain harvest, while the late stalk harvest was started one month after grain harvest. Because of high temperatures, the early harvested stalks were more mature than desired with the high moisture corn containing only 20-22% moisture. The stalks were harvested with a John Deere forage harvester equipped with a stalker head. The late untreated stalks had water added to raise the moisture to 60%. All untreated stalks were ensiled directly into Eberhart Silo-press bags while the treated stalks were sprayed with 3% aqueous ammonia before ensiling.

Ammonia treatment of early or late harvested stalklage improved daily gains only .1 lb/day (.05 kg) over steers fed untreated stalklage (Table 4). The average daily gain for steers fed early harvested stalklage was .60 lb (.27 kg) which was lower than previously obtained due to late harvest but better than late harvested stalks.

Steers fed the early harvest stalklage consumed more dry matter per day than steers fed late harvested stalklage. Ammonia treatment did not further increase the intake of early stalks but did increase the intake of late stalks.

Efficiencies favored steers fed early harvested stalks but the differences were not significant. Ammonia increased the *in vitro* digestibility of the early stalks 5.7 percentage units and increased digestibility 11.4 percentage units for late stalks. The crude protein content of the untreated stalklage samples was 5.7% and was 15.0% for NH_3 treated and aerated stalklage samples.

Ammonia Treatment of Corn Cobs

Mixed steers averaging 470 lb (213 kg) were allotted to fifteen pens. Rations fed were: (1) untreated corn cob ration; (2) ½ untreated cob ration + ½ alfalfa hay; (3) 3% NH_3 corn cob ration; (4) ½ NH_3 cob ration + ½ alfalfa hay, and (5) alfalfa hay (Table 5). Untreated cobs were ground and fed directly. Treated cobs had aqueous ammonia added at a rate of three units NH_3/100 units cob dry matter and were packed into Eberhart silo press bags. Cobs were allowed to react at least 21 days before being fed. Each days feeding was allowed to aerate 24 hours before

(continued on next page)

Table 4. Cattle growth trial 1[a]—performance and laboratory analysis.

Item	Early stalklage		Late stalklage	
	Untreated	NH_3 Treated	Untreated	NH_3 Treated
Daily gain, lb (kg)	.53 (.24)	.64 (.29)	.31 (.14)	.40 (.18)
Daily feed, lb (kg)	10.9 (4.97)	10.9 (4.98)	9.0 (4.09)	10.0 (4.57)
Feed/gain	20.6	17.0	29.0	25.0
	Laboratory analysis			
Dry matter	53.50	34.38	44.19	55.27
In vitro dry matter disappearance, %	46.64	52.31	45.91	57.33
Neutral detergent fiber, %	80.45	67.31	76.43	65.29
Acid detergent fiber, %	45.69	46.37	47.59	49.15

[a]44 steers per treatment (4 pens of 11 steers each), 93 day trial. 482 lbs (279 kg) initial weight.

Table 5. Ration compositions[a]—steer growth trial 2.

Ingredient	Untreated	Untreated + ½ alfalfa	3% NH_3	3%NH_3 + ½ alfalfa	Alfalfa
Corn cobs	89.66	44.63	85.90	42.95	
Alfalfa hay		50.00		50.00	100[c]
Corn gluten meal	4.20	2.10	7.07	3.54	
Blood meal	3.20	1.60	5.30	2.65	
Urea	1.30	.65			
Dicalcium phosphate	1.31	.66	1.31	.66	
Animal fat	.30	.15	.39	.20	
Vitamin A 30,000 IU/g	.01	.005	.01	.005	
Trace minerals[b]	.02	.01	.02	.01	

[a]Dry matter basis.
[b]Trace mineral premix contained 10% Mn, 10% Fe, 10% Zn, 1% Cu, .3% I, .1% Co.
[c]NaCl supplied by salt block.

Table 6. Cattle growth trial 2—performance[a] and laboratory analysis.

Item	Treatment				
	Untreated	Untreated + ½ alfalfa	3% NH_3	3% NH_3 + ½ alfalfa	Alfalfa
Daily gain, lb (kg)	.86 (.39)	1.12 (.51)	1.58 (.72)	1.41 (.64)	.79 (.36)
Daily feed intake, lb (kg)	9.3 (4.22)	16.1 (.34)	15.8 (7.17)	19.8 (8.98)	17.7 (8.03)
Feed/Gain	10.8	14.4	10.0	14.0	22.4
	Laboratory analysis				
Dry matter, %	87.28		71.05		87.09
In vitro dry matter disappearance, %	42.74		47.90		53.27
Neutral detergent fiber, %	86.67		80.62		64.32
Acid detergent fiber, %	47.28		53.71		46.31
Acid detergent lignin, %	4.49		4.88		10.40
Crude protein, %	4.22		9.26		13.78

[a]30 steers per treatment (3 pens of 10 each), 105 day trial, 470 lbs (213 kg) initial weight.

Ammonia Treatment

(continued from page 25)

being fed.

Steers fed the 3% NH_3 treated corn cobs gained faster and more efficiently than steers fed the untreated corn cobs. There was a positive associative effect for gain measured with alfalfa addition to either untreated or NH_3 treated cob rations but none for feed efficiency (Table 6).

Aqueous ammonia treatment increased the DM intake of steers fed either 3% NH_3 cobs or 3% NH_3 cobs + ½ alfalfa hay over steers fed untreated cobs or untreated cobs + ½ alfalfa hay. Ammonia treatment increased the *in vitro* digestibility of the cobs 5.2 percentage units and increased the crude protein content from 4.2% to 9.3%.

Discussion

Ammonia treatment of both corn cobs and corn stalks increased digestibility, intake, and rate and efficiencies of gains. The mode of action of ammonia is probably similar to sodium hydroxide causing increased rate and extent of cell wall digestion.

Animal performance was especially improved by ammonia treatment of cobs. There seemed to be little advantage to feeding the cobs with alfalfa hay. Therefore, the chemical residue does not seem to be a problem as it is with the use of sodium hydroxide. Ammonia treatment of cobs seems to be a very practical means of upgrading the value of crop residues. The remaining problems are primarily mechanical and evaluating the residual nitrogen as a protein source for the cattle.

Response of the corn stalks to ammonia was variable. While digestibility seemed to be increased, increases in cattle gains were minimal. Consistency of treatment, amount of aeration, ammonia load on the animal, fiber form and composition may all be factors involved.

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Hydroxide Treated Cobs, Alfalfa

John Paterson
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Lyle Petersen[1]

Hydroxide treated corn cobs and alfalfa hay were fed to growing steers to evaluate: (1) response to chemical treatment, and (2) associative effects of alfalfa and hydroxide treated cobs. Treatment of corn cobs with 3% sodium hydroxide (NaOH) and 1% calcium hydroxide, $Ca(OH)_2$, increased gains of growing calves the equivalent of .6 lb (.27 kg) per day. Feeding 50% alfalfa with treated cobs increased the response to chemical treatment and showed positive associative effects.

Introduction

NaOH treatment of crop residues improves *in vitro* digestibility but *in vivo* digestibility values do not show the same magnitude of improvement and are sometimes no better than the untreated residue. NaOH often improves dry matter (DM) intake, but daily gains and feed conversion have not been improved as much as expected. Research reported in the 1979 Nebraska Beef Cattle Report showed that NaOH increased rate of passage of fiber from the rumen with decreased rumen fermentation time. With a decreased rumen fermentation time the increase in potential digestibility of the treated fiber could not be adequately expressed.

Alfalfa hay, which is a good source of supplemental protein, and minerals may be the logical choice for addition to NaOH treated rations in an attempt to slow rate of treated fiber passage, increase extent of treated fiber digestion and equilibrate mineral balance. Previous lamb digestion trial data (1979 Nebraska Beef Cattle Report) showed that alfalfa addition to treated crop residue rations produced positive associative effects for both intake and ration digestibility. The objectives of this research were to: (1) evaluate hydroxide treatment of corn cobs, and (2) evaluate associative effects of alfalfa and corn cobs in growing steer rations.

Cattle Growth Trial

One hundred fifty mixed steers averaging 463 lb (210 kg) were allotted to 15 pens (3 replications). Rations were: (1) untreated corn cob ration; (2) untreated corn cob ration + ½ alfalfa hay; (3) 3% NaOH: 1% $Ca(OH)_2$ treated cob ration; (4) 3% NaOH: 1% $Ca(OH)_2$ treated cob ration + ½ alfalfa hay; (5) alfalfa hay (Table 1). Ground corn cobs were mixed with hydroxides in a truck-mounted mixer and water was added to raise the moisture to 40%. The cobs were mixed for 10 minutes and unloaded on a concrete slab and allowed to react for at least 24 hours before being fed. Cobs were usually fed within 60

Table 1. Ration compositions.[a]

Ingredient	1 Untreated cobs	3 3% NaOH: 1% $Ca(OH)_2$ cobs	5 Alfalfa[c] hay
Corn cobs	89.66	89.25	
Alfalfa hay			100
Urea	1.30	.71	
Blood meal	3.20	3.20	
Corn gluten meal	4.20	4.20	
Dicalcium phosphate	1.31	1.31	
Ammonium chloride		1.00	
Animal fat	.30	.30	
Vitamin A 30,000 IU/g	.01	.01	
Trace minerals[b]	.02	.02	

[a]Expressed as a percentage of dry matter; all diets balanced for 11% crude protein, rations 2 & 4 were 50:50 mixtures of ration 5 and rations 1 & 3 respectively.

[b]Premix contained 10% Mn, 10% Fe, 10% Zn, 1% Cu, .3% I, .1% Co.

[c]Sodium chloride provided by free choice salt blocks.

Table 2. Steer growth trial performance.[a]

Item	Untreated	Untreated + 50% alfalfa	3% NaOH: 1% Ca(OH)2	3% Na: 1% Ca + 50% alfalfa	Alfalfa
No. of steers	30	30	29	30	30
Daily gain, lb (kg)	.86 (.39)	1.12 (.51)	1.30 (.59)	1.48 (.67)	.79 (.36)
Daily intake, lb (kg)	9.3 (4.22)	15.5 (7.06)	12.0 (5.45)	15.4 (6.99)	16.7 (7.60)
Feed/Gain	10.8	13.8	9.2	10.4	21.1
In vitro dry matter disappearance	42.74	—	57.88	—	53.50

[a]Three pen replication, 140-day trial, average initial weight 466 lb (212 kg).

hours of treatment. To help minimize differences in animal fill among treatments, all animals were fed corn silage the last three days of the trial.

Steers fed the 3% NaOH: 1% $Ca(OH)_2$ treated corn cob ration gained 1.30 lb (.59 kg) per day while steers fed the untreated corn cob ration gained .86 lb (.39 kg), (Table 2). When treated and untreated corn cobs were each fed with alfalfa hay, the improvement in gain due to chemical treatment was .35 lb (.16 kg) per day. Because the cobs were only half the ration, the response to chemical treatment was 60% greater when fed wtih alfalfa.

The positive associative effect on weight gain of mixtures of corn cobs and alfalfa is shown in Figure 1. Steers fed the 3% NaOH: 1% $Ca(OH)_2$ treated corn cobs with 50% alfalfa hay in the ration gained 1.48 lb (.67 kg) per day which was .44 lb (.20 kg) more than the average gain of steers fed alfalfa hay and steers fed only the 3% Na: 1 Ca treated corn cob ration. Steers fed untreated cobs + ½ alfalfa hay gained significantly more than the average of steers fed only alfalfa hay or only the untreated corn cob ration.

Feed intakes were increased by both chemical treatment and alfalfa additions. Feed efficiency responses were similar to daily gain responses with positive associative effects for mixtures of treated corn cobs and alfalfa. Response to chemical treatment was greatest when treated corn cobs were fed with alfalfa. The positive effects of alfalfa may be due to chemical dilution, minerals in the alfalfa or slowed passage from the rumen.

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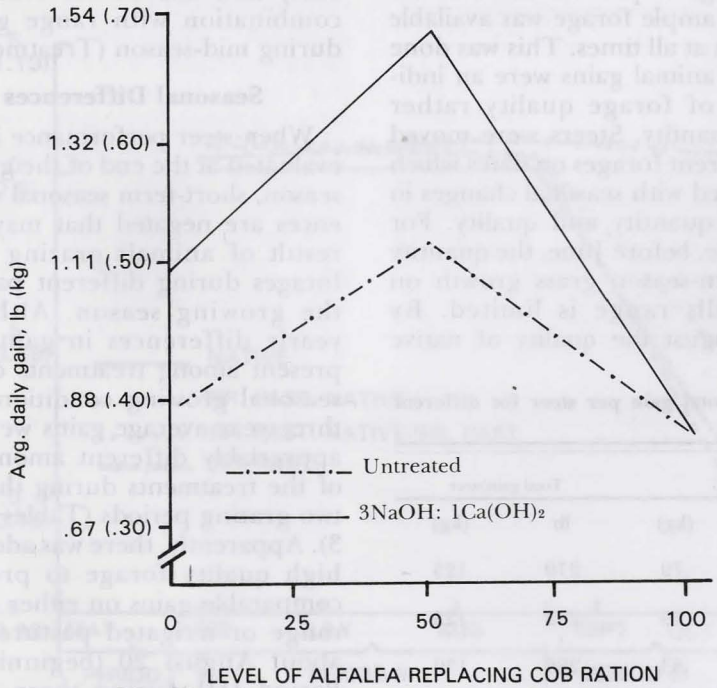
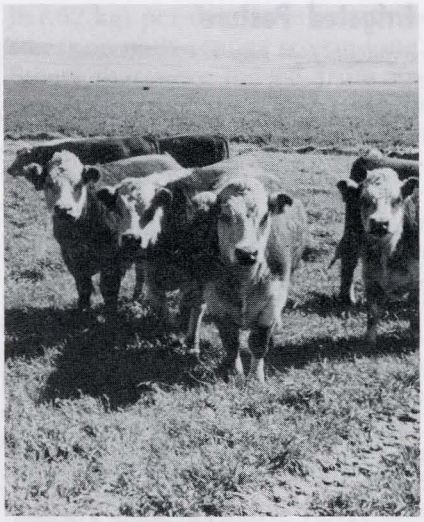


Figure 1. Average daily gains of steers fed corn cob rations with 0, 50, or 100% alfalfa hay addition.



Yearling steers on irrigated pasture, Sandhills Agricultural Laboratory.

Yearling Steers

Irrigated Pasture and Native Range

James T. Nichols
Gary Lesoing[1]

Over a three-year period, yearling steers grazing irrigated pasture season-long gained more than steers grazing native range or steers grazing a combination of irrigated pasture and native range during different segments of the grazing season. Irrigated pasture was most advantageous late in the growing season (after about August 20) when compared to native range. This response was most pronounced in 1978 due to a decline in forage quality on native range, accentuated by a very dry period in late summer.

Introduction

Native range is the primary source of forage for growing cattle in the Sandhills from May through October. Since most of the forage is produced by warm-season grasses, there is a limited quantity of high quality forage available in early spring. In addition, during late summer and fall, forage quality declines rapidly as plants reach

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Irrigated Pasture

(continued from page 27)

maturity. This leaves a relatively short period of time (mid-May to mid-August) during the summer when forage quantity and quality of native range is adequate for optimum livestock gains.

When center-pivot irrigation became feasible on selected Sandhills sites in the lates 1960's, opportunities became available to add complementary forage crops to "fill in" where range forage was considered lacking. Theoretically, grazing steers on a combination of native range and irrigated forage during peak periods of growth and quality should improve animal gains and total production. This study was started to evaluate this concept using irrigated cool-season grass pasture alone; native range alone; and a combination of the two as summer forage programs for yearling cattle.

Procedure

For three consecutive years (1976-1978), 40 yearling Hereford steers averaging about 500 pounds (227 kg) were allotted to 4 treatments. The grazing season was divided into three periods of time: Period I, first week of May to first week of June; Period II, first week of June to third week of August; and Period III, third week of August to second week of October. Forages and periods of use for the four treatments were:

1. Native range season long, first week of May to second week of October.
2. Irrigated pasture, first week of May to first week of June, then to native range until second week of October.
3. Irrigated pasture, first week of May to first week of June, then to native range until third week of August, then to irrigated pasture until second week of October.
4. Irrigated pasture season long, first week of May to second week of October.

Individual animal weights were taken on all treatments to correspond to dates when the steers were moved to a different type of forage. Because a limited amount of green forage was available on native range early in the grazing season, 1 lb (.45 kg) of 20% protein supplement was fed for 20 days to the treatment group on native range. Steers on both native range and irrigated pasture were stocked so that ample forage was available to them at all times. This was done so that animal gains were an indication of forage quality rather than quantity. Steers were moved to different forages on dates which coincided with seasonal changes in forage quantity and quality. For example, before June, the quantity of warm-season grass growth on Sandhills range is limited. By mid-August the quality of native grasses is declining. Irrigated pasture was used for two treatments in an attempt to compensate for these deficiencies.

Table 2. Gain per steer during different periods of the grazing season for different forage systems (3-year average).

Treatment number	Forage system and sequence	Period I[a]		Period II		Period III	
		lb	(kg)	lb	(kg)	lb	(kg)
1	Native range season long	65	30	152	69	53	24
2	Irrigated pasture-native range	69	31	156	71	47	21
3	Irrigated pasture-native range-irrigated pasture	66	30	155	70	67	30
4	Irrigated pasture season long	68	31	156	71	103	47

[a]Period I = First week of May to first week of June.
Period II = First week of June to third week of August.
Period III = Third week of August to second week of October.

Season-long Responses

Average daily gains and total gain per steer for the different forage systems for the entire growing season are given in Table 1. The highest gains were from steers grazing irrigated pasture season-long (Treatment 4). Irrigated pasture early, followed by native range (Treatment 2) did not improve performance compared to native range alone (Treatment 1). A small increase in steer performance was noted when irrigated pasture was grazed both early and late in the season in combination with range grazed during mid-season (Treatment 3).

Seasonal Differences

When steer performance is only evaluated at the end of the grazing season, short-term seasonal differences are negated that may be a result of animals grazing other forages during different parts of the growing season. Although yearly differences in gain were present among treatments due to seasonal growing conditions, the three-year average gains were not appreciably different among any of the treatments during the first two grazing periods (Tables 2 and 3). Apparently, there was adequate high quality forage to produce comparable gains on either native range or irrigated pasture until about August 20 (beginning of Period III) during these years. The fact that steers on native

Table 1. Season-long average daily gains (ADG) and total gain per steer for different forage systems, May-October (3-year average).

Treatment number	Forage system and sequence	ADG		Total gain/steer	
		lb	(kg)	lb	(kg)
1	Native range season long	1.73	.79	270	123
2	Irrigated pasture-native range	1.74	.79	272	123
3	Irrigated pasture-native range-irrigated pasture	1.83	.83	286	130
4	Irrigated pasture season long	2.07	.94	322	146

Table 3. Average daily gains during different periods of the grazing season for different forage systems (3-year average)

Treatment number	Forage system and sequence	Period I[a]		Period II		Period III	
		lb	(kg)	lb	(kg)	lb	(kg)
1	Native range season long	2.03	.92	2.03	.92	1.06	.48
2	Irrigated pasture-native range	2.16	.98	2.08	.94	.94	.43
3	Irrigated pasture-native range-irrigated pasture	2.06	.93	2.06	.93	1.34	.61
4	Irrigated pasture season long	2.13	.97	2.08	.94	2.06	.93

[a]Period I = First week of May to first week of June.
Period II = First week of June to third week of August.
Period III = Third week of August to second week of October.

range were receiving 1 lb (.45 kg) of 20% protein supplement per day for the first 20 days of Period I in conjunction with a light stocking rate probably contributed to the comparable gain during that period.

During Period III (about August 20 to October 10), a substantial increase in steer gains can be attributed to irrigated pasture (Table 3 and Figure 1). Gains were highest for this period when the steers were maintained on irrigated grass throughout the summer, but some advantage was realized when steers were moved from native range to irrigated pasture during the late part of the grazing season (Period III). Steer gains on native range were about half of those on irrigated pasture during Period III. Native range grasses mature during late summer with a corresponding decline in forage quality. In contrast, irrigated pasture forage is maintained in an immature stage of development by successive grazing and regrowth throughout the growing season.

Weather Effects

In 1978 little precipitation was received after mid-June, resulting in lower forage production and earlier than normal curing of the forage. During Period III, steers which were grazed on irrigated pasture season-long averaged 1.37 lb (.62 kg) per day more gain than steers on native range season-long. Steers that were moved from native range to irrigated pasture in late August gained 0.86 lb (.39 kg) per day more than those that remained on native range throughout the study period. This is a more pronounced response than is indicated by the three-year average values shown in Figure 1.

In other years of adequate precipitation late growing season differences in steer gains among treatments were less pronounced. Forage quality is more constant from year to year on irrigated pasture than on native range and as a consequence animal gains are less variable from year to year.

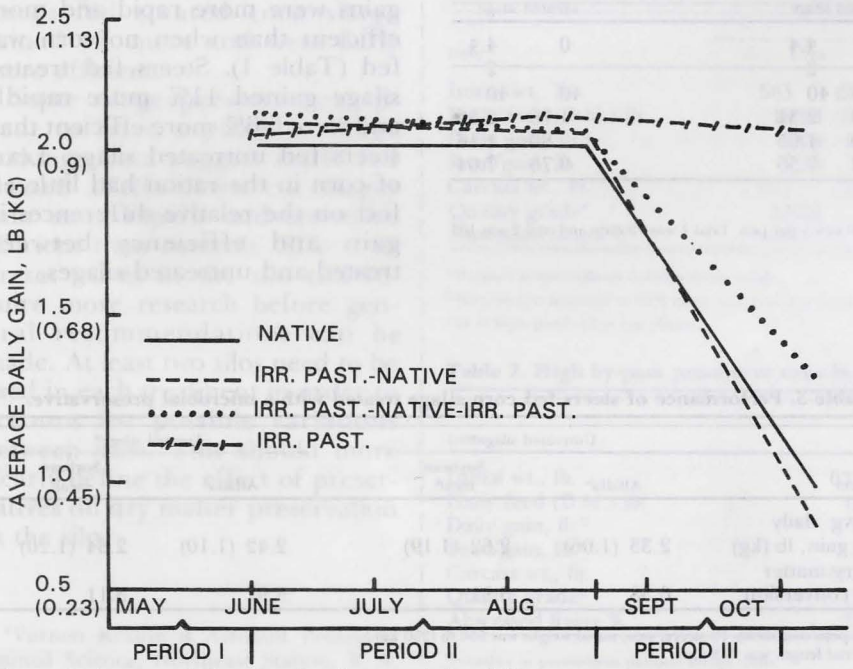

Figure 1. Average daily gains for three periods of the growing season when steers were grazed on four different forage systems. All values are 3-year averages.

Application to a Ranch Situation

This study suggests that the best use of irrigated pasture for yearling steers is during late summer when native grasses are declining in forage quality. Other studies with cows and calves on irrigated pasture have shown that early spring grazing after calving, and during the breeding season, will improve conception rates of cows. Considering these two primary uses for irrigated pasture, it is apparent that the same irrigated pasture can be used during the different parts of the growing season for different classes of cattle—both during a time when it is most advantageous. When used in this manner, greater benefits may be obtained than when use is restricted to only one class of cattle.

When used to its best advantage, irrigated pasture can be considered a complementary forage crop to the basic rangeland resource. Native range is considered the primary forage resource and irrigated pasture is used to "fill in" and provide an abundance of high quality forage during periods of the growing season when range is lacking. Other uses and complementary relationships may exist for different ranches and livestock programs.

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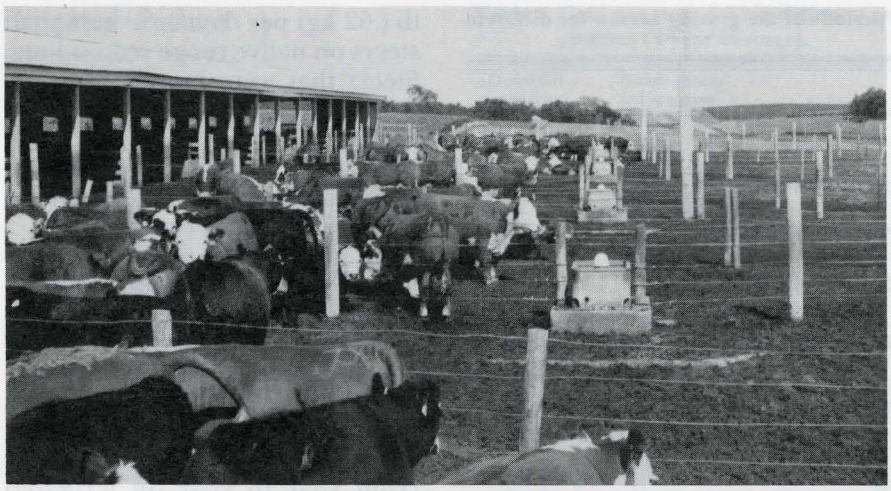

Cattle on alfalfa preservative test.

For Silage

Microbial Preservatives

Vernon Krause
R. A. Britton[1]

A microbial preservative was added to first cutting alfalfa or whole corn plant chopped at 30% dry matter. In two trials, steers fed treated alfalfa silage gained 11% more rapidly and 6.6% more efficiently than controls. Steers fed treated corn silage gained 2.2% more and were 5.5% more efficient than controls.

Silage preservatives have been sold with claims of a more desirable fermentation, less dry matter loss from the silo, and less seepage. Manufacturers of preservatives also recommend that forages be harvested at 30% dry matter. Wetter silages may seep more, but when compared to drier silages, dry matter losses at harvest should be less. Regardless of other claims, to be of value to the farmer, a silage preservative should result in increased beef production, either through increased dry matter preservation in the silo, increased efficiency of gain in cattle, or both.

A microbial preservative was applied at the rate of 1 lb (.45 kg) per 1 ton (907 kg) of wet forage. The preservative contained dried fermentation products from Aspergillus Oryzae, Bacillus Subtilis and Lactobacillus Acidophilus. The product was applied through a metering device attached to the blower of the chopper, or to the blower at the silo.

Alfalfa Trials

Two trials were conducted using first cutting alfalfa that was windrowed, wilted for about two hours, then chopped and ensiled. In trial 1 alfalfa was stored in bunkers. Preservative was added at the silo.

In the second trial, alternate loads had product applied through the blower of the chopper. The alfalfa was stored in above ground piles covered with plastic. In both trials steers were fed either treated or untreated silage with 0 or 4.4 lb (2 kg) of corn dry matter per head daily. When corn was added to the rations steer gains were more rapid and more efficient than when no corn was fed (Table 1). Steers fed treated silage gained 11% more rapidly and were 6.6% more efficient than steers fed untreated silage. Level of corn in the ration had little effect on the relative differences in gain and efficiency between treated and untreated silages.

Table 1. Performance of steers fed alfalfa silage.

Item	Untreated silage		Treated silage	
Corn/head/day, lb	0	4.4	0	4.4
(kg)[a]		2		2
No. of head[b]	40	40	40	40
Avg. daily gain, lb[c]	1.54	2.31	1.76	2.56
(kg)	.70	1.05	.80	1.16
Dry matter conversion	10.42	7.56	9.76	7.04

[a]Dry matter.
[b]Combination of two trials, each trial was 2 pens per treatment, 10 steers per pen. Trial 1 was 79 days and trial 2 was 105 days in length.
[c]Initial weight; trial 1, 559 lb (254 kg); trial 2, 509 lb (231 kg).

Table 2. Laboratory analysis of alfalfa silages fed in Trial 2.

	Treatment	
	Untreated	Treated
Dry matter, %[a]	31.8	34.1
IVDMD, %	63.2	64.1
VFA, %[b] Acetic	6.71	4.00
Propionic	.24	.08
Lactic acid, %[b]	5.22	5.29
Soluble nitrogen, %[c]	55.7	60.3
pH	4.98	4.49

[a]Oven dry matter.
[b]Expressed as a % of dry matter.
[c]% of total N.

Table 3. Performance of steers fed corn silage treated with a microbial preservative.

Item	Untreated silage[a]		Treated silage[a]	
	Alfalfa[b]	Soybean meal[b]	Alfalfa[b]	Soybean meal[b]
Avg. daily gain, lb (kg)	2.33 (1.06)	2.62 (1.19)	2.42 (1.10)	2.64 (1.20)
Dry matter conversion	6.38	5.31	5.97	5.11

[a]2 pens/treatment, 10 steers; pen, initial weight was 550 lb (250 kg). Trial length was 113 days.
[b]Control was 34.1% dry matter; treated was 33.7% dry matter.
[c]Supplemental protein source.

Laboratory analysis of silages in trial 2 (Table 2) shows treated silage had less acetic and propionic acid than control silage, but lactic acid content was about the same. More soluble nitrogen was present in the treated silage and pH was lower in the treated silage compared to the control.

Corn Silage Trial

In another trial, whole corn plant was harvested and alternate loads were blown into upright silos. Preservative was added through the blower at one of the silos.

Steers weighing about 550 lb (250 kg) were fed either treated or untreated corn silage supplemented with alfalfa or soybean meal. Rations consisted of corn silage, rumensin, a trace mineral supplement containing vitamins, minerals and salt and either 27.5% dry matter from alfalfa or 7.8% dry matter from soybean meal.

Steers fed soybean meal gained more and were more efficient than those fed alfalfa (Table 3). When fed soybean meal, steers receiving treated silage had the same gains as steers fed untreated silage, however, steers fed treated silage were 4% more efficient in dry matter conversion. When rations were supplemented with alfalfa, steers fed treated corn silage gained 4% more and were 6.5% more efficient.

Some silage preservatives appear to have a place in silage making. Data suggest cattle fed treated alfalfa direct cut silages gain more rapidly and are more efficient than controls. Effects of preservatives in the silo still require more research before general recommendations can be made. At least two silos need to be used in each treatment in order to account for possible variations between silos. This should more clearly define the effect of preservatives on dry matter preservation in the silo.

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[1]Vernon Krause is Assistant Professor, Animal Science, Northeast Station, R. A. Britton is Associate Professor, Ruminant Biochemist.

High By-Pass Protein, Urea Compared in Finishing Ration

Gregory E. Schindler
Stanley D. Farlin[1]

Yearling cattle supplemented with high rumen by-pass proteins proved no more efficient than animals receiving urea supplementation in finishing rations. Cattle performance was not significantly affected in two trials where blood meal or corn gluten meal was compared to urea as a supplemental protein source.

A high percentage of the protein in high rumen by-pass protein supplements, such as bloodmeal and corn gluten meal, escapes rumen degradation and reaches the small intestine. These proteins were compared with urea to determine if a high by-pass protein is needed in high moisture corn beef finishing rations since high moisture corn may contain high levels of soluble protein. Crude protein levels of 13% were used in Trial 2 to test whether additional by-pass protein will improve performance of yearling cattle fed high moisture corn.

Experimental Procedure

Trial 1 compared urea, corn gluten meal and a mixture of urea and corn gluten meal as sources of supplemental protein for high moisture corn rations. Two hundred sixty-four mixed yearling heifers and steers weighing 585 lb (266 kg) were allotted to 12 pens with 4 pens per treatment. Heifers and steers were fed together. Treatments included rations supplemented to 11% crude protein using: (1) urea, (2) corn gluten meal, and (3) urea plus corn gluten meal where 50% of the supplemental protein was derived from each source.

The rations on a dry matter basis during the 161-day feeding trial included 10% brome-alfalfa hay, 85% high moisture corn (27%

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Table 1. Effect of supplemental nitrogen sources in finishing rations.[a]

Item	Treatments: Urea	Corn gluten meal	Urea & corn gluten meal
Initial wt., lb.	583 (265)	581 (264)	590 (268)
Daily feed (D.M.) lb.	18.94 (8.61)	19.29 (8.77)	19.05 (8.66)
Daily gain, lb.[b]	2.68 (1.22)	2.64 (1.20)	2.62 (1.19)
Feed/gain, lb.	7.16	7.44	7.17
Carcass wt., lb.	611 (278)	602 (274)	605 (275)
Quality grade[c]	12.05	11.97	11.93
Abscessed livers %	15.1	19.4	17.2

[a]Number in parenthesis denotes metric units.
[b]Final weight adjusted to 62% dress based on hot carcass weight.
[c]11 = high good; 12 = low choice.

Table 2. High by-pass protein vs urea in beef finishing rations.[a]

Item	Treatments: Urea	Bloodmeal
Initial wt., lb.	637 (289)	638 (289)
Daily feed (D.M.) lb.	19.75 (8.96)	20.01 (9.08)
Daily gain, lb.[b]	2.41 (1.09)	2.51 (1.14)
Feed/gain, lb.	8.10	8.00
Carcass wt., lb.	650 (295)	660 (299)
Quality grade[c]	12.52	12.36
Abscessed livers %	23.4	23.4

[a]Number in parenthesis denotes metric units.
[b]Final weight adjusted to 62% dress based on hot carcass weight.
[c]11 = high good; 12 = low choice.

Protein, Urea Compared

(continued from page 31)

moisture) stored ground in a bunker silo, 2.4% mineral, vitamin and antibiotic supplement with the remainder of the ration consisting of the appropriate mixture of liquid protein supplement, molasses or corn gluten meal to provide 11% ration crude protein.

In Trial 2 cattle received a high moisture corn based ration balanced for 13% crude protein using either blood meal (high by-pass protein at 89% crude protein) or urea as supplemental protein sources. Ninety-six head of mixed-crossbred steers were randomly allotted to four pens. The cattle were implanted initially and at 56 days with Synovex-S and received rumensin at 30 grams per ton of air dry ration.

The ration for the blood meal fed cattle consisted on a dry matter basis of 10% corn silage, 84% high moisture corn (27% moisture) and 6% dry supplement which was the blood meal carrier. The urea ration on a dry matter basis consisted of 10% silage, 76.87% high moisture corn, 5% dry supplement, and 8.13% liquid supplement as the urea carrier.

Results

There were no significant differences between high by-pass protein and urea as supplemental protein sources in Trials 1 and 2 (Tables 1 and 2). Cattle fed corn gluten meal ate slightly more feed but gains were not changed. Feed efficiency was slightly poorer for corn gluten meal fed cattle. In Trial 2 the blood meal fed cattle tended to consume more (similar to Trial 1), had slightly better gain, and were slightly more efficient. However, these trials illustrate that finishing cattle perform equally as well on urea supplementations as on high by-pass protein supplementation. Urea is utilized as efficiently and usually more economically than high by-pass protein.

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For Finishing

Whole and/or Rolled Corn

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

Whole shelled corn is comparable to dry rolled corn in high energy rations for finishing steers according to a summer feedlot study conducted at the North Platte Station. Switching from whole to rolled corn or vice versa two thirds of the way through the feeding period was not beneficial.

Increased cost of energy, and interest in conservation of energy have again raised the question of the feasibility of using whole shelled corn in cattle finishing rations. Whole corn feeding programs, if properly managed, have worked quite effectively. However, two additional questions have been raised: (1) is there any advantage in switching from whole corn to rolled corn and vice versa the latter part of the feeding program, and (2) is there any difference in fill or shrink in the finished cattle.

Yearling Steers Studied

Ninety-two crossbred yearling steers were randomly assigned within weight classes and previous treatments to three replications of four treatments. There were nine head of Angus × Hereford steers per treatment in one replication and seven head of Simmental × Angus-Hereford steers per treatment in the other two replications. The steers were adjusted to a finishing ration over a three-week period. The finishing ration was 83% corn, 8% corn silage and 9% supplement (dry matter basis). Rations were fed *ad libitum* throughout the trial. The replication of Angus × Hereford steers were fed 120 days (March 16 - July 14, 1978) and the three-way cross steers were fed 134 days (March 16 - July 28, 1978).

The four treatments were: (1) whole corn fed throughout the entire experiment; (2) whole corn fed the first two-thirds of the trial and dry rolled corn the last one-third; (3) dry rolled corn the first two-thirds and whole corn the last one-third; (4) rolled corn fed throughout the entire experiment.

The average of individual weights taken on two consecutive days was used for a starting and ending weight. The ending weights were taken on the day before and the day of shipment to slaughter. Twenty-eight-day group weights were taken to monitor the progress of the steers. Individual weights were taken on all steers the day before the two treatment groups were switched to the type of corn received the last ⅓ of the feeding period.

Table 1. Performance of steers finished with whole and/or rolled corn.

Corn processing Final ⅔ Last ⅓	Whole Whole		Whole Rolled		Rolled Whole		Rolled Rolled	
Initial weight, lb (kg)	717	(326)	716	(325)	718	(326)	712	(324)
Avg daily gain, lb (kg)								
Live weight basis								
First ⅔ trial	3.54	(1.61)	3.74	(1.69)	3.62	(1.64)	3.47	(1.57)
Last ⅓ trial	2.74	(1.24)	2.65	(1.20)	2.62	(1.19)	2.87	(1.30)
Total trial[a]	3.29	(1.49)	3.37	(1.53)	3.29	(1.49)	3.28	(1.49)
Adjusted weight basis[b]	3.23	(1.47)	3.36	(1.52)	3.30	(1.50)	3.40	(1.54)
Feed/gain (dry matter)								
Live weight basis								
First ⅔ trial	5.11		4.91		5.05		5.21	
Last ⅓ trial	7.37		7.57		7.68		7.07	
Total trial[a]	5.64		5.59		5.72		5.74	
Adjusted weight[b]	5.73		5.60		5.66		5.53	

[a]Based on actual final feedlot weight shrunk 3%
[b]Based on carcass weight adjusted to 62% dress

Table 2. Carcass characteristics of steers finished with whole and/or rolled corn.

Corn processing First ⅔ of trial Last ⅓ of trial	Whole Whole	Whole Rolled	Rolled Whole	Rolled Rolled
Dressing %[a]	61.68	61.91	61.99	62.87
Hot carcass wt, lb (kg)	706 (321)	716 (325)	711 (323)	716 (325)
Outside fat, in (cm)	.34 (.86)	.33 (.84)	.35 (.89)	.34 (.86)
Quality grade[b]	12.0	12.1	12.1	12.0
Yield grade	2.64	2.53	2.63	2.58
Cutability, %	51.0	51.2	51.0	51.1

[a]Dressing % is hot carcass weight divided by final full live weight shrunk 3%

[b]11 = high good; 12 = low choice

Gains Compared

Comparing the gains the first two-thirds, the last one-third or the entire trial showed small insignificant differences in gains of the steers on the four different feeding regimes (Table 1). Likewise, minor differences in the feed conversion were observed (Table 1). Gains and efficiency for the entire trial were calculated two ways: (1) using actual final live weight shrunk 3%, and (2) converting hot carcass weight to live weight based on 62% dressing percent. Carcass measurements were not different (Table 2).

The only significant difference in all the data was associated with the dressing percentage of the steers (Table 2). When the two groups that received rolled corn the last third of the trial were compared with the groups that received whole corn the last third of the trial dressing percent was significantly higher for those fed the rolled corn. Likewise, when comparing steers that received whole corn the entire trial with those that received rolled corn the entire trial steers fed the rolled corn had significantly higher dressing percents. However, when the two groups that were switched from one type of corn to the other type two-thirds of the way through the trial were compared no difference in dressing percent was observed. The inconsistency in results leaves doubt regarding dressing percent which has value only in the buying and selling of finished cattle on a live basis.

In practice it is necessary to keep feed in front of the cattle at all times while feeding whole shelled corn. Generally, fewer digestive disturbances are encountered when whole corn is fed. Some data indicate that whole corn in rations containing high levels of roughage may be used less efficiently than rolled corn. Previous experiments in Nebraska have shown that the performance of cattle fed rations of half or more roughage do better when the corn is rolled. Thus, whole corn feeding applies with high energy rations (80 to 85% corn, the balance roughage and supplement).

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Thiopeptin in High Concentrate Rations

Stanley D. Farlin[1]

Thiopeptin, roughage level, and rate of putting cattle on feed were evaluated in a study of methods of putting cattle on feed. Thiopeptin did not significantly alter rate and efficiency of gain but did reduce both incidence and severity of liver abscesses.

Carcasses of cattle fed thiopeptin or 15% roughage graded higher than no thiopeptin or 5% roughage. Cattle fed 15% corn silage in the ration consumed more total feed and had less efficient gains than cattle fed 5% corn silage. Fifteen percent corn silage reduced incidence and severity of liver abscesses as compared to 5% corn silage. There were no significant differences in gain, intake, or efficiency of cattle which were fed step-up rations for 6 or 12 day intervals.

Experimental Procedure

Thiopeptin, a feed additive to

Table 1. Effect of roughage level, thiopeptin and rate of putting cattle on feed on steer performance.[a,b]

Roughage level	15%				5%			
Days on step-up rations	6		12		6		12	
Thiopeptin (ppm)	0	11	0	11	0	11	0	11
Daily dry matter intake, lb	20.6	20.4	20.5	21.1	18.6	18.8	18.9	19.5
(kg)	(9.3)	(9.3)	(9.3)	(9.6)	(8.4)	(8.5)	(8.6)	(8.8)
Daily gain[c], lb	2.66	2.67	2.45	2.47	2.39	2.58	2.38	2.59
(kg)	(1.21)	(1.21)	(1.11)	(1.12)	(1.08)	(1.17)	(1.08)	(1.17)
Feed required/lb gain	7.9	8.1	8.7	8.8	8.0	7.4	8.3	7.6
Hot carcass wt, lb	651	652	633	637	629	645	627	646
(kg)	(295)	(296)	(287)	(289)	(285)	(293)	(284)	(293)
Quality grade[d]	12.0	12.1	11.4	12.0	11.3	11.5	11.5	12.3
Yield grade	3.3	3.0	3.2	3.2	3.3	3.3	3.2	3.5
Incidence of liver abscesses, %	11	10	17	4	37	27	42	25

[a]Number in parenthesis on metric scale.

[b]Adjusted for initial weight.

[c]Final weight adjusted to 62% dress from hot carcass weight.

[d]11 = high good; 12 = low choice.

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Thiopeptin . . .

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reduce digestive disturbance while cattle are starting on and being maintained on high concentrate rations, was evaluated using 379 mixed yearling steers. The animals consisted of a heavy group (725 lb, 330 kg) and a light group (611 lb, 278 kg) which were fed for 134 and 154 days, respectively. The lighter group was fed in outside lots. The heavy group was fed in a confinement barn with concrete slatted floors. The cattle were assigned to eight treatments arranged in a 2 × 2 × 2 factorial design. Treatments included 0 or 11 ppm thiopeptin, 5 or 15% roughage dry matter in ration and 6 or 12 day intervals for step-up rations while going on feed. Thiopeptin was removed from the ration 14 days prior to slaughter.

The final rations (dry matter basis) consisted of 5 or 15% corn silage and 86 or 76% high moisture corn respectively, 4% liquid protein supplement and 5% dry supplement as a carrier of thiopeptin, minerals and vitamins. The rations were formulated for 11.5% protein, .35% phosphorus, .45% calcium and .55% potassium.

Results and Discussion

Rate of gain was not different for any of the treatments (Table 1). Thiopeptin was not effective in improving steer performance as measured by gain and efficiency. Carcass quality grade was improved ($P<.05$) with thiopeptin. There was also a significant ($P<.05$) interaction where thiopeptin increased grade more with 12 day intervals than with 6 day intervals for step-up rations. Thiopeptin reduced ($P<.05$) both incidence and severity of liver abscesses although thiopeptin did not improve rate of gain or feed efficiency significantly. Cattle fed thiopeptin with 5% roughage gained slightly faster and more efficiently than steers getting no thiopeptin. However, thiopeptin at the higher roughage level was ineffective whereas with the higher roughage level thiopeptin treatment was ineffective.

Steers fed 15% roughage consumed more ($P<.01$) feed than those fed 5% roughage. Incidence and severity of liver abscesses were reduced ($P<.01$) with the higher level of roughage. Roughage was more effective than the thiopeptin. There was a significant ($P<.01$) roughage level by day for step-up rations interaction for carcass quality grade.

There were no significant differences between 6 and 12 day intervals for step-up rations. However, with 15% roughage the cattle fed each ration for 6 days appeared to gain faster (2.66 vs 2.46).

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Avoparcin and Synovex-S Implants

Stanley D. Farlin[1]

Avoparcin, an additive which has been shown to alter rumen fermentation, was tested for its effect on feedlot performance. Avoparcin in a 154-day finishing trial did not significantly improve rate and efficiency of gain.

Synovex-S implanted at the beginning and reimplanted after 56 days of the trial improved feed efficiency, rate of gain, feed intake, carcass weight, loin eye area and marbling. Kidney, heart and pelvic fat was reduced with Synovex-S.

Experimental Procedures

Treatments involving zero or 45 gm Avoparcin per ton of ration with Synovex-S or no implants were used in a feeding trial with 175 mixed crossbred yearling steers weighing 700 lb (318 kg). Steers were randomly allotted to 16 pens in a confinement barn open to the south with concrete floors and a flush-flume system. Avoparcin was withdrawn after 147 days on test and 7 days before slaughter. Steers receiving Synovex-S were implanted at the beginning and reimplanted after 56 days on test.

The trial was conducted from October 19, 1978 to March 22, 1979. Initial and 147 day weights were obtained after an overnight shrink off feed and water. Gains for 154 days were calculated using final weight computed from actual

Table 1. Effect of Avoparcin[a] and Synovex-S[b] on steers.[c]

	Avoparcin (gm/ton)			
	0		45	
	No. implants	Synovex-S	No. implants	Synovex-S
Daily dry matter intake, lb	19.40 (8.80)	20.85 (9.46)	19.62 (8.90)	19.92 (9.04)
Daily gain[d], lb	2.14 (.97)	2.77 (1.26)	2.23 (1.01)	2.73 (1.24)
Dry matter required/gain	9.20	7.53	8.84	7.19
Carcass weight, lb	640 (290)	700 (318)	649 (294)	697 (316)
Quality grade[e]	12.2	12.3	12.5	12.0
Liver abscesses, %	42	50	48	56

[a]Avoparcin withdrawn at 147 days

[b]Implanted at beginning and reimplanted after 56 days

[c]Numbers in parenthesis expressed on metric scale

[d]Final weight adjusted to 62% dress from hot carcass weight

[e]11 = high good; 12 = low choice

carcass weights and a constant 62% dress. The cattle were fed a ration consisting, on a dry matter basis, of 10% corn silage, 60.51% high moisture corn (stored ground in a bunker silo), 20% dry corn, 5% dry supplement as carrier for minerals, vitamins plus Avoparcin, and 4.49% liquid supplement as the protein carrier. The ration was formulated to contain 11.5% crude protein, .35% phosphorus, .45% calcium and .55% potassium.

Results

Avoparcin had no significant effect on growth, feed intake, or feed efficiency of finishing yearling steers (Table 1). Two subjective carcass characteristics were affected by Avoparcin. Kidney, heart and pelvic fat was reduced ($P<.05$). There was an Avoparcin by Synovex-S implant interaction ($P<.05$) for marbling. Synovex implanted cattle had less marbling when Avoparcin was fed but more marbling when Avoparcin was not used.

Synovex-S implants at 0 and 56 days were effective in improving animal performance. Feed efficiency was improved ($P<.01$) by 18.4%. Weight gain was 25.9% faster ($P<.01$). Carcasses were 8.4% heavier ($P<.01$) Loin eye area was increased ($P<.01$) while kidney, heart and pelvic fat was reduced ($P<.05$) with Synovex.

Although Avoparcin did not support significant improvements in feed efficiency and weight gain, the small changes noted appeared to be additive with the significant changes observed for Synovex. Feed efficiency was improved by 18.2% by Synovex alone and 3.9% by Avoparcin alone. Combined they gave 21.8% improvement. Rate of gain was improved 29.4% with Synovex and 4.2% by Avoparcin. Combined they improved gain 27.6%. Avoparcin is not cleared for use in cattle rations.

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High Moisture Snapped Corn

Paul Q. Guyer
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Cattle performed well when fed processed high moisture snapped corn (35-40% of the corn kernels stored whole) to provide about 8 and 12% roughage in finishing rations.

However, when processed high moisture snapped corn (PHMSC) was fed without supplemental grain (24-25% roughage) or with only enough grain to decrease roughage content to 18-19% in the first trial, rate and efficiency of gain were less desirable.

Processed high moisture snapped corn kept well when stored in bunker silos as did processed high moisture corn with whole high moisture shelled corn (WHMC) added at the rate of about .4 bushel for each bushel of grain in the processed snapped corn (about 36% of the dry weight of snapped corn).

Introduction

Harvest, storage and feeding of corn grain at high moisture content offers potential for minimizing harvest and storage costs on farms where both corn is raised and cattle are fed. Harvesting the cob and shuck (or cob only) along with the grain provides an opportunity to harvest and store the roughage needed in finishing rations in one operation. Limited studies with high moisture ground snapped corn indicate that it can be stored satisfactorily in covered trench or bunker silos but that it contains too much roughage for maximum rate and efficiency of gain.

Following reports that whole high moisture shelled corn appeared to produce faster and more efficient gains than high moisture corn stored in ground form, LeDioyt Land & Cattle Company, in cooperation with Brown Feedlots, harvested high moisture snapped corn ground coarsely so that 35-40% of the kernels were left whole. The product appeared to store well in bunker silos. As a result of their interest, a cooperative trial was started to gather more complete information on methods of handling and feeding this product. Because it was processed through a large screen to allow a significant portion of the grain kernels to remain in shelled form we labeled the product "processed high moisture snapped corn" (PHMSC) rather than ground high moisture snapped corn.

In the first trial, treatments were (1) PHMSC, (2) PHMSC plus high moisture shelled corn added as the product was stored, and (3) PHMSC plus dry shelled corn added at feeding time to provide a similar concentrate-roughage ratio to treatment 2. The rations were designed to provide 11.5% protein for the first 28 days and followed by 11% protein for the rest of the trial, .35% calcium, .30% phosphorus and 30,000 IU Vitamin A daily. Cattle were implanted with Ralgro at the beginning of the experiment.

Approximately 150 fleshy heifers (wintered on corn silage) and 150 thin steers (wintered on stalks with limited supplemental energy) of Angus-Hereford or Hereford ancestry were fed on each treatment. They were fed to choice grade and a representative sample (about 30 head) of each lot followed through slaughter to evaluate carcass data.

Whole high moisture corn was mixed with PHMSC at the rate of .4 bushel WHMC per bushel of PHMSC to provide the basal feed for treatment 2. This mixture provided a ration containing about 19% roughage—about 50-60% of the grain was in whole shelled form. Less high moisture shelled corn was included in the mixture than planned because it would not pack firmly enough for the mix to be pushed up during filling of the bunker silo. This "blend" corn averaged 27.3% moisture as fed. The PHMSC, harvested after harvesting the "blend" corn, had 24.9%

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Snapped Corn

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average moisture content. Both bunkers kept well with minimal evidence of spoilage loss or mold.

Neither the heifers nor the steers gained as rapidly as desired on any of the rations fed (Table 1). Cattle fed the PHMSC with additional grain had somewhat more rapid and efficient gains than those fed PHMSC. Rate and efficiency of gain was practically the same when additional corn was added either at storage or at feeding. Only minor differences occurred in carcass desirability between treatments. Steers yielded highly acceptable carcasses while heifers had slightly more finish and more "good" grade carcasses than desirable. Both heifers and steers fed PHMSC had slightly lower carcass quality grades, more desirable yield grades, and lower dressing percentages than those with supplemental corn in their ration.

Low rate and efficiency of gain appeared to be partially due to the high level of low quality roughage supplied by the cob and shuck in the PHMSC. Cob refusal occurred in all rations but was less of a problem among those fed the "blend" PHMSC. The higher moisture content of this corn resulted in a softer and more palatable cob portion. Had we planned the feeding program for more frequent cob removal and required less clean-up of bunks at each feeding, we believe that rate of gain would have been more acceptable.

In the second trial, high concentrate rations using the cob and shuck of PHMSC as the roughage were compared with a conventional corn-alfalfa hay ration as follows: (1) shelled corn plus 12% alfalfa hay, (2) shelled corn plus PHMSC to provide 8% roughage equivalent, and (3) shelled corn plus PHMSC to provide 12% roughage equivalent. Treatment 2 was estimated to have about the same energy for gain and treatment 3 the same roughage equivalent as treatment 1.

PHMSC was stored as before — in a bunker with about 35-40% of the grain in whole shelled form — but the moisture content was somewhat higher (avg. 27.4%). The rations were designed to provide 11% crude protein, .35% calcium, .3% phosphorus, and 30,000 IU daily. Cattle were implanted with Ralgro just before the test began and midway through the test.

About 150 yearling Hereford and Hereford-Angus cross steers were fed on each of the three rations. The steers had been wintered on corn stalks supplemented with corn silage and then brought to dry lot and fed a high silage growing ration for a short period before being placed on test. They were fed until they reached low choice grade and a representative group (about 30 head) from each treatment followed through slaughter.

Performance of steers was excellent on each of the rations (Table 2). Rate and efficiency of gain was highest for the cattle fed the lower level of PHMSC and lowest for those fed the higher level of PHMSC.

Differences in carcass desirability between treatments were minor. However, the sample followed through slaughter carried somewhat more finish than desirable indicating that they should have been sold somewhat sooner.

These data indicate that the cob and shuck portion of processed high moisture snapped corn can provide an acceptable roughage for high concentrate rations. The ration containing 8% roughage from PHMSC fed well without appreciable digestive disturbances and appeared in this trial to be superior to the 12% level of roughage from PHMSC.

Table 2. Processed high moisture snapped corn vs alfalfa hay as a roughage source for finishing cattle.

	Shelled corn-alfalfa hay (12% roughage)		Shelled corn-PHMSC[a] (8% roughage)		Shelled corn-PHMSC[a] (12% roughage)	
	lb	(kg)	lb	(kg)	lb	(kg)
Initial weight[b]	680	(308)	683	(310)	690	(313)
Final weight[b]	1056	(479)	1072	(486)	1058	(480)
Daily gain	3.11	(1.41)	3.21	(1.46)	3.04	(1.38)
Feed consumed (dry matter)						
Daily	21.2	(9.6)	20.6	(9.4)	21.3	(9.7)
/gain	6.80		6.45		7.00	

[a]Shelled corn added at feeding.
[b]Shrunk 3% from scale weight.
[c]Trial length—121 days.

Table 1. Processed high moisture snapped corn vs PHMSC and whole shelled high moisture corn vs PHMSC and dry shelled corn.[a]

	PHMSC		PHMSC + dry shelled corn		PHMSC + WHMC	
	lb	(kg)	lb	(kg)	lb	(kg)
Heifers						
Initial weight[b]	613	(278)	604	(274)	626	(284)
Final weight[b]	880	(399)	890	(404)	906	(411)
Daily gain[c]	1.98	(.90)	2.12	(.96)	2.07	(.94)
Feed consumed (dry matter)						
Daily	20.8	(9.4)	20.4	(9.3)	20.3	(9.2)
/gain	10.54		9.65		9.81	
Steers						
Initial weight[b]	603	(274)	593	(269)	594	(269)
Final weight[b]	1021	(463)	1038	(471)	1027	(466)
Daily gain[c]	2.50	(1.13)	2.66	(1.21)	2.59	(1.17)
Feed consumed (dry matter)						
Daily	21.0	(9.6)	19.9	(9.0)	19.9	(9.0)
/gain	8.41		7.46		7.67	

[a]Whole high moisture corn was mixed with PHMSC at harvest; dry corn was mixed in ration just before feeding.
[b]Shrunk 3% from scale weight.
[c]Trial length—heifers 167 da; steers 127 da.

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