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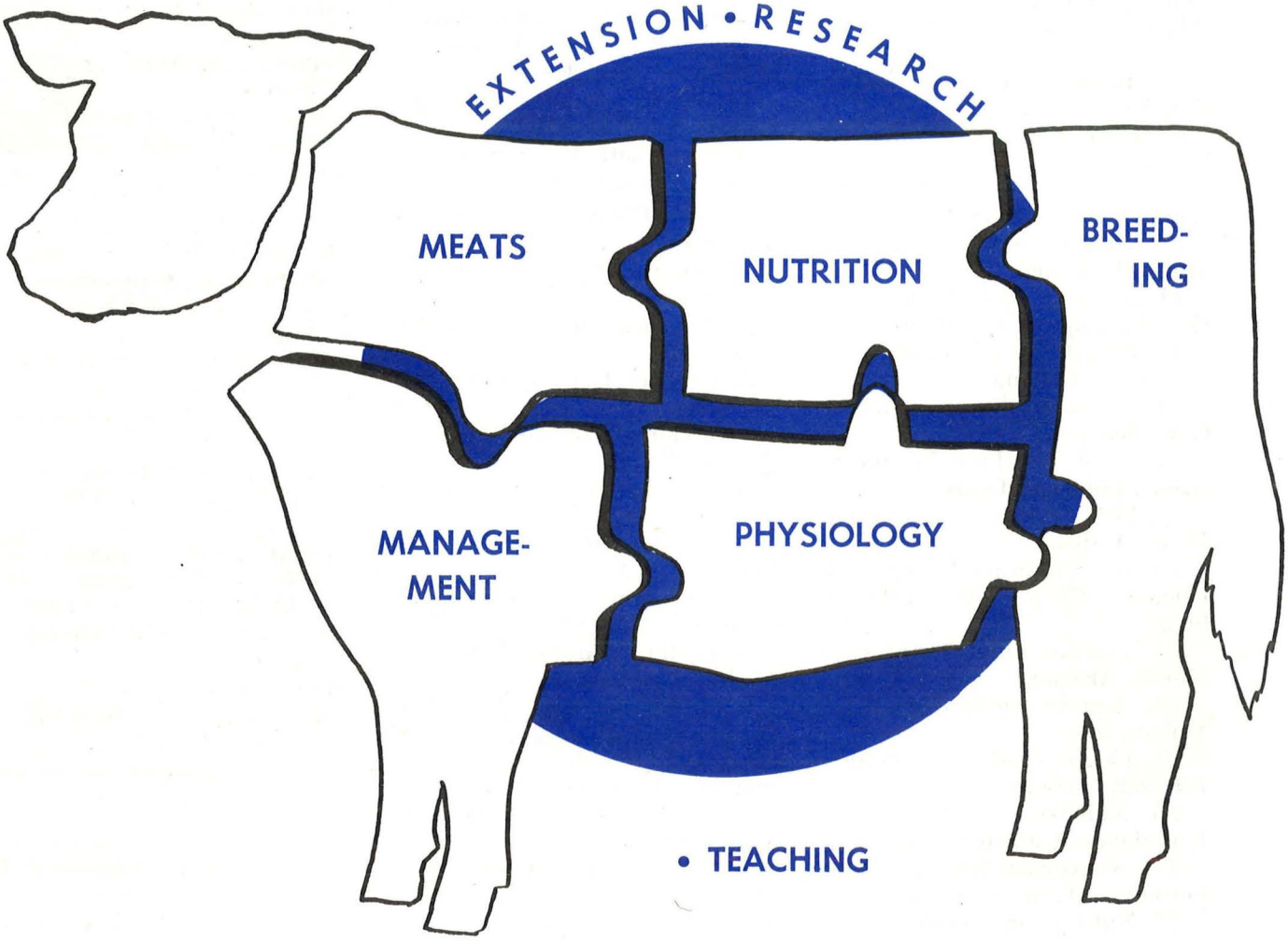
1977 NEBRASKA BEEF CATTLE REPORT



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

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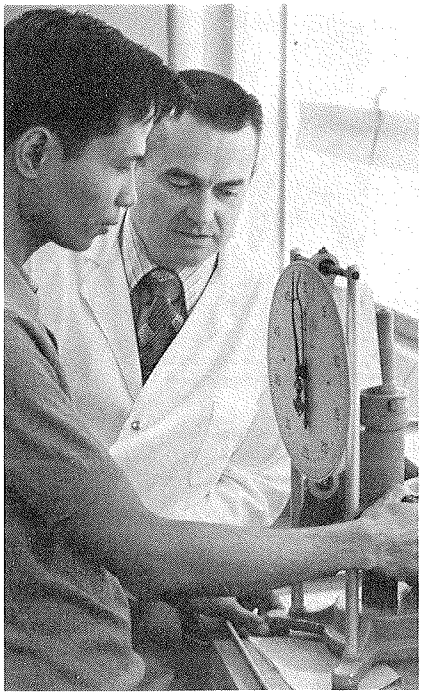


Tenderness measured by the Warner-Bratzler shear machine.

Cooking U.S. Choice, Standard Round Steaks

R. W. Mandigo
J. F. Campbell
P. Thiratinrat[1]

Feed grain price increases encourage a reduction in amount of concentrate fed to beef cattle. This reduction has raised questions concerning quality and ultimate consumer acceptability of beef produced under these circumstances.

Method of preparation has a tremendous impact on acceptability of beef. Tender cuts of beef usually are cooked using dry heat (oven roasting, broiling, pan-frying) and less tender cuts normally are prepared using moist heat methods (stewing, cooking in liquid). The degree of doneness also influences the eating characteristics of meat due to the increased moisture losses encountered when meat is cooked to more advanced stages of doneness.

Four Methods Tested

In this study U.S. Choice and U.S. Standard top round steaks were prepared by four methods (still-air oven roasting, deep fat frying, convection oven roasting with air currents, and moist heat cookery in pyrex containers). Steaks were cooked to different degrees of doneness; 140°F (60°C)—rare; 150°F (66°C)—medium rare; 160°F (71°C)—medium and 170°F (77°C)—well done.

Cooked U.S. Standard steaks had higher moisture and lower fat contents than Choice steaks. U.S. Choice steaks had a higher degree of marbling causing more fat to be present within the muscle. Taste panelists could not tell the difference between U.S. Choice and Standard steaks regarding tenderness, juiciness, flavor and overall acceptability. This suggests that, for marginal cuts (e.g. top round), the U.S. quality grade may not be a valid indicator of eating quality.

Steaks cooked in the still-air oven had less cooking loss than those cooked by the other three methods. Taste panelists preferred steaks cooked in the still-air oven as compared to the other three methods of cookery (Table 1). This preference probably was caused by higher moisture content of these steaks as a direct result of the lower cooking loss.

Steaks cooked to a rare degree of doneness, 140°F (60°C) had less cooking loss and shorter cooking time. They were more tender and juicy than steaks cooked to greater degrees of doneness due to greater moisture content (Table 2). Flavor and acceptability were essentially the same for the rare and medium rare steaks. They were both more acceptable than the medium and well done steaks primarily because of the dryness and toughness of steaks cooked to the advanced degrees of doneness.

Still-air Oven Best

This study showed that top round steaks cooked in a still-air oven were more desirable than those cooked in a convection oven, by moist-heat cookery or by deep fat frying. Steaks cooked to a rare state also were more desirable than those cooked to greater degrees of doneness.

There were no detectable differences concerning eating quality between U.S. Choice and Standard top round steaks; however, this by no means indicates that all cuts from U.S. Choice and Standard carcasses will be equally acceptable.

---

[1]R. W. Mandigo is Professor of Animal Science. J. F. Campbell and P. Thiratinrat are former graduate students.

Table 1. Comparison of cookery methods for taste panel scores.

Traits	Cooking method			
	Still-air oven	Convection oven	Pyrex moist heat	Deep fat frying
Tenderness[a]	4.60	4.22	3.76	3.70
Juiciness[b]	4.31	4.06	3.36	4.12
Flavor[c]	4.63	4.27	3.90	4.14
Acceptability[d]	4.54	4.15	3.81	3.88

[a]1 = extremely tough; 7 = extremely tender
[b]1 = extremely dry; 7 = extremely juicy
[c]1 = extremely poor; 7 = extremely good
[d]1 = extremely unacceptable; 7 = extremely acceptable

Table 2. Comparison of degrees of doneness.

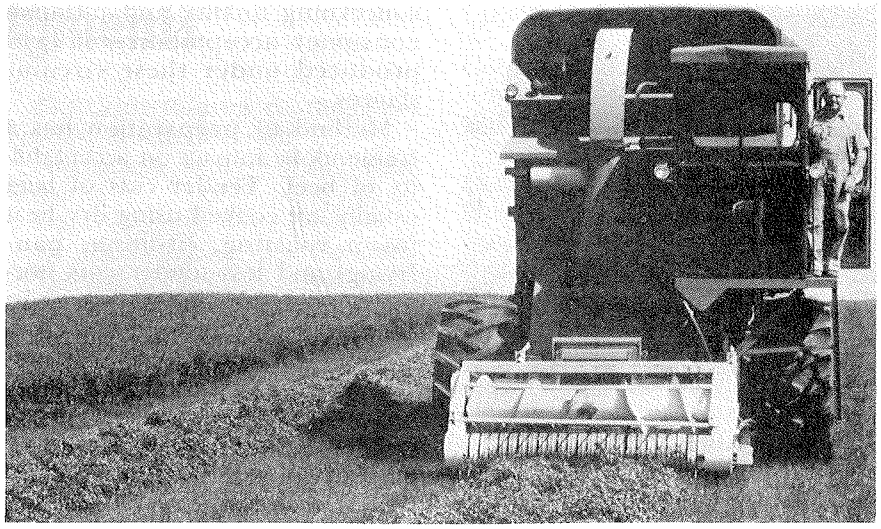
Traits		Degree of doneness			
		Rare	Medium rare	Medium	Well done
Cooking loss	%	19.20	25.11	29.62	33.01
Cooking time	Min.	16.80	21.78	27.68	31.98
Tenderness[a]	Score	4.63	4.22	3.72	3.73
Juiciness[b]	Score	4.79	4.23	3.62	3.21
Flavor[c]	Score	4.59	4.29	4.09	3.08
Acceptability[d]	Score	4.60	4.28	3.83	3.69

[a]1 = extremely tough; 7 = extremely tender
[b]1 = extremely dry; 7 = extremely juicy
[c]1 = extremely poor; 7 = extremely good
[d]1 = extremely unacceptable; 7 = extremely acceptable

For Growing Calves

Wilted vs Direct Cut Dehy

Cecelia Dorn
Terry Klopfenstein
Bob Ogden
Bill Kehr[1]



Harvesting wilted alfalfa.

Dehydrated alfalfa (dehy) has been a very popular feedstuff for the past 30 years. The increasing cost of fuel used by the dehydrating industry requires changes that will maintain a quality product yet allow dehy to be an economical alternative for the livestock feeder. Field wilting alfalfa before dehydration has potential as a less costly production method.

In the field wilting process, alfalfa is cut with a windrower and allowed to wilt several hours before dehydration. Less fuel is required for this type of production and total output is increased because of less drying time necessary.

In August 1974, alfalfa was direct cut and dehydrated as usual while other sections of the same field were allowed to wilt six hours in the field to 65% moisture. The following year, three dehy products were obtained from alternating swaths in one field. One was processed as usual (direct cut), the second allowed to field wilt to about 60% moisture and the third was wilted to 40%moisture. All were pelleted through a ¼ in. (.63 cm) die. Pertinent data are shown in Table 1. Two cattle growth trials were conducted to compare these dehys.

Table 1. Characteristics of dehydrated alfalfa.

	1974		1975		
	Direct cut	Wilted (65%)	Direct cut	Wilted (60%)	Wilted (40%)
Moisture entering drum, %	74.3	65.6	75.0	57.0	40.5
Moisture leaving drum, %	5.6	5.6	6.8	5.3	4.4
Drum outlet temperature, °C	191	171	157	146	127
Protein, %	20.7	20.3	18.6	18.5	18.4
Carotene, mg/kg	246	242	174	150	121

Table 2. Wilted and direct cut dehy for calves,[a,b]

	Direct cut dehy	Wilted dehy	SBM control	Urea control
Avg. daily gain	1.74 (.79)	1.73 (.79)	1.96 (.89)	1.31 (.60)
Avg. daily feed[c]	16.24 (7.37)	16.83 (7.64)	16.61 (7.54)	16.01 (7.27)
Feed efficiency	9.35	9.76	8.48	12.31

[a]Numbers in parenthesis is expressed in kilograms.
[b]Fed 107 days to 48 calves/treatment, avg. initial weight 450 lb (204 kg).
[c]Dry matter basis.

Table 3. Direct cut and two levels of wilting of dehy for calves.[a,b]

	Direct cut	Wilted to 60% moisture	Wilted to 40% moisture	Urea
Avg. daily gain, lb	1.03 (.47)	.99 (.45)	.99 (.45)	.64 (.29)
Avg. daily intake,[b] lb	14.4 (6.54)	14.4 (6.54)	14.1 (6.0)	13.7 (6.22)
Feed/gain	13.96	14.58	14.29	21.41

[a]Numbers in parenthesis expressed in kilograms.
[b]Fed 132 days to 39 calves/treatment, avg. initial weight 506 lb (230 kg).
[c]Dry matter basis.

Cattle Growth Trials

The first trial utilized wilted and direct cut dehy obtained in 1974. One-hundred-ninety-two steers weighing an average of 450 lb (204 kg) were allotted randomly to 8 pens of 24 head each. Four rations were fed with two pens fed each ration. Each pen had the same number of Angus, Hereford and crossbred calves.

The major feed was a mixture of 60:40 (dry matter basis) drought corn silage to sodium hydroxide treated husklage. Wilted or direct cut dehy was fed at the rate of 2 lb (.91 kg) per head per day in two treatment groups. The dehy supplied 22.5% of the total crude protein in rations where fed and urea was added to increase the crude protein to 11.5%. In the soybean meal control, SBM provided about 50% of the total crude protein. Urea used in the 4th ration to provide a negative control

was added to provide about 50% of the total crude protein equivalent in the ration.

The addition of 2 lb (.91 kg) per day of dehy produced a substantial increase in gain compared to the urea control (Table 2). Field wilting did not appear to have any detrimental effect on the protein or other nutrients found in dehy.

A second cattle growth trial was conducted to further evaluate the three dehydrated alfalfas harvested in 1975. A liquid urea supplemented ration was included as a control. The dehys were fed at the rate of 2 lb (.91 kg) per head per day supplying 22% of the total crude protein fed daily. Rations were based on a 60:40 dry matter ratio of silage to sodium hydroxide treated cobs. Liquid supplement was added to the dehy rations to equalize crude protein. Each ration was fed to two pens of 21 Hereford steers.

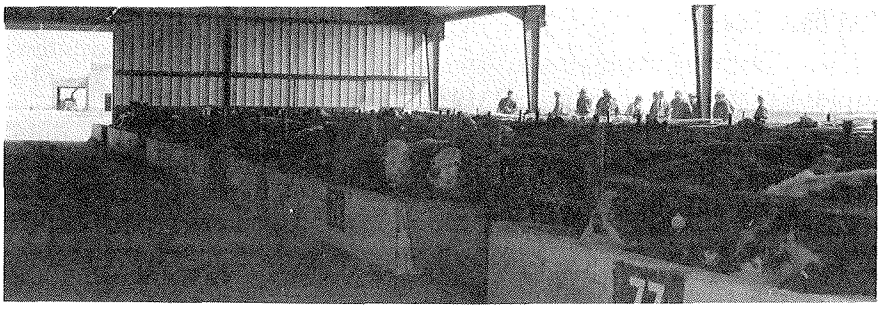
Steers fed the dehydrated alfalfa rations gained significantly faster than those fed the urea ration (Table 3). There were no significant differences among the three dehydrated alfalfa rations for any of the performance criteria.

No Difference Found

Dehy has been shown to be an excellent source of protein and digestible dry matter. In all the experiments, wilted dehy proved to be no different than direct cut dehy. Dry matter, nitrogen and fiber digestibilities were equal for direct cut and wilted dehys. In two cattle performance trials, rates and efficiencies of gains were similar for wilted and direct cut dehys.

The process of drying field wilted alfalfa must be controlled carefully to allow production of a quality product since less heat and time are required to dehydrate wilted than direct cut alfalfa. From results obtained the last two years we think there are essentially no differences in direct cut and wilted dehy.

[1]Cecelia Dorn is graduate assistant. Terry J. Klopfenstein is Professor, Ruminant Nutrition. Bob Ogden is Assistant Professor (Alfalfa Processing). Bill Kehr is Professor, Alfalfa Breeding.



Confinement building and cattle used in study of distillers feeds.

Distillers Feeds

John Waller
Terry Klopfenstein[1]

Protein in distillers feeds is at least equal to soybean meal in feeding value for ruminants consuming low quality roughage rations. Much of the protein in distillers feeds bypasses rumen digestion and appears to complement rapid rumen ammonia release of urea when the two are fed in combination. Three trials were conducted to further evaluate this complementary effect.

Rations used contained equal parts of corn silage and ensiled crop residues treated with 3% sodium hydroxide and 1% calcium hydroxide. This ration provides energy nearly equal to corn silage and is low enough in protein to allow maximum evaluation of protein supplements. Each cattle trial contained urea and soybean meal control rations for comparing performance of cattle receiving supplemental nitrogen from nonprotein nitrogen and natural protein nitrogen. Rations were balanced for 12% crude protein, .4% calcium and .35% phosphorus.

Corn distillers dried grains with solubles (DDGS) fed alone and in combination with 28% and 41% urea were studied in the 1st trial. Animals fed DDGS performed equal to those fed soybean meal (SBM) (Table 1). Gain of calves consuming urea and DDGS-urea were equal. A complementary effect of DDGS and urea was not observed.

Distillers grains from fermentation of milo was studied in the second trial. Distillers dried grains with solubles are produced by drying distillers solubles on distillers dried grains. Drying of protein sources has been shown to alter the portion of protein bypassing rumen digestion. Therefore, this trial was conducted to determine if drying the distillers solubles on the grains influenced the feeding value of the DDGS.

Distillers dried grains (DDG) appeared to be equal to SBM when fed at the same level of protein in the ration (Table 2). Calves consuming the DDG + urea supplemented ration gained nearly as

(continued on next page)

Table 1. Effect of DDGS and DDGS-urea combinations on rate of growing calves.[a,b,]

	Supplement				
Item	Soybean meal	Urea	DDGS + 41% urea	DDGS + 28% urea	DDGS
Avg. daily gain, lb	1.91 (.87)	1.54 (.70)	1.52 (.69)	1.69 (.77)	1.91 (.87)
Feed[c]/gain	6.83	74	8.71	7.89	6.81

[a]Numbers in parenthesis expressed in kilograms.
[b]10 calves/treatment; 462 lb (210 kg) average initial weight; fed 106 days.
[c]Dry matter basis.
[d]Dry matter basis.

Distillers Feeds

(continued from page 5)

rapidly as those receiving SBM and slightly faster than those receiving DDGS + urea indicating a complementary effect which was more apparent with DDG than DDGS.

Drying the solubles back on the DDG appeared to have a slight beneficial effect (rations 5 & 7). This could be in response to altering the bypass of protein present in the distillers solubles fraction of the DDGS.

The performance of calves receiving condensed distillers solubles (CDS) at two levels did not differ from those receiving urea as a supplemental nitrogen source indicating that the protein in CDS was all digested in the rumen and broken down into ammonia. DDG is superior to DDGS and CDS from the standpoint of a complementary effect with urea and bypass protein.

Corn DDGS was fed in combination with urea at two levels and in combination with SBM in the 3rd trial. Cattle fed combinations of DDGS and urea performed equal to or superior to those consuming SBM and urea combinations (Table 3).

As percent urea increased in rations containing DDGS, performance was reduced slightly indicating the quantity of DDGS protein bypassing rumen digestion was important in supporting animal performance. The combination of DDGS, SBM and urea produced gain and feed efficiency equivalent to rations supplemented with either DDGS (ration 6) or SBM (ration 3), which also contained 10.5% of the ration protein as natural protein. Complementary effect of DDGS with SBM and urea was not apparent.

These three trials indicate DDG gives a better complementary effect with urea than DDGS. If this complementary effect can be maximized, distillers feeds plus urea could be effectively used to reduce cost of protein supplementation for roughage rations.

[1]John Waller is graduate assistant. Terry Klopfenstein is Professor, Ruminant Nutrition.

Table 2. Distillers feeds from milo as supplemental protein sources for growing steers.[a,b]

	Supplemental N supplied by:							
	1	2	3	4	5	6	7	8
	Urea	SBM	DDG	DDG + 43% urea	DDGS + 34% urea	CDS[c] + 74% urea	DDG[c] + CDS + 34% urea	CDS + 95% urea
Avg. daily gain, lb	1.42	2.35	2.37	2.06	1.95	1.33	1.81	1.34
	(.65)	(1.07)	(1.08)	(.94)	(.86)	(.60)	(.82)	(.61)
Feed[d]/gain	10.34	6.28	6.28	7.15	7.57	11.12	8.15	11.04

[a]Numbers in parenthesis expressed in kilograms.
[b]20 steers/treatment; 480 lb (218 kg) average initial weight; fed 112 days.
[c]Same levels as in DDGS in ration 5.
[d]Dry matter basis.

Table 3. Corn DDGS, SBM vs urea supplemental rations[a,b]

	Supplemental N supplied by:							
	1	2	3	4	5	6	7	8
	Urea	SBM	SBM + 29% urea	SBM + 64% urea	DDGS	DDGS + 29% urea	DDGS + 64% urea	DDGS[c] + SBM + 29% urea
Avg. daily gain, lb	.80	1.20	1.17	.98	1.24	1.16	1.02	1.10
	(.36)	(.46)	(.53)	(.44)	(.56)	(.53)	(.46)	(.50)
Feed[d]/gain	16.2	12.7	11.1	13.3	10.5	11.2	13.4	11.8

[a]Numbers in parenthesis expressed in kilograms.
[b]22 steers/treatment; 520 lb (236 kg) average initial weight, fed 110 days.
[c]Same levels of DDGS, SBM and urea as in rations 4 & 7.
[d]Dry matter basis.

Slow Ammonia

Michael J. Prokop
Terry J. Klopfenstein[1]

Ruminant nutritionists have tried for more than 30 years to improve utilization of urea. Reducing the rate at which urea is hydrolyzed to ammonia by rumen microbes has been a primary goal.

The University of Nebraska for the past four years has cooperated with Liquid Feed Commodities, Inc., in developing a molasses based liquid supplement (SARU) possessing a form of slow ammonia release urea.

The supplement, SARU, is formulated at 36 percent crude protein with urea, molasses, water, vitamins and trace minerals. It can only be distinguished from a conventional molasses based liquid supplement by chemical analysis.

The supplement is unique in that it contains a small amount of formaldehyde per ton. The formaldehyde and urea are carefully blended to form a urea-formaldehyde condensate. The condensate has been chemically identified as methylenediurea. Only part of the supplemental urea is chemically bound in the condensate. Laboratory studies with SARU have shown the rate of ammonia release to be slower than a conventional urea liquid supplement but faster than soybean meal.

Lamb Infusion Trial

Both rate of ammonia release and potential urea toxicity were evaluated in a lamb infusion trial. Lambs were infused with near lethal levels of urea (0.62 grams of urea per kilogram of body weight) from either SARU or a conventional urea liquid supplement. Rumen fluid and blood ammonia concentrations were determined on samples obtained before infusion and subsequent samples at one-half, one, one and one-half, two and three hours post infusion. Averaged across all hours, SARU gave lower rumen ammonia concentrations (79.9 vs. 106.9 mg

Release Urea

NH_4–N/100 ml) than the control (Table 1).

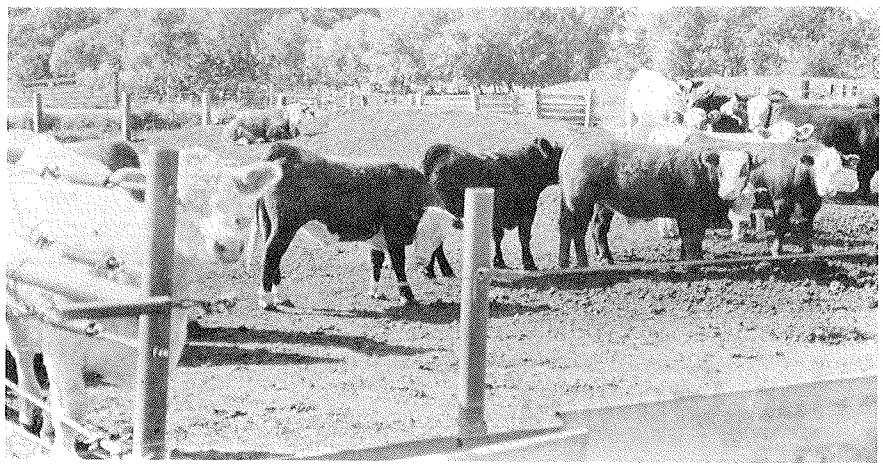
Within sampling hours SARU produced significantly lower rumen ammonia levels at hours 0.5, 1.0 and 2.0. Averaged across all hours, blood ammonia levels for the control and SARU were 16.4 and 9.0 ug NH_4–N/ml, respectively. Blood ammonia for SARU lambs was significantly lower than the urea control lambs at all hours post infusion. Together these two ammonia parameters demonstrate that SARU is a form of slow ammonia release urea in the animal. As indexes of urea toxicity these two parameters show that SARU is less toxic than urea.

Lamb Digestion Trial

A lamb nitrogen balance trial was conducted to evaluate the nutritional value of SARU. Lambs were fed a 60 percent ground corn cob ration balanced at 12 percent crude protein with either soybean meal, a urea control liquid supplement, or SARU.

As measured by nitrogen retained and the percent of dietary nitrogen retained, SARU supported nitrogen balance intermediate to that of rations supplemented with soybean meal or a conventional urea liquid supplement (Table 2).

However, compared with both soybean meal and the urea control, SARU supplementation resulted in slightly increased fecal nitrogen and decreased urinary nitrogen. Together with the previous ammonia release trial these data demonstrate that SARU contains a form of slow ammonia release urea which is of a nutritional value intermediate to that of soybean meal and a conventional urea liquid supplement.



Cattle on slow ammonia release urea (SARU) liquid supplement.

Cattle Growth Trials

Two cattle growth trials were conducted to evaluate SARU under feedlot conditions. A total of 496 head were fed. Trial 1 compared SARU to a conventional urea liquid supplement. Each supplement was fed with an all silage ration or a 50:50 dry matter blend of silage and ground corn cobs.

The two supplements, each fed with a blend of silage and ground corn cobs or silage and chemically treated ground corn cobs, were compared in Trial 2. Pooled performance data for the two trials are presented in Table 3. With all cattle grouped by the source of supplemental nitrogen, no differences occurred in average daily gain, daily feed or feed required per unit of gain.

These data show SARU and a conventional urea supplement to be comparable sources of nitrogen for the growing animal. The primary advantage of SARU is found in a reduced rate of ammonia formation and a subsequent reduction in urea toxicity.

[1]Michael J. Prokop is Asst. Prof. Ruminant Nutrition. Terry J. Klopfenstein is Professor, Ruminant Nutrition.

Table 1. Effect of ruminal infusion of urea and Slow Ammonia Release Urea (SARU) upon rumen fluid and blood ammonia concentration.[a]

Supplement	Hours post infusion 0	0.5	1.0	1.5	2.0	3.0
	Rumen ammonia, mg NH_4-N/100 ml[b]					
Urea control	37	135	153	103	79	65
SARU	42	103	92	75	66	65
	Blood ammonia, ug NH_4-N/ml[b]					
Urea control	6	14	18	18	17	14
SARU	6	8	9	11	8	8

[a]Three period switch back trial using 4 lambs.
[b]Each value is mean of 6 observations.

Table 2. Nitrogen balance data for lambs supplemented with soybean meal, urea control liquid supplement or SARU.[a]

Parameter	Source of supplemental nitrogen: Soybean meal	Urea control supplement	SARU
Nitrogen retained, gm[b]	3.71	1.97	2.43
Percent nitrogen retained	25.6	15.0	18.3
Nitrogen intake, gm	15.24	13.15	13.31
Fecal nitrogen, gm	3.65	3.58	3.77
Urinary nitrogen, gm	7.89	7.61	7.11

[a]Two, seven day collection periods.
[b]Each value is the mean of six observations.

Table 3. Pooled cattle performance data for cattle supplemented with urea and SARU.[a]

Parameter	Source of suppplemental nitrogen: Urea supplement	SARU
No. of animals	247	250
Starting wt., lb (kg)	562 (255)	560 (254)
Final wt., lb (kg)	681 (309)	673 (306)
Avg. daily gain, lb (kg)[b]	1.12 (0.51)	1.11 (0.50)
Daily feed, lb (kg)	15.2 (6.9)	15.1 (6.9)
Feed/gain	13.5	13.5

[a]Trial 1, 301 head, 100 days, 12% crude protein.
[b]Trial 2, 196 head, 112 days, 11.5% crude protein.

Rumensin and Protein for Growing Cattle

Tom Hanson
Terry Klopfenstein[1]

Rumensin increases efficiency of gain primarily by increasing energy utilization. Increased energy utilization means protein requirement might become a critical factor for maximizing rate and efficiency of gain.

Two steer growth trials were conducted to determine the effect Rumensin may have on urea and natural protein utilization. Two levels of protein supplementation were included in each trial.

Two Trials

Eight rations in Trial 1 consisted of a 60:40 ratio of corn silage to sodium hydroxide treated husklage supplemented with either natural protein from brewers dried grains (BDG), or nonprotein nitrogen from urea. Crude protein content was either 10.5 percent or 12.5 percent. BDG supplied 10.6 percent and 24.4 percent of the ration dry matter for the low natural (rations 1 and 2) and high natural (rations 3 and 4) protein supplemented rations, respectively. Urea content of rations 5 and 6 was 1.3 percent of the ration dry matter whereas rations 7 and 8 contained 2.1 percent.

Results of Trial 1 (Table 1) shows appreciable Rumensin response when BDG was used as the supplement (rations 1–4). A 16.3 percent increase in feed efficiency from feeding Rumensin occurred on the low protein level and an 8.7 percent increase in feed efficiency occurred on the higher level. No increase in performance was evident from adding Rumensin at either level of urea supplementation. If microbial protein synthesis was stimulated by Rumensin addition, a performance response should have occurred when it was added to these urea supplemented rations.

Soybean meal (SBM) was fed the second trial. Rations consisted of 74 percent corn silage and 18 percent high moisture corn supplemented to contain either 11.1 percent (NRC requirement) or 13.1 percent crude protein. Results were similar to Trial 1. A 9.1 percent improvement in feed efficiency occurred when the lower level of protein was fed and only a 3.2 percent improvement occurred on the higher protein level.

Positive Response

Calves fed rations supplemented with natural protein showed a positive response in feed efficiency when Rumensin was fed. Maximum response to Rumensin occurred on the lower protein levels (10.5 percent crude protein in Trial 1 and 11.1 percent crude protein in Trial 2).

Data indicate that current protein recommendations for growing calves are appropriate when Rumensin is fed. Rumensin addition to urea supplemented rations showed no effect on utilization of nonprotein nitrogen at either level. Research in our lab aimed at determining the effect of Rumensin on microbial protein synthesis and rumen bypass of protein may help determine the reason for the results of these growth trials.

[1]Tom Hanson is a graduate assistant. Terry J. Klopfenstein is Professor, Ruminant Nutrition.

Table 1. Effect of Rumensin, protein source and protein levels on performance of growing steers (Mead Station).[a,b]

	BDG				Urea			
	10.5% Protein		12.5% Protein		10.5% Protein		12.5% Protein	
	–	+ Rumensin[c]	–	+ Rumensin[c]	–	+ Rumensin[c]	–	+ Rumensin[c]
Avg. daily gain, lb	1.28 (.58)	1.53 (.69)	1.68 (.76)	1.85 (.84)	1.15 (.52)	1.13 (.51)	1.28 (.58)	1.17 (.53)
Feed intake[d], lb/day	14.8 (6.7)	14.8 (6.7)	15.3 (7.0)	15.4 (7.0)	15.2 (6.9)	15.3 (7.0)	15.3 (7.0)	15.3 (7.0)
Feed/gain[d]	11.56	9.67	9.11	8.32	13.22	13.54	11.95	13.08

[a]Numbers in parenthesis expressed in kilograms.
[b]Fed 127 days; 12 steers/treatment; average initial weight 525 pounds (238 kg).
[c]200 mg per day.
[d]Dry matter basis.

Table 2. Effect of Rumensin and protein levels on performance on growing steers (Mead Station).[a,b]

	SBM supplemented ration			
	11.1% Protein		13.1% Protein	
	–	+ Rumensin[c]	–	+ Rumensin[c]
Avg. daily gain, lb	1.40 (.64)	1.58 (.72)	1.78 (.81)	1.88 (.85)
Feed intake[d], lb/day	15.44 (7.01)	15.84 (7.19)	15.64 (7.10)	16.00 (7.26)
Feed/gain[d]	11.03	10.03	8.79	8.51

[a]Numbers in parenthesis expressed in kilograms.
[b]Fed 120 days; 51 or 49 steers/treatment; average initial weight 470 pounds (213 kg).
[c]10 grams Rumensin per ton first 21 days and 30 grams per ton thereafter.
[d]Dry matter basis.

Protein-Bentonite Complexes

Robert Britton
Dan Colling
Terry Klopfenstein[1]

Complexing soybean meal (SBM) with sodium bentonite (NaB) reduces rate of breakdown of the SBM *in vitro*, improves nitrogen retention, gain, and feed efficiency in both growing lambs and steers. This combination allows us to more effectively use urea by reducing the ruminal breakdown of the preformed protein in the rations. In this way preformed protein can be used more efficiently to meet the animal's nitrogen requirement and urea can be used to meet the microorganism's nitrogen requirement.

Recent research has emphasized the importance of meeting the ruminant animal's amino acid requirement at the small intestine. The most efficient way of increasing the amount of amino acids reaching the small intestine is to have dietary protein go through the rumen undegraded and be digested in the abomasum and small intestine.

The work reported here describes a method of increasing utilization of soybean meal protein by complexing it with sodium bentonite and increasing ruminal bypass of the complex.

SBM was complexed with NaB by mixing the dry ingredients (3 parts SBM to 1 part NaB), adding water (equal to the dry weight of both ingredients), mixing and drying at 65°C. Laboratory evaluations were first made using rumen microorganisms and measuring amounts of ammonia released (Figure 1). Complexing SBM with NaB reduced the amount of ammonia formed *in vitro*. This may indicate increased ruminal bypass of protein.

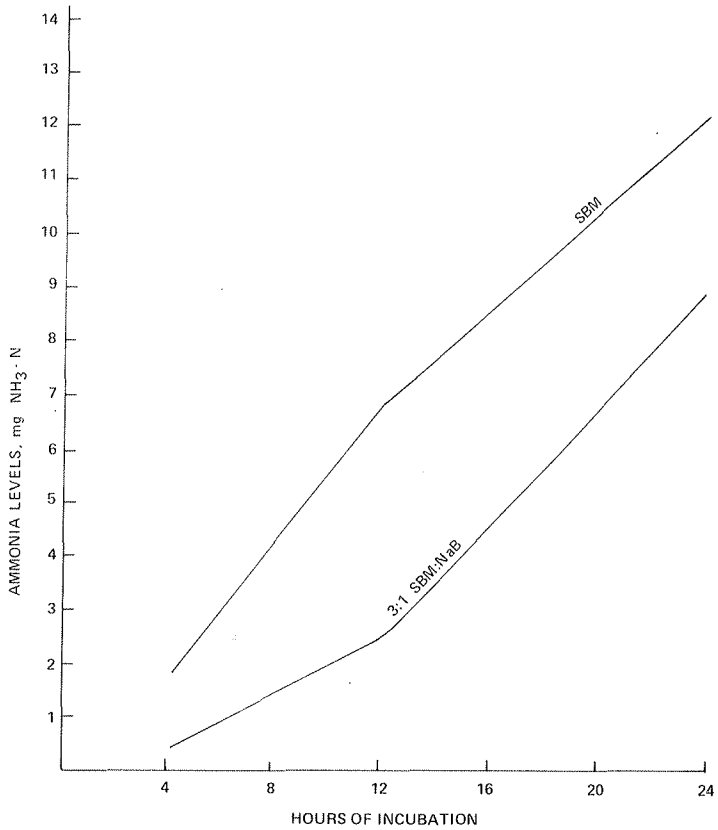


Figure 1. ***In vitro*** **ruminal ammonia release from SBM and SBM complexed with sodium bentonite (NaB).**

These results prompted evaluation of the complex in a nitrogen balance trial using six treatments (Table 1). SBM, urea or combinations of SBM and urea (each supplying half the supplemental nitrogen) were the three control treatments and were compared to the same treatments complexed with NaB.

The SBM treatments complexed with NaB showed increased nitrogen retention compared to untreated controls. This indicates that complexing SBM with NaB has a positive effect on nitrogen utilization in lambs. SBM was used more effectively than urea and the treatments in which half the supplemental nitrogen came from each were approximately intermediate betwen the two. Complexing urea with NaB did not have a beneficial effect on nitrogen utilization. Addition of NaB did not affect nitrogen digestibility except for an increase in the all SBM:NaB treatment.

A lamb growing trial was started to further evaluate the SBM:NaB complex. Control treatments were

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Table 1. Effect of complexing sodium bentonite (NaB) with soybean meal (SBM) and/or urea (U) on nitrogen utilization in lambs.

	Control			NaB[a]		
Item	Soybean meal	Urea	SBM + Urea	Soybean meal	Urea	SBM + Urea
Apparent N digestibility, percent	64.6[b]	61.43	65.40	70.89	61.44	65.34
N retention[c], percent	38.87	8.76	21.59	45.03	10.93	31.16
Apparent organic matter digestibility, percent	63.79	62.49	64.62	66.19	58.75	65.47

[a]NaB = Sodium Bentonite
[b]Data are the average of 8 sheep per treatment.
[c]N retention expressed as a percent of absorbed N.

Protein-Bentonite

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the same as those included in the nitrogen balance trial, but the NaB complexed urea was replaced by a second SBM:NaB complex (1.5 parts SBM to 1 part NaB) plus urea.

Lambs fed the SBM supplemented rations gained more rapidly and more efficiently than those supplemented with urea (Table 2). SBM complexed with NaB alone or in combination with urea performed at least equally to the SBM control. The SBM:NaB (3:1) plus urea performed equally to the all SBM supplemented control with only half the amount of preformed protein in the diet. This is equivalent to doubling the value of the SBM in these diets.

The SBM:NaB plus urea treatment with 1.5 parts of SBM to 1 part NaB did not perform as well as the 3 to 1 SBM:NaB plus urea. This might indicate that the 1.5 to 1 ratio reduces the availability of the SBM throughout the whole gut.

The last trial reported here was further evaluation of the SBM:NaB complex using growing steers (six animals per treatment) individually fed using electronic gates. Rations consisted of corn cobs supplemented with either SBM, urea, SBM plus urea (each supplying half the supplemental nitrogen) and SBM:NaB (3 to 1) plus urea.

Results (Table 3) show that SBM complexing with NaB has a beneficial effect on nitrogen utilization in steers. Gain and feed efficiency of steers fed SBM:NaB plus urea was better than the other half SBM and half urea treatment and not quite as good as the all SBM control.

The improvements in steer performance suggest more efficient use of SBM when complexed with NaB. These results plus those obtained with sheep, may indicate enhanced nitrogen utilization may be from increasing rumen bypass of complexed SBM. The increases in performance are large enough to warrant more research to characterize and define how to utilize the complex. The performance of the all SBM control was excellent for a ration of corn cobs and supplement. The urea supplemented calves did not consume the ration as well as the other rations and performance was reduced considerably.

The SBM:NaB complex was developed in our laboratory and is not available commercially. It is not known at this time if or when a commercial preparation will be made.

[1]Robert Britton is Asst. Prof., Ruminant Nutrition. Dan Colling is former graduate assistant. Terry Klopfenstein is Professor, Ruminant Nutrition.

Table 2. Effects of supplementing SBM complexed with NaB on growth and feed efficiency in lambs.

	Control			NaB[a]		
Item	Soybean Meal	Urea	Soybean meal + Urea	Soybean meal 3:1[b]	SBM + Urea 3:1	SBM + Urea 1.5:1
Total gain, lb[c]	24.22 (11.01)	17.65 (8.02)	22.48 (10.22)	27.48 (12.49)	24.31 (11.05)	23.98 (10.90)
Feed/gain	5.46	7.04	6.02	5.18	5.62	5.78

[a]NaB = sodium bentonite.
[b]Ratios of SBM to NaB.
[c]Average of six lambs per treatment; number in parenthesis expressed in kilograms.

Table 3. Evaluation of SBM complexed with NaB as a supplemental nitrogen source for growing steers.

Item	Soybean meal	Urea	SBM + Urea	SBM:NaB + Urea
Daily gain, lb[b]	2.69 (1.22)	1.09 (.50)	1.83 (.83)	2.25 (1.02)
Daily feed, lb	19.7 (9.0)	14.5 (6.6)	17.7 (8.1)	18.2 (8.3)
Feed/gain	7.31	16.18	9.95	8.43

[a]NaB = sodium bentonite.
[b]Average of six steers per treatment individually fed for 112 days; numbers in parenthesis expressed in kilograms.

A High By-pass Protein

Corn Gluten Meal

Lyle Petersen
Terry Klopfenstein[1]

Combinations of corn gluten meal (CGM) and urea are highly effective sources of supplemental protein for growing cattle. Slow breakdown of CGM protein in the rumen allows rumen microbes to more efficiently use ammonia nitrogen from urea than if a more rapid breakdown protein such as soybean meal (SBM) were fed. Much of the CGM protein bypasses rumen digestion and supplies protein directly to the small intestine.

Four cattle growth trials were conducted to evaluate different combinations and processing methods of CGM and urea in comparison with SBM.

In the first trial rations based on 80 percent corn husklage treated with 4 percent sodium hydroxide were supplemented with SBM, urea, or combinations of CGM and urea with either half or two-thirds of the supplementary protein equivalent coming from CGM and the remainder from urea. Steers fed 2/3 CGM:1/3 urea gained nearly as fast and as efficiently as steers fed SBM (Table 1). Cattle fed 1/2 CGM:1/2 urea gained somewhat slower but were as efficient as cattle fed 2/3 CGM:1/3 urea. Cattle fed urea had the least gain and were the least efficient.

In the second trial, the ration contained 65 percent ground corn cobs supplemented with SBM, urea or 2/3 CGM + 1/3 urea. Rations were balanced on metabolizable protein. Urea and CGM + urea rations contained 11 percent crude protein while SBM rations contained 14 percent crude protein. As inthe first trial, cattle fed CGM + urea performed nearly as good as those fed SBM (Table 2).

Table 1. Ratios of corn gluten meal and urea for growing calves.[a,b]

Treatment[c]	SBM	2/3 CGM: 1/3 urea	1/2 CGM: 1/2 urea	Urea
Daily gain, lb	1.36 (.62)	1.28 (.58)	1.17 (.53)	1.08 (.49)
Daily feed, lb[d]	14.2 (6.42)	13.1 (5.94)	13.2 (5.99)	14.4 (6.55)
Feed/gain	10.37	10.25	10.32	13.39

[a]Numbers in parenthesis expressed in kilograms.
[b]11 or 12 steers/treatment; fed 105 days; average initial weight 529 lb (240 kg).
[c]Rations balanced for 12 percent crude protein.
[d]Dry matter basis.

However, it appears that efficiency of natural protein utilization was much better for cattle fed CGM + urea combination than for SBM.

Combinations of CGM + urea and CGM + urea + SBM were compared with SBM or urea alone in Trial 3. In addition pelleted and extruded combinations of CGM and urea were compared with meal forms. Rations were based on 65 percent ground corn cobs. Protein was balanced at 10.5 percent to be slightly limiting. A 12 percent protein SBM control was also included. Cattle fed the SBM at 12 percent gained faster and more efficiently than those fed SBM at 10.5 percent. Cattle fed CGM-urea gained more rapidly and efficiently than those fed urea and as well as those fed SBM (10.5 percent). Gains were improved by pelleting but not by extrusion.

Because the amount of urea fed in these rations varied and therefore the amount of natural protein, the ratio of gain/protein in excess of that in the urea control was calculated. This should be a good indication of the efficiency of supplemental protein use. CGM protein was more efficiently used than SBM protein (.70 vs .29 and .39). The mixture of CGM and SBM was utilized as efficiently as CGM indicating a supplementary effect of the two protein sources.

Mixtures of CGM + urea, SBM + urea, and CGM + SBM + urea were used to supplement rations containing 40 percent corn silage and an equal amount of 4 percent sodium hydroxide treated corn cobs in the fourth trial. Each combination was fed in both meal and pellet form. In contrast to the previous trial, no consistent benefit due to pelleting was found (Table 4). Cattle fed CGM + urea performed slightly better than those fed SBM + urea, but the three-way combination was not as effective as either two-way combination.

Three of four trials showed a complementary effect of CGM and urea. Quality of protein in CGM which bypassed rumen digestion might be limiting calf performance. When soybean meal was fed with CGM + urea in Trial 3, a supplementary effect was observed. This, however, was not confirmed in Trial 4. A complementary effect of CGM and urea appears to exist but extent of the complementary effect and supplementary effect of SBM and CGM needs further research.

[1]Lyle Petersen is a research technician. Terry J. Klopfenstein is Professor, Ruminant Nutrition.

Table 2. Calf performance on corn gluten meal and urea (115 days).[a]

Treatment[b]	SBM	CGM + urea[c]	Urea
Daily gain, lb	1.64 (.75)	1.50 (.68)	1.14 (.52)
Daily feed, lb[d]	16.3 (7.4)	15.8 (7.2)	15.5 (7.0)
Feed/gain	9.94	10.53	13.60

[a]Numbers in parenthesis expressed in kilograms.
[b]Complete mixed rations contained 65 percent corn cobs, 8 percent molasses, vitamins, minerals and ground corn and protein source balanced to meet metabolizable protein requirements. Eight or nine head/treatment; average initial weight 451 pounds (205 kg).
[c]Two-thirds of supplementary protein from CGM, one-third from urea.
[d]Dry matter basis.

Table 3. Calf performance on mixtures of CGM, urea and SBM and pelleted and extruded mixtures of CGM + urea.[a,b]

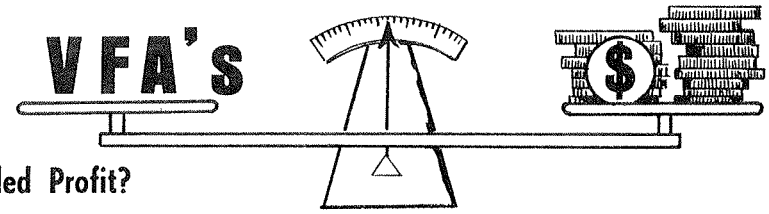
	Supplemental protein from urea, percent	Daily gain, lb	Feed/gain[f]	Added gain[g], lb	Added protein[g], lb	Gain/protein
SBM, 12 percent protein[c]	0	1.80 (.82)	9.2	.55 (.25)	1.41 (.64)	.39
SBM, 10.5 percent protein	0	1.58 (.72)	9.6	.33 (.15)	1.14 (.52)	.29
Urea	100	1.25 (.57)	12.3	–	–	–
CGM-urea, meal	50	1.61 (.73)	9.7	.33 (.15)	.46 (.21)	.70
CGM-urea, SBM	34	1.74 (.79)	9.0	.48 (.22)	.68 (.31)	.71
CGM-urea-pellet[d]	34	1.91 (.87)	8.1	.66 (.30)	.68 (.31)	.97
CGM-urea-extruded[d]-SBM	20	1.85 (.84)	9.0	.59 (.27)	.92 (.42)	.64
CGM-urea-extruded[e]-SBM	50	1.61 (.73)	9.5	.35 (.16)	.59 (.27)	.60

[a]Numbers in parenthesis expressed in kilograms.
[b]7 head individually fed rations based on 65 percent corn cobs for 105 days; average initial weight 518 lb (235 kg).
[c]Balanced to 12 percent protein, remaining rations balanced to 10.5 percent protein.
[d]90 percent CGM and 10 percent pelleted and extruded.
[e]70 percent CGM and 30 percent urea and extruded.
[f]Dry matter basis.
[g]Pound of gain and protein in excess of the urea control ration.

Table 4. Mixtures of CGM/Urea and CGM-SBM-urea in meal and pellet form for growing calves (113 days).[a]

Treatment	SBM	CGM + urea[b] Pellet	CGM + urea[b] Meal	SBM + urea[c] Pellet	SBM + urea[c] Meal	CGM + SBM + urea[d] Pellet	CGM + SBM + urea[d] Meal	Urea
No. animals	20	40	39	20	20	20	20	20
Daily gain, lb (kg)	2.00 (.91)	1.82 (.83)	1.87 (.85)	1.82 (.83)	1.77 (.80)	1.70 (.77)	1.69 (.77)	1.62 (.74)
Daily feed, lb[e] (kg)	19.2 (8.73)	18.1 (8.22)	18.1 (8.23)	18.4 (8.36)	17.8 (8.09)	17.8 (8.09)	17.8 (8.09)	18.2 (8.28)
Feed/gain	9.47	9.95	9.83	10.12	10.07	10.49	10.55	11.29

[a]On dry matter basis, rations were 40 percent corn silage, 40 percent corn cobs ensiled with 4 percent sodium hydroxide and 20 percent supplement containing vitamins, minerals, ground corn and protein source. Balanced for 11.5 percent crude protein. Average initial weight 505 lb (229 kg).
[b]Combined results of 90 percent CGM/10 percent urea and 80 percent CGM/20 percent urea.
[c]86 percent SBM/14 percent urea.
[d]Combination of 80 percent CGM/20 percent urea and 86 percent SBM/14 percent urea with equal amounts of protein from CGM and SBM.
[e]Dry matter basis.



Added Profit?

Volatile Fatty Acids

Michael J. Prokop[1]

Altering proportions of volatile fatty acids (VFA's) in the rumen can reduce the amount of feed required to produce a pound of beef.

Seventy percent of an animal's feed is converted to beef through a VFA intermediate. Microbial digestion in the rumen converts both hay and grain to VFA's principally acetic, propionic and butyric acids. VFA's enter the animal's blood stream and are used for growth and fattening.

In our experiments lambs fed a 95 percent chopped hay ration produced a total VFA concentration of 45 millimoles per liter of rumen fluid. The distribution was 78 percent acetic, 18 percent propionic and 4 percent butyric. Lambs fed a 60 percent ground corn ration produced 48 millimoles per liter of VFA, distributed as 66 percent acetic, 24 percent propionic and 10 percent butyric. Each type of ration produces a characteristic VFA distribution. High roughage rations produce high proportions of acetic acid. High concentrate rations, however, produce proportionately less acetic acid, and more propionic and butyric acid (Figure 1).

Efficient conversion of feed to red meat depends heavily on (1) the efficiency of VFA production from dietary carbohydrates and (2) the efficiency of animal tissue production from VFA's.

Each VFA is not produced with the same efficiency. If the starch in corn were completely converted to acetic acid, 37.8 percent of the original energy would be lost in forms not usable by the animal (Table 1). If only butyric acid was produced from the corn, 22.1 percent of the energy would be lost. Propionic acid production is a special process in which 9.1 percent more energy is available to the animal than the original corn carbohydrate contained. The added energy comes from the reutilization of rumen waste products in the process of propionic acid production.

Superimposing these energy recoveries upon the previous lamb data, we calculate a 10.9 percent increase in the recovery of usable energy from the concentrate ration compared to hay. This increased energy is due to the decreased production of acetic acid and the increased production of propionic and butyric acids.

The efficiency with which animal tissue is produced from VFA's is not clearly understood. Research literature suggests that each VFA is used with a specific efficiency when the acids are studied separately. However, when studied together, as the animal uses them, there appears to be no difference in the efficiency of utilization for production of animal tissue.

The main advantage in altering the proportions of VFA's is an increased recovery of usable energy. For the previous lamb data the increased efficiency of grain over hay is explained in terms of the increased energy savings to the animal. The challenge then is to alter the proportion of VFA's produced by either a hay or a grain ration and improve the efficiency of energy utilization. Can a change be effected in microbial fermentation which will produce more propionic acid and effectively increase the usable energy of rations? As with the lamb data, can the distribution of VFA's on any ration be altered to reduce the amount of feed required to produce gain by 10 percent.

Recent research has shown that altering VFA proportions is possible and can reduce the amount of feed required to produce gain. Examples of feed additives which can favorably alter the proportion of VFA's in the rumen are: monensin, amicloral and specialized antibiotics.

However, care must be taken in assessing the degree of improved feed efficiency obtained. The calculated energy savings due to a more favorable VFA distribution can be demonstated but this savings is only part of the animal's needs. In maximum production systems improved energy availability can be masked by imbalanced rations, disease, poor animal management and nutrient interactions not fully understood.

[1]Michael Prokop is Asst. Prof., Ruminant Nutrition.

Table 1. Energy return in VFA production.

VFA produced	% of energy usable	% of energy lost
Acetic	62.2	37.8
Butyric	77.9	22.1
Propionic	109.1	0

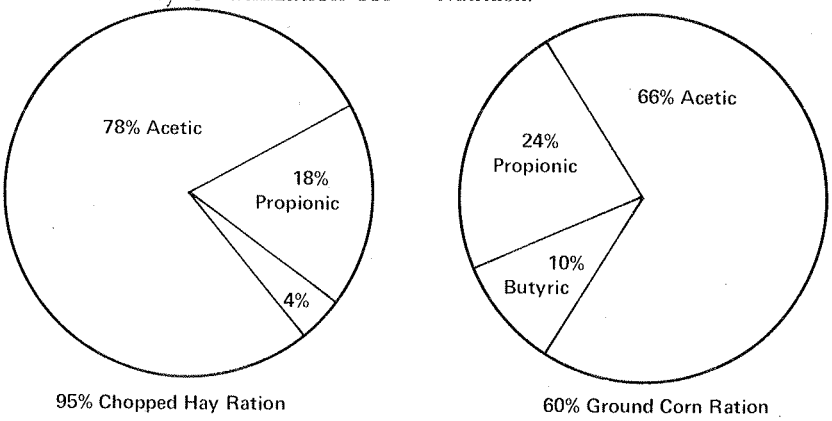


Figure 1. Distribution of VFA's in lamb rumen fluid.

Probiotics For Finishing Rations

Stanley D. Farlin[1]

Probios, a microbial product containing primary cultures of *Lactobacillus, Torulopsis* and *Aspergillus* oryzae failed to show any appreciable advantage when added to beef finishing rations in three trials.

Trial 1 involved feeding 30 Hereford and Angus yearling heifers weighing about 600 pounds (272 kg) for 150 days. The ration consisted of 85 percent rolled corn, 5 percent supplement and 10 percent cobs on a dry basis. Cattle were implanted with 36 mg Ralgro. Treatments included zero and five grams Probios per head per day. Heifers that received Probios gained 4.7 percent slower and 5.3 percent more efficiently than the controls (Table 1). Heifers that received five grams Probios had carcasses which graded slightly higher than controls even though carcass weights were somewhat lighter.

Table 1. The effect of feeding Probios to yearling heifers.[a,b]

Items	Level of Probios (g/day) 0	5
Initial wt., lb	613 (278)	592 (269)
Adj. daily gain[c], lb	2.60 (1.18)	2.48 (1.13)
Avg. daily feed (DM), lb	20.3 (9.22)	18.3 (8.32)
Feed/gain	7.83	7.39
Hot carcass wt., lb	622 (282)	598 (272)
Marbling[d]	12.93	13.53
USDA carcass grade[e]	11.7	12.3
Abscessed livers, percent	28.6	26.7

[a]Numbers in parentheses expressed in kilograms.
[b]Fourteen and 15 heifers per treatment; fed 150 days.
[c]Final weight adjusted to 62 percent dress from carcass weight.
[d]12 = small; 13 = small plus.
[e]11 = high good; 12 = low choice.

Trial 2 involved feeding 0, 2.5, 5.0 and 10.0 grams Probios per head per day to 96 mixed breed 670 pound (305 kg) yearling steers for 136 days. The steers were implanted with DES but were not fed antibiotics. Cattle were housed in a confinement barn with flush system providing about 22 square feet (2.0 square meters) per head.

The ration included 10 percent hay and 90 percent concentrate to provide 11 percent protein, .35 percent phosphorus and 40 percent calcium on a dry matter basis. The concentrate included whole shelled corn, a liquid protein supplement and a dry supplement fed at the rate of one pound (.45 kg) per head per day to provide the proper amount of Probios.

Results (Table 2) showed a 16.5 percent increase in feed consumption and a 4.5 percent faster gain with five grams Probios. However, feed efficiency was 11.6 percent poorer than the controls. The 2.5 and 10.0 gram level of Probios did not support performance equal to the control cattle. There was no appreciable effect on carcass measurements or incidence of abscessed livers.

Table 2. Effect of level of Probios in finishing rations.[a,b]

Items	Level of Probios (g/day) 0	2.5	5.0	10
Initial wt., lb	671 (305)	674 (306)	668 (303)	667 (303)
Adj. daily gain[c], lb	2.69 (1.22)	2.39 (1.09)	2.81 (1.28)	2.44 (1.11)
Avg. daily feed (DM), lb	18.1 (8.22)	18.1 (8.22)	21.1 (9.58)	18.2 (8.24)
Feed/gain	6.72	7.57	7.51	7.44
Hot carcass wt., lb	643 (292)	619 (281)	651 (296)	619 (281)
USDA carcass grade[d]	11.7	11.5	12.0	11.3
Yield grade	3.2	3.0	3.1	2.9
Abscessed livers, percent	16.7	12.5	12.5	20.8

[a]Numbers in parentheses expressed in kilograms.
[b]24 steers per treatment; fed 136 days.
[c]Final weight adjusted to a 62 percent dress from carcass weight.
[d]11 = high good; 12 = low choice.

Trial 3 compared zero and five grams of Probios when fed to 140 mixed breed yearling steers for 146 days. The steers were implanted with 36 mg Ralgro but received no antibiotic. The ration consisted of 85 percent high moisture corn (25 percent moisture), 10 percent hay and 5 percent supplement on a dry matter basis. The Probios was added in a dry supplement to provide about five grams per head per day. The ration was formulated to 11 percent protein, .4 percent calcium and .35 percent phosphorus.

Steers receiving Probios ate slightly more feed, gained slightly less and were slightly less efficient than control steers (Table 3). There was no appreciable effect on carcass measurements or average severity of liver abscess.

It can be concluded from these trials that five grams Probios per head per day does not enhance rate of gain [2.84 pounds (1.29 kg) vs. 2.86 pounds (1.3 kg) for control] or feed efficiency (7.50 vs. 7.22 for control) for high concentrate finishing rations fed to yearling cattle.

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[1]Stanley D. Farlin is Associate Professor, Beef Nutrition.

Table 3. The effect of feeding Probios to finishing yearling steers.[a,b]

Items	Level of Probios (g/day) 0	5
Initial wt., lb	751 (341)	746 (339)
Adj. daily gain[c], lb	2.16 (.98)	2.10 (.95)
Avg. daily feed (DM), lb	22.7 (10.30)	23.3 (10.57)
Feed/gain	10.50	11.09
Hot carcass, lb	661 (300)	653 (296)
USDA carcass grade[d]	12.4	12.4
Yield grade	3.6	3.5
Abscessed livers[e], percent	15.5 [.34]	25.0 [.44]

[a]Numbers in parentheses expressed in kilograms.
[b]71 and 68 steers per treatment; fed 146 days.
[c]Final weight adjusted to a 62 percent dress from carcass weight.
[d]11 = high good; 12 = low choice.
[e]Number in brackets denotes severity of abscess.

Waxy Corn For Beef Rations

Scott E. Brady
Stanley D. Farlin[1]

Isogenic waxy and normal corns in 90 percent concentrate rations caused no significant differences in daily gain, feed efficiency, feed intake or carcass measurements when fed to yearling steers.

Variety 1 of waxy corn and its normal dent counterpart grown at the same location were fed to yearling crossbred steers for 100 days. In Trial 1 the rations contained no supplemental protein. Protein content of the waxy corn was 11.75 percent and normal dent corn was 11.34 percent on a dry basis. Rations consisted of 10 percent chopped hay, 85 percent whole shelled corn and 5 percent supplement containing vitamins, minerals and antibiotic.

There were no differences (Table 1) in gain associated with type of corn. Although not statistically different waxy corn produced 2.7 percent more efficient gains. Cattle fed waxy corn consumed 3.5 percent less daily dry matter. Carcass measurements were not different.

A second variety of waxy corn and its normal dent counterpart grown in the same location were compared in rations supplemented with either soybean or urea to 12.5 percent protein in Trial 2. The rations consisted of 85 percent whole shelled corn, 10 percent chopped hay and 5 percent supplement. Antibiotic was fed at 70 mg per head per day. Rations were fed for 112 days to 192 Angus and Angus crossbreed yearling steers. No significant differences were observed between waxy and normal corn supplemented with either soybean meal or urea (Table 2). There was a small but consistent advantage when soybean meal was the source of supplemental protein.

Other tests have shown that lambs, if given a choice, will select waxy corn over normal corn. However, cattle in these trials did not consume more waxy corn than normal corn. These results indicate no real advantage for waxy corn over normal corn when used in high concentrate rations for yearling cattle.

[1]Scott E. Brady is former graduate assistant, now Loup County Extension Agent. Stanley D. Farlin is Associate Professor, Beef Nutrition.

Table 1. Effect of waxy corn in finishing rations.[a,b]

Items	Corn type: Waxy	Corn type: Normal
Initial wt., lb	647 (294)	642 (292)
Adj. daily gain[c], lb	2.64 (1.20)	2.66 (1.21)
Daily feed (DM), lb	18.0 (8.18)	18.7 (8.50)
Feed/gain	6.83	7.02
Carcass wt., lb	565 (257)	563 (256)
Quality grade[d]	10.7	10.7
Yield grade	2.9	2.7

[a]Numbers in parentheses expressed in kilograms.
[b]20 steers per treatment; fed 100 days.
[c]Final weight adjusted to 62 percent dress from carcass weight.
[d]10= good; 11 = high good.

Table 2. Effect of waxy and normal corn when supplemented with soybean meal or urea.[a,b]

Items	Waxy corn: Soybean meal	Waxy corn: Urea	Normal corn: Soybean meal	Normal corn: Urea
Initial wt., lb	781 (335)	744 (338)	755 (343)	755 (343)
Adj. daily gain[c], lb	2.69 (1.22)	2.71 (1.23)	2.63 (1.20)	2.50 (1.14)
Daily feed (DM), lb	25.5 (11.59)	25.5 (11.59)	25.3 (11.50)	25.3 (11.50)
Feed/gain	9.46	9.39	9.61	10.10
Carcass wt., lb	671 (305)	649 (295)	651 (296)	642 (292)
Quality grade[d]	12.3	11.8	11.9	12.4
Yield grade	3.4	3.0	3.0	3.2

[a]Numbers in parentheses expressed in kilograms.
[b]48 steers per treatment; fed 112 days.
[c]Final weight adjusted to 62 percent dress from carcass weight.
[d]11 = high good; 12 = low choice.

Probios for

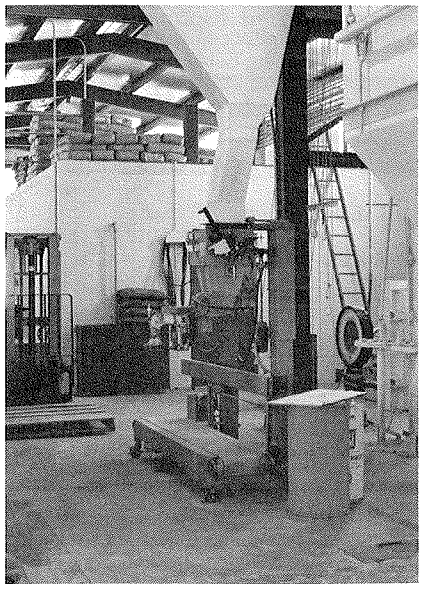
Vernon Krause
Stanley D. Farlin[1]

Results of three trials show no significant beneficial effects due to Probios treatments. Cattle gains, feed conversion, and numbers of cattle requiring antibiotic treatment were not improved due to Probios bolus or feed additive treatment.

It has been suggested that a microbial product, Probios, will reduce the stress effect of shipping on newly arrived cattle. Probios bolus and feed additive are intended to increase amounts of favorable bacteria in the digestive tract.

Three trials were conducted to evaluate Probios products. Upon arrival at the feedyards, cattle were vaccinated for IBR, BVD, 7-way clostridium, and leptospirosis.

At Mead, Angus X Brangus cattle were received from east Texas. Half of the cattle were given a bolus while the other half received a sham treatment. Within each bolus treatment, cattle were divided and fed rations either with or without the Probios feed additive. The additive was mixed with one pound of ground corn fed each steer per day. Cattle received hay initially, but were switched to



Feed mixing facilities used in formulating supplements.

r Stress in Newly Arrived Cattle

Table 1. Effect of Probios bolus and feed additive on performance of new cattle (Mead).

	No bolus			Bolus (32 gm)		
Feed additive, gm	0	10	Avg.	0	10	Avg.
No. of calves	95	79		90	85	
Avg. gain, lb (kg)[a]	39.58 (18.0)	37.69 (17.1)	38.64 (17.6)	40.84 (18.6)	40.32 (18.3)	40.58 (18.4)
Calves treated, %[b]	15.8	19.2		16.7	11.8	

[a]Calves weighing 430 lb (196 kg) fed 24 days.
[b]Treatment consisted of 30cc Terramycin or 15cc Pen-Strep.

silage over a two or three day period.

Average total gain of cattle that received the bolus was less than two pounds more than those not receiving the bolus (Table 1). Cattle fed Probios feed additive gained the same as cattle fed no additive.

Only a small number of cattle needed antibiotic treatment for respiratory disease. Neither bolus nor feed additive had any effect on the number of cattle needing treatment. However, number of cattle needing treatment from the group that received the combination of bolus and feed additive was slightly, though not significantly, less than cattle in other treatments.

Another trial at Northeast Station involved steer calves given a bolus or sham treatment at the purchase site in north central South Dakota. On arrival at Concord, cattle were weighed and given routine immunizations. Three Probios feed additive levels of 0.0, 2.5 and 5.0 grams per head per day were fed within each bolus treatment. Cattle were fed brome hay initially, then switched to corn silage.

Cattle given the 30 gram bolus gained slightly more, though not significantly, than steers given the sham treatment (Table 2). Bolus treatment did not affect the number of calves needing treatment for respiratory diseases.

Average steer gains were slightly, though not significantly ($P<.10$), improved with increased levels of Probios feed additive (Table 3). The number of antibiotic treatments required was slightly, though not significantly, reduced for cattle fed 5.0 grams of feed additive over steers fed either 0.0 or 2.5 grams of additive.

A third trial was conducted at Northeast Station to evaluate Probios bolus and feed additive. Gain and feed efficiency records were kept for 21 days, then cattle were placed on a growing experiment. Cattle receiving Probios treatments were randomly allotted to treatments in the growing experiment, but Probios treatment in the previous 21 day trial was also recorded. Weight gains of cattle according to Probios treatment were determined after the growing trial. Results of the first 21 day trial are shown in Table 4.

Gains and feed conversion of steers that received Probios bolus treatments were less than steers that received no bolus during the first 21 days. Probios feed additive appeared to improve gain and feed conversion in cattle that received no bolus, but depressed gain and feed conversion in steers that received the bolus.

Gains of the steers after 119 days are shown in Table 5.

Steers that received no bolus or feed additive had the fastest rate of gain, while steers that received the bolus and no feed additive had the lowest gain. Steers that received no bolus had greater gains than steers that were given a bolus.

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[1]Vernon Krause is District Extension Specialist, Animal Science. Stanley D. Farlin is Associate Professor, Beef Nutrition.

Table 2. Probios bolus for steer calves before shipping. (Northeast Station).

	No bolus	Bolus (30 gm)
Avg. daily gain, lb (kg)[a]	1.67 (.76)	1.84 (.84)
No. of antibiotic injections[b]		
Tylan	42	51
Liquimycin	91	101

[a]155 calves per treatment weighing 410 lb (186 kg) fed 21 days.
[b]Animals may have received more than one injection.

Table 3. Probios feed additive for steer calves (Northeast Station).

	gm/steer/day		
	0.0	2.5	5.0
Avg. daily gain, lb (kg)[a]	1.60 (.73)	1.75 (.80)	1.90 (.86)
No. antibiotic injections[b]			
Tylan	42 (3)	31 (1)	17 (0)
Liquimycin	70 (3)	80 (4)	48 (1)

[a]104 calves per treatment weighing 410 lb (186 kg) fed 21 days.
[b]Some cattle may have been treated more than once. Single numbers in parenthesis are steers receiving 4 or more injections.

Table 4. Effects of Probios bolus and feed additive for yearling steers at 21 days (Northeast Station).

	No bolus			30 gm bolus		
Gm feed additive	0.0	5.0	Avg.	0.0	5.0	Avg.
Avg. daily gain, lb (kg)[a]	2.40 (1.1)	2.84 (1.3)	2.62 (1.2)	2.43 (1.1)	1.83 (.83)	2.13 (.97)
Dry feed/gain	3.73	3.12	3.43	3.30	4.36	3.83

[a]Daily gain taken from unshrunk weights. 38 steers per treatment; initial weight 478 lb (217 kg).

Table 5. Gains of steers with and without Probios bolus and feed additive (Northeast Station).

	No bolus			30 gm bolus		
Feed additive, gm	0.0	5.0	Avg.	0.0	5.0	Avg.
Avg. daily gain, lb (kg)[a]	2.33 (1.1)	2.17 (.97)	2.25 (1.0)	2.03 (.92)	2.25 (1.0)	2.14 (.97)

[a]Combination of a 21 day trial and a 98 day growing trial. 38 steers per treatment; initial weight 478 lb (217 kg).

Bentonite for Finishing Rations

Stanley D. Farlin
Robert A. Britton
Greg Schindler[1]

No differences were noted in live weight gain, feed efficiency, carcass measurements or number of abscessed livers for cattle fed zero or 2.5 percent sodium bentonite in high moisture corn rations with zero or 12 percent corn silage. Roughage-fed cattle consumed more feed and had fewer and less severe abscessed livers than cattle fed an all-concentrate ration.

This study was designed to test whether sodium bentonite has a beneficial effect for cattle fed a high moisture corn-corn silage ration and whether it could substitute for roughage in a high moisture corn ration.

One hundred-ninety Hereford yearling steers were fed for 151 days on high moisture corn rations with either zero or 12 percent corn silage. The high moisture corn (about 26 percent) was stored ground in a bunker silo. Each level of corn silage was fed with zero and 2.5 percent sodium bentonite.

Cattle were implanted with Ralgro at the beginning of the trial and with Synovex-S midway through the trial. No antibiotics were fed. Cattle were brought up to the 12 percent corn silage level in 15 days. Cattle fed the zero roughage level were put on the all-concentrate ration at 20 days from start of the trial. There was a noticeable reduction in feed consumption the first few days after the cattle were switched to the all-concentrate ration.

Sodium bentonite had little effect on live or carcass measurements for finishing steers when added to either an all-concentrate high moisture corn ration or a high moisture ration containing 12 percent corn silage dry matter (Table 1). The only significant effect of sodium bentonite was a slightly lower dressing percent.

Steers fed the ration with 12 percent corn silage consumed more feed and had fewer abscessed livers than cattle fed the all-concentrate ration. The addition of sodium bentonite to the all-concentrate high moisture corn ration did not increase feed intake or reduce appreciably the incidence of abscessed livers. These observations indicate that sodium bentonite was not an effective substitute for roughage.

[1]Stanley D. Farlin is Associate Professor, Beef Nutrition. Robert A. Britton is Assistant Professor (Ruminant Biochemist). Greg Schindler is research technician.

Table 1. Effect of sodium bentonite on all-concentrate and 12 percent corn silage high moisture corn finishing rations.[a,b]

	Treatments			
Corn silage, percent	0		12	
Sodium bentonite, percent	0	2.5	0	2.5
Initial wt., lb	649 (295)	658 (299)	657 (299)	657 (299)
Adj. daily gain[c], lb	2.56 (1.16)	2.47 (1.12)	2.66 (1.21)	2.59 (1.18)
Avg. daily feed (DM), lb	17.1 (7.75)	16.8 (7.64)	19.2 (8.72)	19.3 (8.76)
Feed/gain	6.88	6.99	7.39	7.58
Dressing, percent	62.5	61.9	62.4	61.9
Carcass wt., lb	660 (300)	656 (298)	674 (306)	667 (303)
Quality grade[d]	11.4	11.7	11.4	11.2
Yield grade	3.2	3.0	2.9	3.1
Liver abscesses[e], percent	66.0 [1.34]	56.3 [1.02]	25.0 [.40]	21.3 [.50]

[a]Forty-seven or 48 steers per treatment fed 151 days.
[b]Numbers in parentheses expressed in kilograms.
[c]Final weight adjusted to 62 percent dress from carcass weight.
[d]11 = high good; 12 = low choice.
[e]Number in brackets is average severity of abscesses. Lower numbers indicate least severe abscesses.

Systems for Growing

P. Q. Guyer
D. C. Clanton[1]

Rate and efficiency of gain of steer calves fed different growing rations which caused a wide range in rate of gain for 112 days, and a finishing ration for 115 days were not appreciably different for the total combined period. Growth gains varied from 1 lb (.45 kg) to 2 lb (.9 kg) per head daily.

Calves continued on a fast growing program [2 lb (.9 kg)/head/day] for an additional 42 days, shortening the finishing period to 73 days, required more dry matter but less grain per unit of gain. Data indicate that variation in rate of gain during a relatively short growing period may have only slight influence on the final results of the two periods combined. Also, when cattle are fed a ration designed for relatively fast growth gains, delaying the date of switching to the finishing ration by 42 days has only a limited influence.

These suggestions resulted from research at the North Platte Station. Crossbred Angus-Hereford and a few Charolais x Angus-Hereford steer calves were used in a study of protein sources for growing calves (published in the 1976 Beef Cattle Progress Report).

Following completion of the protein evaluation, five lots of the calves were started on a finishing ration, while three others were continued on a growing ration for 42 days before the finishing ration was fed (Table 1).

Corn silage was the basal feedstuff for the growing ration. A mineral supplement was fed to all groups. One lot not fed supplement gained about 1 lb (.45 kg) per head daily. A second lot fed urea to the estimated urea fermentation potential (UFP) gained 1.6 lb (.73 kg) per head daily. Six other lots fed plant protein or plant protein plus urea gained 1.94 to 2.31 lb (.88 to 1.05 kg) per head daily. As gain increased performance became more efficient in terms of feed required and cost per unit of gain.

ng & Finishing Steers

For the finishing phase the two low gaining lots during the growing phase and a random selection of three of the six fast gaining lots during the growing phase were fed a high concentrate finishing ration until they were slaughtered. The other three fast growing lots of steers were continued on the growing ration for 42 days before being fed the finishing ration.

Steers making the slower gains during the growing period gained more rapidly and efficiently during the finishing phase, i.e., they compensated for their poorer nutrition during the growing phase.

Calves continued on the growing ration for an additional 42 days and fed a finishing ration only 73 days had reduced rate and efficiency of gain. Feed dry matter requirement was increased and gains would probably be more costly if corn silage price was based on price of grain it contained.

Study of the combined results shows that the compensatory gain during the finishing period largely overcame slower growth gains. Total feed per unit of gain was nearly the same except that steers fed an additional 42 days on a corn silage growing ration required more total dry matter because of lower ration energy content.

Except for the group with the slow growth gain, carcass weights and grades were similar. Steers with the slow growth produced lighter carcasses, lower quality grades and better yield grades. Had they completely caught up in live and carcass weight, their efficiency data might not have been quite as attractive as it appears.

More data of this type are needed for firm conclusions. But these preliminary data indicate that it may not be critical how calves are fed during the growing period before finishing as far as total economics are concerned because of the compensatory gain phenomena.

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Table 1. Methods of growing and finishing steer calves.[a]

Growing treatment	No protein		Urea to UFP[b]		Plant protein and/or urea			
Finishing treatment	Full fed 115 da.		Full fed 115 da.		Full fed 115 da.		Growing-additional 42 day. Full fed 73 da.	
	lb	(kg)	lb	(kg)	lb	(kg)	lb	(kg)
			Growing period[c]					
Number	10		10		30		30	
In weight	522	(237)	521	(236)	522	(237)	522	(237)
Final weight	633	(287)	700	(318)	748	(339)	766	(347)
Daily gain	.99	(.45)	1.60	(.73)	2.02	(.91)	2.18	(.99)
Daily feed	12.6	(5.7)	14.2	(6.4)	16.0	(7.2)	15.7	(7.1)
Feed/Gain[b]	12.73		8.91		7.93		7.24	
			Finishing period					
Final weight	1011	(459)	1053	(478)	1068	(484)	1044	(474)
Daily gain	3.31	(1.50)	3.10	(1.41)	2.80	(1.27)	2.44	(1.11)
Daily feed	18.7	(8.5)	19.5	(8.8)	18.7	(8.5)	19.6	(8.91)
Feed/Gain	5.65		6.29		6.70		8.08	
			Combined Period					
Daily gain[d]	2.15	(.98)	2.35	(1.07)	2.42	(1.10)	2.31	(1.05)
Feed/Gain								
Corn	3.75		3.38		3.16		2.00	
Corn silage	3.09		3.30		3.36		4.95	
Supplement	.41		.49		.69		.74	
Total	7.25		7.17		7.21		7.69	
Hot carcass wt.	627	(284)	653	(296)	662	(300)	647	(293)
Carcass grade[e]	11.3		11.7		11.6		11.7	
Yield grade	2.5		2.9		2.7		2.6	

[a]All feed expressed as dry matter; figures in parentheses are kilograms.
[b]UFP = Urea fermentation potential
[c]Fed 112 days in growth phase
[d]Adjusted to 62% dress
[e]11 = High good; 12 = Low choice (old grading system)

Worming Steers On Grass

R. G. White
D. L. Ferguson
J. T. Nichols
D. C. Clanton[1]

Most cattle in Nebraska have some internal parasites, but the degree of infestation will vary with age, degree of exposure, and environment. The degree of infestation determines whether it pays to worm cattle under each set of conditions encountered.

This study was designed to determine if maintaining cattle relatively worm-free with an anthelmintic would increase weight gain.

Two separate experiments were conducted on different forage types: irrigated pasture and native sandhills range. In the first experiment, 120 Hereford yearling steers with a similar genetic background were weighed and allotted to 10 groups. Fecal samples were collected and half the calves from each group were wormed with 43% thiabendazole cattle wormer paste at the rate of 7.5 grams of thiabendazole for each 250 pounds (113.4 kg) of body weight. These groups were randomly assigned to 10 different irrigated grass pastures.

In the second experiment, 71 steers were weighed and allotted into six groups. Fecal samples were collected and half of each group wormed as in the first experiment.

(continued on next page)

Worming Steers on Grass

(continued from page 17)

These groups were randomly assigned to six different native grass pastures.

Steers in both experiments were weighed, fecal samples collected, and wormed at 28-day intervals throughout the grazing period. The last weigh period was 38 days for cattle on the native grass.

Average steer weight and worm eggs per gram of feces (EPG) at the 28-day intervals are shown in Tables 1 and 2.

There was no difference in weight gains of the two groups on either experiment.

The EPG counts were low in both groups of cattle. These counts are about typical of cattle in western Nebraska range areas. The anthelmintic treatment reduced the EPG counts in the treated steers. The EPG counts increased in cattle on the irrigated grass but not to a point where treatment would pay during the grazing period.

Numerous coccidia were noted in the feces throughout the study; however, no clinical cases of coccidiosis were observed.

Fecal egg counts are not the answer for determination of parasite infestation; however, they are the only tool available outside of a postmortem examination to give some idea of the degree of internal parasite infestation.

Fecal egg counts, when used with a clinical evaluation, will give an estimate of parasite infestation and are a useful tool for determining if a worming program is necessary. Because feed intake could not be evaluated under the existing circumstances of these studies, feed conversion could not be evaluated.

Animal age has some influence on the degree of parasite infestation. In general, older animals develop some resistance to internal parasites, while younger animals may not have this resistance. Animals in these studies were of an age when infestation should have been at its maximum.

Fecal worm egg counts should be checked on 20 samples or 10% of the herd before the determination is made to buy worm medication.

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[1]R. G. White is Associate Professor (Veterinary Science). D. L. Ferguson is Professor (Veterinary Science). J. T. Nichols is Professor of Agronomy (Range and Forage). D. C. Clanton is Professor, Animal Science (Beef).

Table 1. Average steer weight and worm eggs per gram of feces (EPG) of steers on irrigated grass (133 days).

	TBZ treated			Controls		
	Avg. wt. lb	kg	EPG	Avg. wt. lb	kg	EPG
April	455	(206.4)	26	456	(206.8)	20.3
May	516	(234.1)	1.7	516	(234.1)	15.9
June	565	(256.4)	2.1	565	(256.4)	24.6
July	589	(267.3)	9.2	590	(267.7)	44.3
August	618	(280.5)	9.2	621	(281.8)	45.1
September	649	(294.5)	1.3	655	(297.3)	31.7
Average gain	194.4	(88.2)		199.5	(90.5)	
Average daily gain	1.46	(.66)		1.50	(.68)	

Table 2. Average steer weight and worm eggs per gram of feces (EPG) of steers on native grass (122 days).

	TBZ treated			Controls		
	Avg. wt. lb	kg	EPG	Avg. wt. lb	kg	EPG
May	492	(223.2)	51.4	494	(224.1)	69.9
June	567	(257.3)	2.4	568	(257.7)	26.6
July	628	(285.0)	1.4	626	(284.1)	17.8
August	660	(299.5)	1.3	651	(295.5)	14.8
October	720	(326.6)	.6	718	(325.9)	14.9
Average gain	226.4	(102.7)		224.4	(101.8)	
Average daily gain	1.86	(.84)		1.84	(.83)	

Grazing Systems and Range Fertilization

J. Stubbendieck[1]

Rotation grazing systems on the Panhandle Experimental Range increased beef production by as much as 20% and improved range condition. Fertilized range produced up to 51% increase in gain per acre (ha) compared to unfertilized range.

Vegetation under fertilization changed to predominantly cool season grasses with an invasion of broadleaf weeds. Steers on the continuous-fertilized range utilized the weeds more completely than on the rotation-fertilized range.

Rotation grazing systems pay, but feasibility of annual fertilization of rangeland in this precipitation zone is questionable because of vegetation changes and fertilizer cost.

Many techniques are used to increase beef production on rangeland. However, no range livestock operation can obtain maximum production without a grazing system. To develop a grazing system it is necessary to divide the range into units.

Generally, existing pastures can accommodate a grazing system on a ranch unit. Each pasture is systematically grazed for a certain period and then allowed to rest. This provides at least as much grazing as before and, at the same time, improves vegetation and soil cover.

Concentration of more livestock on a given area forces them to use plants and areas of the range that previously received little or no grazing. This provides use of both undesirable and desirable plants and tends to equalize the grazing stress for all plants throughout the pasture.

A good system allows range plants to recover from close grazing, regain vigor and build up food reserves. Therefore, greater forage production can be obtained from most range plants by grazing, rather than by allowing complete rest.

Using fertilizer is one method often proposed to increase range production. This is not a new concept, but the amount of research on range fertilization has been meager. Livestock production per unit of land is relatively low, and even substantial increases in forage production due to fertilization may not give a favorable economic return. Most range improvement practices should be designed to improve forage production and range condition over a period of several years; however, fertilization has the potential to greatly increase forage and beef production during the first growing season.

An experiment was started in 1969 and ended in 1976 to determine effects of a combination of grazing systems and range fertilization. The study was conducted at the Panhandle Experimemtal Range (PER) located in southern Sioux County, about 12 miles (19 km) northwest of Scottsbluff. Average annual precipitation is 13 inches (330 mm).

The soil is Valentine fine sand on gently rolling slopes and is unique in that a greater percentage of the soil separates is in the fine sand and very fine fractions than is found in the Valentine sand found in central Nebraska. Thus, the soil can retain more water than that of the sandhills.

Table 1. Effect of grazing systems and fertilization on beef production (eight-year average).[a]

System	Nitrogen lbs/acre	Nitrogen (kg/ha)	Stocking rate A/steer	Stocking rate AUM/A	Average gain Animal lb	Average gain Day lb	Average gain Acre lb
Continuous	0		6.2	0.56	203 (92.1)	1.68 (.76)	33.2 (15.1)
Continuous (Fert.)	30	(33.6)	4.5	0.78	222 (100.7)	1.81 (.82)	50.1 (22.7)
Rotation	0		5.6	0.62	195 (88.4)	1.61 (.73)	35.3 (16.0)
Rotation (Fert.)	30	(33.6)	5.2	0.67	213 (96.6)	1.78 (.81)	44.3 (20.1)
Complex rotation	0		5.8	0.60	195 (88.4)	1.62 (.74)	35.3 (16.0)
Complex rotation	0		5.3	0.66	208 (94.4)	1.73 (.78)	39.8 (18.1)

[a]Data in parentheses are kilograms.

Blue grama, prairie sandreed and needleandthread were a major part of the total vegetation. Sand bluestem was of minor importance.

Six grazing systems were used with yearling steers from May 15 until September 15. Two continuous systems (one unfertilized and one fertilized; Fig. 1a) were each composed of one pasture. Steers remained on these pastures throughout the grazing season.

Two rotational systems (one unfertilized and one fertilized; Fig. 1b) were composed of a set of four pastures of nearly equal size where each pasture was grazed once during the season. Two complex rotational systems (one in good range condition and one in much lower range condition; Fig. 1c) were also composed of four pastures of nearly equal size. For each of these systems the grazing season was divided into six periods. Two pastures were grazed simultaneously during the first period. This was designed to make more forage available to the animals when forage availability generally is limited. A systematic rotation followed this first period. Three of the four pastures were grazed twice during the season. The grazing sequence was changed each year in the rotational and complex rotational systems.

Thirty pounds per acre (33.6 kg/ha) of nitrogen (from ammonium nitrate) were applied in March each year to the fertilized pastures. In addition, these pastures were fertilized with 100 pounds of phosphorus per acre at the beginning of the experiment.

On May 15, each year after a 10-day adjustment period, yearling steers weighing about 575 lb (261 kg) were allotted to pastures according to weight, breed and previous wintering trials. Stocking rates were adjusted each year according to level of utilization during the previous season and soil moisture conditions.

Grazing intensity, expressed as stocking rate, on continuous-unfertilized was maintained at a moderate level throughout the eight-year experiment.

Steers on this pasture produced 33 pounds (15 kg) of gain per acre (Table 1). Rotation-unfertilized and complex rotation-low range condition each produced 35 pounds (16 kg) of beef per acre. This level of production was over 6% greater than continuous-unfertilized, even though beginning range condition in these systems was much lower than in the continuous-unfertilized range. Beef production from complex rotation-good condition-unfertilized was 40 pounds (18 kg) per acre—20% higher than from continuous-unfertilized which was in similar range condition at the beginning. Range condition of continuous-unfertilized remained stable, but improved significantly in

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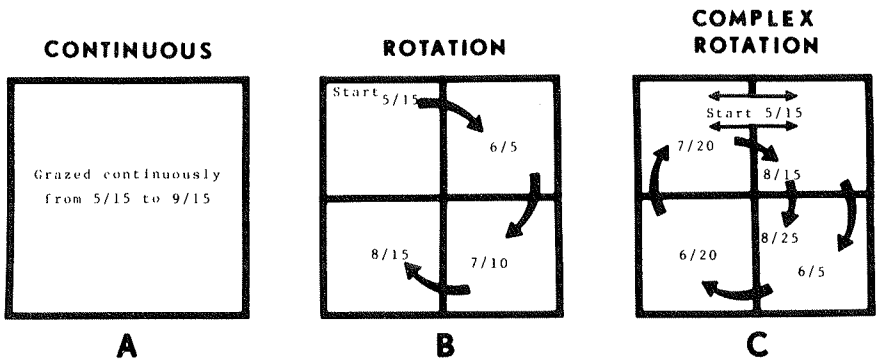


Figure 1. Diagram of grazing systems used on the Panhandle Experimental Range. All systems were grazed from 5-15 to 9-15, and dates in diagram B and C indicate approximate beginning grazing dates for each pasture.

Grazing Systems . . .

(continued from page 19)

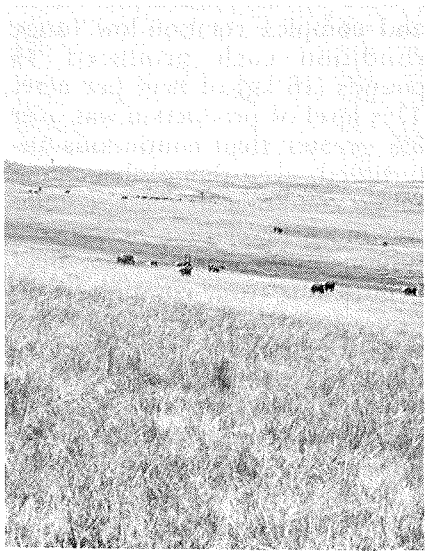
all rotation systems over the eight-year period.

Rotation-fertilized and continuous-fertilized produced more pounds of beef per acre than unfertilized range, 33 and 51% respectively.

Rotation-fertilized did not produce as much beef as continuous-fertilized. Fertilizer caused a species composition shift from a mixture of cool season and warm season grasses to predominately cool season grasses under both fertilized systems.

Broadleaf weeds (lambsquarters, sunflowers and Russian thistle) also were stimulated by the fertilizer. Steers were able to utilize these plants throughout the continuously grazed pasture early in the grazing season. These weeds in rotation pastures, other than the first pasture in the grazing sequence, were less palatable due to maturity and were only lightly utilized. Previous research on the PER has shown that up to 60% of early and mid-spring consumption was composed of broadleaf weeds.

[1]J. Stubbendick is District Range Management Specialist.



Cattle on Nebraska rangeland.

Post-Calving Supplements

Methionine Hydroxy Analog

D. C. Clanton[1]

Results of three experiments indicate that methionine hydroxy analog (MHA) in the supplement fed to cows between calving and breeding has little effect on the weight performance of the cows or calves. In the case of nutritionally stressed cows there may be a benefit in reproductive performance.

Research at the USDA Range Livestock Research Station, Miles City, Montana in the early 1970's indicated a desirable effect in terms of milk production and weaning weights from feeding small amounts of MHA to the cows. Methionine is an essential amino acid which can be synthesized in the rumen, thus has not been considered necessary in supplements for ruminants.

Three experiments have been completed at the University of Nebraska Sandhills Agricultural Laboratory to evaluate MHA in supplements fed to cows from calving until breeding.

In the first experiment (1974) 6 groups of 25 mature Hereford cows were placed in 6 similar pastures. Assignment was on the basis of calving date within each age group, so that the average age of the calves during the supplementation period (51 days) was similar in each pasture.

Six supplements (Table 1) were fed at the rate of 3 pounds (1.36 kg) per head per day. Four corn-based supplements contained 13.3 percent protein. Two soybean meal-based supplements contained 20.4 percent protein. Because soybean meal is a good source of methionine and corn is not, higher levels of MHA were used with the corn-based supplements.

No significant difference was observed due to feeding varying levels of MHA (Table 1). Cows fed the 20 percent protein supplement and their calves gained more during the supplemental period than those fed the 13 percent protein supplement (Table 1).

In the second and third experiments conducted in 1975 and 1976, respectively, only one level of protein was used with six levels of MHA (Table 2). The number of cows per treatment was reduced

Table 1. The effect of feeding different levels of methionine hydroxy analog (MHA) on the performance of cows and calves (1974).

	Corn and MHA grams/day				Soybean meal and MHA grams/day	
	0	5	10	15	0	5
Cow avg. daily gain, lb (kg)						
Calving to May 15	.53	.58	.24	.32	.91	.80
	(.24)	(.26)	(.11)	(.15)	(.41)	(.36)
Calving to Sept 20	.26	.24	.27	.27	.25	.25
	(.12)	(.11)	(.12)	(.12)	(.11)	(.11)
Calf avg. daily gain, lb (kg)						
Calving to May 17	1.43	1.63	1.46	1.25	1.71	1.59
	(.65)	(.74)	(.66)	(.57)	(.78)	(.72)
Calving to Sept 20	1.82	1.88	1.85	1.66	1.83	1.81
	(.83)	(.85)	(.84)	(.75)	(.83)	(.82)
205 day adj weaning wt, lb (kg)	468	483	472	429	468	465
	(212)	(219)	(214)	(195)	(212)	(211)
Reproductive performance						
Heat cycles 1st 21 days breeding season, %	76	82	80	92	79	72
Settled, %						
AI[a]	80	67	80	65	67	68
Clean up bull	8	25	0	15	12	16
Open, %[b]	12	8	20	20	21	16

[a]The breeding season consisted of 30 days of artificial insemination followed by 20 days with clean up bulls.
[b]Based on October, 1974 palpation for pregnancy.

Table 2. The effect of feeding different levels of methionine hydroxy analog (MHA) on the performance of cows and calves (1975).

	MHA levels grams/day					
	0	2	4	6	8	10
Cow avg. daily gain, lb (kg)						
Calving to May 30	.44	.32	.16	.13	.58	.54
	(.20)	(.15)	(.07)	(.06)	(.26)	(.24)
Calving to Sept 29	.88	.75	.69	.69	.87	.81
	(.40)	(.34)	(.31)	(.31)	(.39)	(.37)
Calf avg. daily gain, lb (kg)						
Calving to May 30	1.81	1.81	1.87	1.74	1.84	1.81
	(.82)	(.82)	(.85)	(.79)	(.83)	(.82)
Calving to Sept 29	1.79	1.88	1.90	1.86	1.97	1.85
	(.81)	(.85)	(.86)	(.84)	(.89)	(.84)
205 day adj weaning wt, lb (kg)	488	490	493	488	515	468
	(221)	(222)	(224)	(221)	(234)	(212)
Reproductive performance						
Heat cycle 1st 21 days breeding season, %	93	86	93	79	86	85
Settled, %						
AI[a]	93	93	60	93	86	85
Clean up bull	0	7	20	7	14	7
Open, %[b]	7	0	20	0	0	8

[a]The breeding season consisted of 30 days of artificial insemination followed by 20 days with clean up bulls.
[b]Based on October, 1975 palpation for pregnancy.

and the number of days on the supplements was increased. Ninety Angus-Hereford cross 4-and 5-year-old cows were used in 1975 and 90 mature Hereford and 3-year-old Angus-Hereford cross cows were used in 1976. The average number of days during the supplementation period was 54 and 57 in 1975 and 1976, respectively.

Results of the second and third experiments show no beneficial effect from MHA in terms of weight changes of either the cows or calves (Tables 2 and 3). The cows in the third experiment were stressed nutritionally more before and following calving than those in the previous two experiments. In the third experiment there was a significant improvement in the reproductive performance of the cows fed the higher levels of MHA (Table 3). There was no difference in the previous two experiments (Tables 1 and 2).

[1]D. C. Clanton is Professor, Animal Science (Beef).

Table 3. The effect of feeding different levels of methionine hydroxy analog (MHA) on the performance of cows and calves (1976).

	MHA levels grams/day					
	0	2	4	6	8	10
Cow avg. daily gain, lb (kg)						
Calving to May 29	−.30	−.16	−.07	−.25	−.15	−.37
	(−.14)	(−.07)	(−.03)	(−.11)	(−.07)	(−.17)
Calving to Sept 28	.73	.84	.82	.78	.72	.78
	(.33)	(.38)	(.37)	(.35)	(.33)	(.35)
Calf avg. daily gain, lb (kg)						
Calving to May 29	1.55	1.62	1.50	1.62	1.69	1.71
	(.70)	(.73)	(.68)	(.73)	(.77)	(.78)
Calving to Sept 28	1.82	1.84	1.69	1.84	1.87	1.83
	(.83)	(.83)	(.77)	(.83)	(.85)	(.83)
205 day adj weaning wt., lb (kg)	486	483	477	482	499	481
	(220)	(219)	(216)	(219)	(226)	(218)
Reproductive performance						
Heat cycles 1st 21 days breeding season, %	69	50	57	67	81	81
Settled, %						
AI[a]	69	37.5	64	60	81	81
Clean up bull	19	25	36	13	13	13
Open, %[b]	12	37.5	0	27	6	6

[a]The breeding season consisted of 30 days of artificial insemination followed by 30 days with clean up bulls.
[b]Based on October, 1976 palpation for pregnancy.

Cow Utilization Of Crop Residues

John K. Ward
Dennis Lamm
John Schmitz
Gary White
Monte Stauffer[1]

Eleven corn stalk and three grain sorghum stubble winter grazing trials have been conducted over the past five years at the University Field Laboratory at Mead, Nebraska. With a stocking rate of about two acres per cow and an average winter grazing period of 88 days, average weight change of gestating beef cows was .68 lb (.31 kg) per day. Daily weight change of −.3 (−.14) to 1.47 lb (.67 kg) was observed in groups of cows receiving .5 lb (.23 kg) of supplemental crude protein (CP) from soybean meal (SBM).

In winter drylot trials, stacked corn stalks supported weight change of approximately .6 lb (.27 kg) per day. A drylot summer trial involving stacked corn stalks or grain sorghum stalks and 4 lb (1.8 kg) of corn per head daily with protein supplementation failed to maintain lactating cow weight.

Grazing

A total of 328 gestating dry spring calving cows were used on 28 different treatments involving corn stalk grazing over the period

(continued on next page)

Table 1. Days of winter grazing and snow accumulation at Mead, Nebraska.

Year	Avg. days of continuous grazing	Avg. snow accumulation during grazing
		inches (cm)
1971–72	111	Not available
1972–73	73	Not available
1973–74	65	1.81 (4.53)
1974–75	86	3.84 (9.60)
1975–76	105	.08 (0.20)
Avg.	88	——

Crop Residues . . .

(continued from page 21)

from 1970–71 to 1975–76. Cows were allotted about two acres (.8 ha) per head with grazing periods varying from 63 to 111 days depending on weather and forage availability (Table 1).

Grazing began as soon after harvest as possible and lasted until forage availability was severely reduced or snow cover prevented effective grazing. The average starting date for grazing trials was November 10 with a range of October 17 to December 19. The average termination date was February 4 with a range of January 14 to March 2.

Snow cover was extremely variable between and within grazing seasons with an average accumulation within season from .08 (.2 cm) to 3.84 inches (9.6 cm). Weather, particularly deep snow cover, was undoubtedly the single most important factor in successful winter grazing of corn or grain sorghum stalks. Protein, energy, phosphorus and vitamin A may be limiting factors in the performance of cows winter grazing crop residues.

Research reported in this paper will relate primarily to protein sources and levels as they affect cow performance on crop residues. In Tables 2 and 3 the effect of no protein supplementation compared to .4 (.18 kg) or .5 lb (.23 kg) of protein equivalent from SBM, urea, biuret and dehydrated poultry waste (DPW) is shown.

In both trials a corn cube was used as one treatment to compare with SBM on the basis of equal energy. Weight change shown in Table 2 ranged from .75 lb (.34 kg) on no supplementation to .99 lb (.45 kg) daily on SBM with urea and biuret ranging from .76 lb (.35 kg) to .83 lb (.38 kg) daily. Comparable response to source of nitrogen can be seen in Table 3 with no supplementation and SBM supporting .99 lb (.45 kg) and 1.47 lb (.67 kg) daily weight change, respectively.

Data reported in Table 4 show a significant response to level of protein in trials involving SBM and biuret fed at about 1/4 (.11 kg) and 1/2 lb (.23 kg) CPE daily. Supplements were self-fed using salt to control intake. Difficulty was experienced within and between trials in effectively controlling supplement intake. Although snow accumulation was below normal during Trial 2, a severe mud problem made grazing difficult and may have been partially responsible for lower winter gains.

Gestating yearling heifers were provided supplemental protein from three sources (liquid, SBM and alfalfa hay) at either half or all of their protein requirement levels (Table 5). Performance tended to be higher when the protein was from either SBM or alfalfa hay rather than from liquid supplement.

Cows grazing grain sorghum stubble gained significantly more when supplemented with .5 lb (.23 kg) CP from SBM (Table 6). In a subsequent trial using a corn cube to equalize energy intake as compared to SBM, the difference in weight change was reduced. It is possible that grain sorghum stubble may be adequate in protein and that cows may respond as well

Table 4. Performance of dry pregnant cows self fed protein supplements while winter grazing corns stalks.[a]

	Supplements			
	Low CP level		Moderate CP level	
	SBM	Biuret	SBM	SBM and Biuret
Trial 1 (12-19-72 to 3-2-73)				
No. of cows (4-yr-olds)	15	15	15	15
Supplemental CP daily lb	.18 (.08)	.18 (.08)	.33 (.15)	.46 (.21)
Avg. daily wt. change lb[b]	.51 (.23)	.62 (.28)	1.01 (.46)	.89 (.40)
Avg. final wt. lb	952 (433)	948 (431)	991 (450)	981 (446)
Trial 2 (11-28-73 to 2-7-74)				
No. of cows (5-yr-olds)	14	15	15	15
Supplemental CP daily lb	.15 (.07)	.26 (.12)	.46 (.21)	.73 (.33)
Avg. daily wt. change lb[c]	−.30 (−.14)	−.42 (−.19)	−.03 (−.01)	−.14 (−.06)
Avg. final wt. lb	1028 (467)	1019 (463)	1047 (476)	1039 (472)

[a]Numbers in parentheses are expressed in kilograms.
[b]¼ lb (.11 kg) vs ½ lb (.23 kg) level (P<.01).
[c]¼ lb (.11 kg) vs ½ lb (.23 kg) level (P<.05).

Table 2. Effect of level and source of nitrogen on 3-year-old cows winter grazing corn stalks (11-11-71 to 2-2-72).[a]

	Treatments			
	1	2	3	4
Variables	Corn	Soybean meal	7.5% Urea	9.2% Biuret
No. of cows	10	10	20	20
Supplemental C.P.E. daily lb	.09 (.04)	.40 (.18)	.40 (.18)	.40 (.18)
NPN in supplement (%)	0.00	0.00	52.5	52.5
Avg. daily wt. change lb	.75 (.34)	.99 (.45)	.76 (.35)	.83 (.38)
Avg. final wt. lb	893 (406)	898 (408)	892 (405)	912 (415)

[a]Numbers in parentheses are expressed in kilograms.

Table 3. Effect of nitrogen source on cows grazing corn stalks (10-23-74 to 1-17-75).[a]

	T_1 Control	T_2 Corn	T_3 SBM	T_4 DPW	T_5 Liquid
No. of cows	10	10	10	10	10
Daily supplemental C.P.E. lb	0	.13 (.06)	.51 (.23)	.51 (.23)	.59 (.27)
Avg. daily wt. change lb[b]	.99 (.45)	1.06 (.48)	1.47 (.67)	1.19 (.54)	1.08 (.49)

[a]Numbers in parentheses are expressed in kilograms.
[b]T_1 vs T_2, T_3, T_4, T_5 (P<.05)
T_5 vs T_3, T_4 (P<.05)
T_3 vs T_4 (P<.05)

to energy supplementation as to protein. In trials comparing corn stalks with grain sorghum stubble, it was observed that during heavy snow accumulation sorghum stubble stays more erect allowing more effective grazing.

Data indicate that mature dry pregnant cows winter grazing either corn stalks or grain sorghum stubble will show a weight change of about .5 lb (.23 kg) daily for 65–100 days. Bad weather can severely reduce days of grazing and cow performance. Supplying .5 lb (.23 kg) of supplemental natural protein daily can increase gains by about .2 lb (.09 kg) to approximately .7 lb (.32 kg). The feeding of .5 lb (.23 kg) of CPE from a nonprotein nitrogen (NPN) source will increase weight change from .5 (.28) to approximately .6 lb (.27 kg) daily.

Drylot

Corn stalks stacked with a Hesston Stackhand 30-A were used as wintering forage for dry pregnant cows. Weight change shown for Trials 1 and 2 in Table 7 range from .26 (.12) to .90 lb (.41 kg) daily. Cows used in Trial 2 previously had grazed corn stalks for 65 days which may have accounted for their lower performance in drylot than for cows used in Trial 1. Stacks averaged 4,510 lb (2045 kg) with a dry matter content of 77.7 percent. Disappearance of stacked material fed with feeding panels around the stacks was about 26 lbs (11.8 kg) daily. Wastage may have been as high as 10–20 percent of material fed.

In Trial 3 (Table 7) lactating cows receiving stacked forage, four pounds (1.8 kg) of corn and protein supplement lost more than one pound (.45 kg) per day. It apparently would be necessary to feed six to eight pounds (2.7 to 3.6 kg) of corn daily to provide sufficient energy for lactating cows on stacked stalks.

Summary

1. Weight change on dry pregnant cows grazing or fed harvested corn or grain sorghum residue will

(continued on next page)

Table 5. Effect of protein level and source on performance of pregnant yearling heifers winter grazing corn stalks (10-21-75 to 1-14-76).[a]

	Protein source		
	Liquid supplement free choice	Soybean meal	Alfalfa hay
Trial 1 .46 lb (.21 kg) CP			
No. of heifers	12	12	12
Supplemental CP lb	.50 (.23)	.46 (.21)	.46 (.21)
Avg. daily wt. change lb	.71 (.32)	.73 (.33)	1.03 (.47)
Avg. final wt. lb	837 (380)	865 (393)	898 (408)
Trial 2 .92 lb (.42 kg) CP			
No. of heifers	12	12	11
Supplemental CP lb	.67 (.30)	.92 (.42)	.92 (.42)
Avg. daily wt. change lb	.65 (.30)	.89 (.40)	.93 (.42)
Avg. final wt. lb	863 (392)	867 (394)	864 (393)
Avg. daily wt. change by protein source lb	.68 (.31)	.81 (.37)	.98 (.45)

[a]Numbers in parentheses are expressed in kilograms.

Table 6. Daily weight change lb for dry mature pregnant cows (22/treatment/trial) grazing grain sorghum stalks.[a]

		Daily protein supplementation	
	No supplement	Corn cube .13 lb (.06) CP	SBM .51 lb (.23) CP
Trial 1 86 days (11-19-74 to 2-13-75)	.22 (.10)[b]	–	.49 (.22)[c]
Trial 2 105 days (10-21-75 to 2-4-76)	–	.59 (.27)[b]	.68 (.31)[b]

[a]Numbers in parentheses are expressed in kilograms.
[b,c]Trials means with different superscripts differ (P<.05).

Table 7. Performance of cows in drylot on corn stalk and/or grain sorghum stalk stacks.[a]

	Supplements			
	None	Corn	SBM	Liquid
Trial 1. (75 days on corn stalk stacks)				
No. of cows (mature dry Herefords)	5	5	5	5
Supplemental CP daily lb	0	.13 (.06)	.51 (.23)	.51 (.23)
Avg. daily wt. change lb	.62 (.28)	.70 (.32)	.90 (.41)	.81 (.37)
Avg. final wt. 2-11-75 lb	1212 (591)	1220 (555)	1235 (561)	1229 (559)
Trial 2. (43 days on corn stalk stacks)				
No. of cows (3 & 7-yr-old dry X-breds)	14	–	14	–
Supplemental CP daily lb	0	–	.24 (.11)	–
Avg. daily wt. change lb	.26 (.12)	–	.48 (.22)	–
Avg. final wt. 2-4-76 lb	971 (441)	–	980 (445)	–

	Supplements (Self-fed with salt controlling intake)	
	SBM	SBM and Biuret
Trial 3. Lactating 3-yr-old X-bred cows in summer trial on corn stalk and grain sorghum stalk stacks plus 4 lb (1.8 kg) of corn (66 days)		
No. of cows	14	14
Supplemental CP daily lb	.84 (.38)	.92 (.42)
Avg. daily wt. change lb	−1.24 (−.56)	−1.12 (−.51)
Avg. final wt. 8-6-73 lb	864 (393)	871 (396)

[a]Numbers in parentheses are expressed in kilograms.

Crop Residues . . .

(continued from page 23)

be about .5 lb (.23 kg) daily without protein supplementation.

2. Supplying .5 lb (.23 kg) of CP from natural sources may increase weight change to .7 lb (.32 kg) daily.

3. Weight change response to .5 lb (.23 kg) CPE from NPN sources will be somewhat less than from natural protein sources.

4. Weather conditions are the most important factor in cow weight change while winter grazing crop residues.

5. Mature cows in good condition in mid-to-late gestation need little or no supplemental protein as long as selective grazing of crop residues is possible.

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[1]John K. Ward is Professor, Ruminant Nutrition. Monte Stauffer is graduate assistant. Dennis Lamm, John Schmitz and Gary White are former graduate assistants, University of Nebraska.

Cervical Mucus—Indicator of Reproductive Activity

Earl F. Ellington
John J. Noonan[1]

For maximal reproductive efficiency it is essential to use available information and procedures in making management decisions on such things as the best time to breed heifers, the best time to breed cows following calving, the best time during the cycle for breeding, the actual animals that should be given a particular corrective treatment and the animals that should be culled.

Presently, standing heat is widely used to establish the time for insemination, and pregnancy testing by rectal palpation is used for culling cows with conception problems. Even though several procedures are available, additional and more accurate methods are needed if maximal reproductive efficiency is to be accomplished.

An area with some potential in this regard is the study of characteristics of mucus collected from the female reproductive tract. Certain physical and chemical properties of such mucus appear to reflect changes in reproductive status. Two such properties are dry matter concentration of mucus and crystallization patterns (ferning) that form when the mucus is dried and subsequently viewed under a microscope (see Figure 1).

Mucus at Estrus

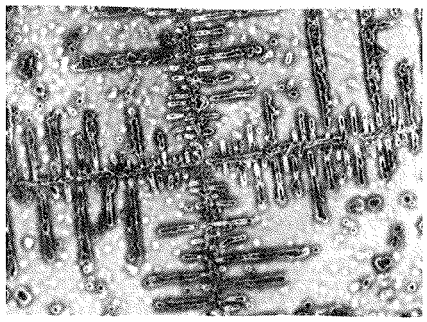
University of Nebraska–Lincoln research has shown that the character of mucus changes throughout the estrous cycle with the most pronounced change occurring at time of estrus. For example, the volume of mucus increases, the ferning characteristics are much more pronounced and the dry matter concentration declines at this time. Changes in mucus at estrus are believed due to the actions of estrogen, the hormone which causes the cow to show heat or estrus.

Another hormone produced by the ovary, progesterone, is produced in rather high concentrations during much of the remaining part of the cycle and tends to oppose the action of estrogen in this regard. Generally, mucus collected closer to the cervix showed these changes more dramatically than mucus collected closer to the exterior of the tract. This may be accredited to closer proximity to the origin of the secretions in the cervix.

Many animals had relatively low mucus dry matter concentrations and marked ferning not only on the day of estrus but also the day before estrus and the day after estrus. Because of this, these particular measures do not offer much promise for precisely determining the occurrence of cycle events such as the time of estrus and ovulation.

Mucus and Conception

Our findings suggest that ferning and dry matter characteristics may give an idea of conception rates to expect. In one study a group of cows was artificially inseminated with respect to observed estrus, and mucus samples also were obtained.



Example of ferning seen in cervical mucus collected at estrus.

Cows that conceived had an average mucus dry matter concentration on the day of insemination of 2.26% compared to 6.32% for cows that failed to conceive. Similar differences also were shown with respect to ferning. It is possible that the mucus differences are explainable on the basis of hormonal disturbances. These same disturbances could adversely affect conception. Data on hormonal patterns are needed to test this concept.

Conclusions

The association indicated between mucus characteristics and conception deserves further study. On the other hand, mucus ferning values and dry matter concentrations were of little value in pinpointing events of the ovarian cycle such as the time of ovulation. Attempts to characterize different types of ferning patterns were likewise not helpful in pinpointing such events.

Since the character of mucus changes in response to mechanisms that control other aspects of the reproductive system, it is believed that there still exists some means for using mucus samples to give an evaluation of ovarian status. Work with cattle is underway to study the electrical properties of mucus.

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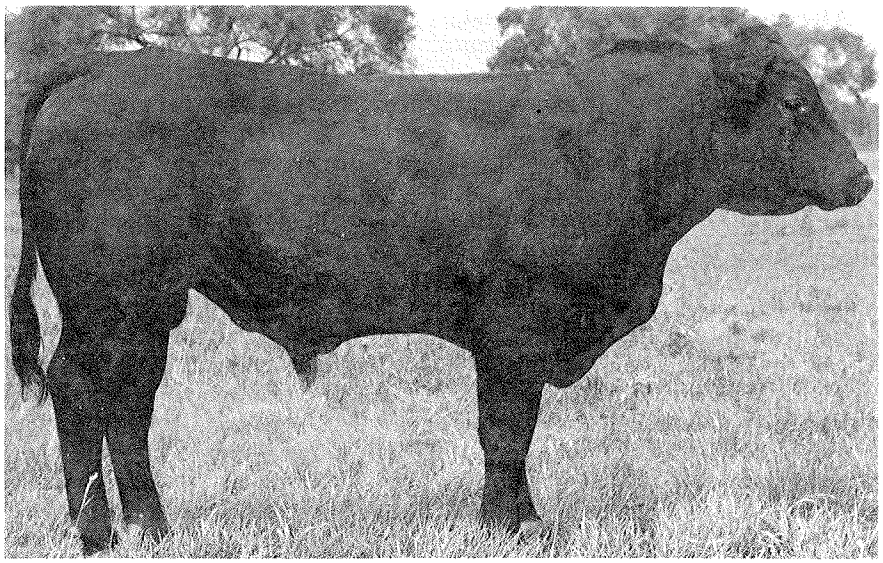
[1]Earl F. Ellington is Professor, Beef Physiology. John J. Noonan is graduate assistant.



NU Bardoliermere 5021, yearling herd sire. Wn. wt. ratio 125, yearling wt. ratio 111.

University of Nebraska

Angus Cattle History

Vincent H. Arthaud[1]

Angus cattle were bred by the University of Nebraska as early as the turn of the century. The foundation of the present purebred herd was started after World War I by the purchase of cattle from Jim McClung, Indianola, Nebraska.

Following the use of the McClung bull, herd bulls were purchased from the Hollinger herd, Wheatland, Kansas. In 1935, Epponian of Rosemere 6th was purchased from Congdon and Battles at their sale in Maquokta, Iowa. As the mating of his related offspring was increased in the herd, it was discovered that he was a carrier for a dwarf gene. These dwarfs were called "long heads" because their heads continued to grow and the body remained small. Females with questionable pedigrees were kept in the herd for a number of years. No sons were kept as herd sires or sold for herd bulls after the discovery of the gene in the herd. Hollinger bulls were again used following the use of the carrier bull.

In 1953, two bulls of Applewood Bandolier 24 and Bandolier Anoka 3rd breeding were purchased from Harold Logan, Diller, Nebraska.

About this time, an Angus herd was established at Fort Robinson through the gift of cows given to the Fort by Nebraska and South Dakota breeders. A group of Bandolier bred cows was also purchased for the Fort. Each of the Logan bulls was used for two years on these Bandolier cows. The gift cows were mated to bulls bred by Gauger Bros. in South Dakota. Each of the Logan bulls was used two years or more in the University herd.

D's Eileenmere Bardoliermere was borrowed from William Drahota, Columbus, Nebraska and produced a good son which was used in the herd. The Drahota bull was purchased in 1959 and used artificially for two years, siring some very good calves. In 1958, the Fort Robinson Angus were added to the Lincoln herd.

In 1960, the herd was moved to the 1120 acre (452.5 ha) Dalbey-Halleck Farm, 4 1/2 miles (7.2 km) south of Virginia, Nebraska. The farm is made up of a section of native prairie grasses given to the University by Dwight S. Dalbey, a quarter section purchased from George Wignall and a half section from Aller and Pease, Inc.

This land was purchased with money from the sale of other land given to the University by Milo M. and Emily Halleck. The herd had increased to over 200 head through the addition of the Fort Robinson cattle, 12 cows of Eileenmere breeding from Floyd Andre in Iowa and 32 Bardolier bred cows from Michigan State University. Bulls used at this time were from Michigan State, McCormick Farms, Kansas State and University bred bulls.

Vibriosis infection was found in the herd in the fall of 1961. All herd bulls were sold for slaughter and artificial insemination was used for two years, 1962 and 1963, to remove the infection. Semen was used from two Ohio State University bulls, sons of Bardoliermere 2nd. Natural service was again practiced in 1964. Bulls used during the following years were sons of one Ohio State bull, a Kansas State bull, O. Bardoliermere 100, the Drahota, Michigan State and McCormick bulls.

In 1967, a decision was made to send most of the purebred cows to the USDA Meat Animal Research Center (MARC), Clay Center, and to sell them the cows with carrier pedigrees for their grade herd. Six Wye Plantation bulls purchased by MARC were used in the University herd for two breeding seasons. The production records of the calves by the Wye bulls were no better than those by University bulls so only one son was used for one breeding season. A few daughters of the Wye bulls remained in the herd.

The bulls used since that time have been principally Bandolier, Bardolier and Eileenmere breeding. Three University bred bulls have been borrowed from MARC. NU Bardoliermere 8014 was used three years. NU Bardoliermere 2195, with the highest weaning and yearling weight ratio of the 1972 calves, was used in 1974 and in 1976. A University bred Eileenmere bull from MARC was also used in 1976. In recent years, two sons and two grandsons of NU Bardoliermere 7136, a bull sold to International Beef Breeders, Colorado, and sons of NU Bardolier-

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Angus Cattle History

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mere 8014 and 2195 have been used.

Management

Data in this report cover the years from 1959 when the herd increased to 200 cows and moved to the Dalbey-Halleck Farm to the present.

The farm has one section of native prairie grasses given to the University in 1945. This land had never been plowed and by the terms of the will, was to remain in its native state. Prior to 1959, half had been leased for pasture, and hay was cut from the remainder. The Agronomy Department studied the effect of time of cutting on the vegetation and Animal Science studied the value of the hay when fed to wintering calves. A 90-acre nongrazed corner has been reserved for agronomic studies and is cut for hay. The remainder is divided into four pastures.

Buildings and corrals are on the purchased quarter across the road east by northeast of the section. This land was seeded to warm and cool season grasses.

The half section which joins the Dalbey section on the north by northeast was seeded to a mixture of brome grass and alfalfa and divided into eight pastures.

The cattle are divided into breeding groups the first of May and moved to the half section of brome-alfalfa pasture. A 60-day breeding season, June 1 to August 1, is used. Heifers are bred to calve at two years of age. On June 1, four breeding groups are left on the half section with each assigned to two pastures which are rotated. One group is moved to the quarter section. Two groups are moved to the section of warm season grass pastures. The two pastures are alternated each year. On August 1, the bulls are removed and the calves and yearling heifers are weighed. All the cows are moved to the section of native grasses where they remain until weaning about October 13.

After weaning, they are moved to brome grass pasture and graze the fall growth until early December. Fall grazing has been available every year except for two dry years. The cows are moved to the section and graze the warm season grass and are fed one pound (0.45 kg) 40% protein supplement per day. Cows graze until snow covers the grass or until no more growth should be removed. They are fed grass hay until they are moved to the quarter section for calving about March 1. After calving, they are moved back to the section and fed alfalfa hay. Young cows are separated from the older cows. Shelter is available to use if needed for these young cows at calving, but all older cows calve in the open.

Selection

Weight records have been kept on the University Angus herd since 1947. In 1966, the University herd, including prior records from 1959, was enrolled in the Angus Herd Improvement Records (AHIR) program. This report covers only the data from 1959 to date.

At birth the calves are weighed, tattooed and ear tagged. Open yearlings are culled at palpation in early September and open cows are culled after weaning in mid October. Cows and calves are weighed at weaning. Date of birth, birth weight, actual weaning weight, and weight of dam are sent to the Angus Association and become a part of the AHIR program. Summaries are received from AHIR which report adjusted 205-day weight, daily gain, weight ratio and cow efficiency. Selection work sheets report the breeding value ratio of the calves, their sires and their dams. Breeding value is based on the individual's record and those of the paternal and maternal half sibs and progeny.

Heifer calves are fed hay and about five pounds (2.3 kg) of oats daily during their first winter and gain about one pound (0.45 kg) per day. Most selection of replacement heifers is reserved until after palpation, however, a few heifers are culled on the basis of weaning and yearling performance. If the percentage of cows and heifers palpated pregnant is high, more females are culled on their breeding value ratio and performance.

From 1959 through 1962, all bull calves were fed a growing ration after weaning and fed a grain ration on pasture from May until the middle of August. Selection of replacement and possible sale bulls during these years was based on 205 and 550-day adjusted weights.

From 1963 through 1966, all bull calves were individually self fed a ration of about 58% TDN. Each year 12 to 15 bulls with the highest 205-day adjusted weights were designated as potential herd

Table 1. Birth and adjusted 205-day weights of Angus calves.

All calves birth weight			Bull calves 205-day weight			Heifer calves 205-day weight		
Year	Lb	(kg)	Number	Lb	(kg)	Number	Lb	(kg)
1959	66	(29.9)	29	422	(191)	29	411	(186)
1960	65	(29.5)	42	425	(193)	44	396	(180)
1961	66	(29.9)	45	450	(204)	45	422	(191)
1962	73	(33.1)	37	461	(209)	26	420	(190)
1963	66	(29.9)	58	419	(190)	75	433	(196)
1964	66	(29.9)	62	442	(200)	64	421	(191)
1965	70	(31.7)	72	491	(223)	55	461	(209)
1966	69	(31.3)	78	478	(217)	85	461	(209)
1967	71	(32.2)	82	518	(235)	79	479	(217)
1968	70	(31.7)	79	516	(234)	94	476	(216)
1969	75	(34.0)	11	507	(230)	11	464	(210)
1970	74	(33.6)	13	538	(244)	16	467	(212)
1971	76	(34.5)	17	520	(236)	18	452	(205)
1972	75	(34.0)	19	523	(237)	21	485	(220)
1973	69	(31.3)	17	511	(232)	24	467	(212)
1974	72	(32.6)	21	520	(236)	15	487	(221)
1975	76	(34.5)	23	500	(227)	26	485	(220)
1976	73	(33.1)	17	542	(246)	17	495	(224)

Table 2. Adjusted 365-day weights of Angus bulls and heifers.

	Bulls			Heifers		
Year	Number	Lb	(kg)	Number	Lb	(kg)
1968	16	898	(407)	13	633	(287)
1969	11	873	(214)	10	607	(275)
1970	9	916	(415)	16	635	(288)
1971	10	964	(437)	14	681	(309)
1972	10	882	(400)	19	593	(269)
1973	10	941	(427)	14	649	(294)
1974	11	960	(435)	14	633	(287)
1975	12	953	(432)	22	638	(289)

bulls. A random half of the remaining bull calves were castrated. After the feeding period these bulls and steers were slaughtered in two groups, 15 and 16 months of age and their carcasses evaluated for quality and for cutability by actual cut out of one side. Final selection of the bulls kept from the potential herd bulls was based on 205 and 365-day adjusted weights and gain efficiency. In 1967 and 1968, the bull calves not designated as potential herd bulls were slaughtered at 9, 12, 15 and 24 months of age. Results of this carcass experiment were used to aid the change of USDA grading standards for young bulls.

In 1968, all but 25 of the Angus females were moved to MARC.It was decided that grade cows could provide calves for carcass studies, but a herd of 50 purebred cows should be maintained. In exchange for 196 Angus females, 175 bred Angus three-year-old grade cows and 50 registered Hereford heifer calves were received from MARC. Selection of the 25 females remaining at Dalbey-Halleck was based on individual and progeny records. Some were calves and yearlings with the highest weight ratios.

Since the purebred cow herd was reduced, all heifer calves are kept until yearlings. Selection is then based on 205, 365 and 450-day weight ratios, their individual and dam's breeding value ratios. The top 10 or 12 bulls with the highest 205-day weight ratios are selected and fed as a group at Lincoln until yearlings. Selection of replacement bulls and possible sale bulls is based on 205-day and 365-day weight ratio and breeding value ratios. The rest of the bulls are sent to market. Cows that produce calves with lowest weight ratios and lowest breeding values are culled.

Data presented cover the period of 1959 to 1976; however, data can be considered in two parts due to smaller numbers since 1968.

Table 1 shows that birth weight has increased about one-half pound (.226 kg) per year since 1959. Calf birth weights since 1968 have been consistently heavier.

There has been a consistent increase in weaning weights of both bull and heifer calves with an average change of 5.5 pounds (2.5 kg) per year (Table 1). The 365-day weights since 1968 are included in Table 2. The average change per year in yearling weight was about 9 pounds (4.1 kg). Adjusted 365-day weights were computed for the heifers in previous years but some years the 550-day weights were included in AHIR summaries instead of 365-day weights. It was difficult to have a complete record of all bulls due to use of the bulls in

Table 3. Weight of Angus cows first week of August, cows 3 years old and older nursing calves.

Year	Number	Lb	(kg)
1960	88	990	(449)
1963	125	1008	(457)
1964	124	1005	(478)
1965	112	1017	(461)
1966	130	1015	(460)
1967	108	1033	(468)
1968	138	1084	(492)
1969	23	1153	(523)
1971	33	1132	(513)
1972	32	1086	(493)
1973	35	1125	(510)
1974	32	1105	(501)
1975	38	1135	(515)
1976	31	1155	(524)

carcass evaluation studies prior to 1969.

Weights of cows over three and nursing calves have increased with an average change in mature weight of 11 pounds (5 kg) per year (Table 3). There was a consistent gain from 1960 to 1968 when numbers were larger, but the selected cows caused a large increase in 1969. Since that time there was little change.

Cow weights, average 205-day weight of bull and heifers and calf birth weight from 1959 through 1976 are shown in Figure 1. As selection for heavier calves progressed, cow weights and birth weights also increased.

Some herd sires are used for one season, some for two and in one

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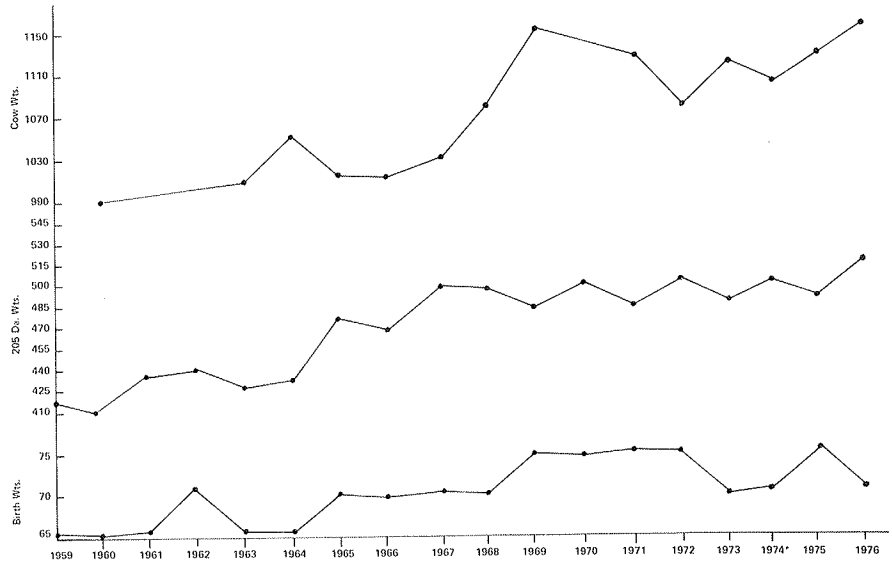

Cow weights, average 205-day weight of bull and heifers and calf birth weight from 1959 through 1976.

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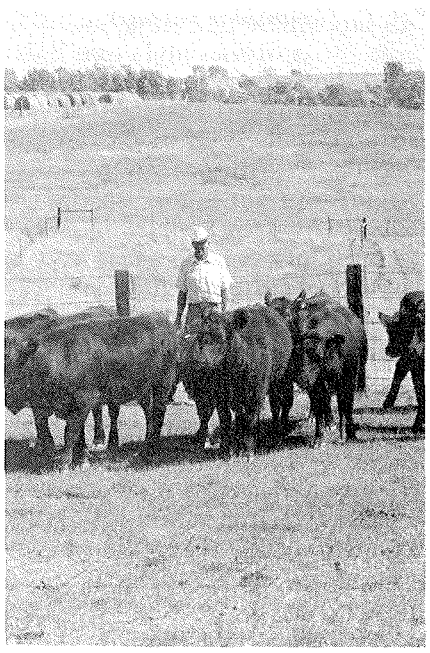
instance, for more than three seasons. A good bull should produce a son with a breeding value better than his, and hopefully, he will sire calves with better performance.

The grade cows have previously been used to produce calves for carcass studies but beginning in 1976, they will be involved in a study of the effects of different levels of milk production.

Some purebred bulls have been sold by sealed bids or privately. Only yearling bulls with the better records and previously used herd bulls are sold. The first females offered for sale were sold privately to a purebred herd in 1971. Since then, auction sales were held in 1973, 1975 and 1976 to sell surplus females.

The purebred herd will be maintained by the Animal Science Department to provide animals for evaluation by visual appraisal combined with production records in live animal evaluation classes, to provide production, selection and other records for breeding and production classes and to demonstrate the effective use of performance selection.

[1]Vincent H. Arthaud is Professor, Animal Science.



1975 yearling replacement heifers.

Scheduled Breeding Dates With Progestogen and Prostaglandin

Gary D. Stauffer
Earl F. Ellington[1]

Effective estrous cycle control procedures have long been of interest to beef cattle producers and researchers. The ability to control or synchronize breeding dates within narrow time limits would greatly facilitate use of artificial insemination in beef cattle. Heat detection would be accomplished more easily and more efficient use could be made of time, labor and semen.

Even more preferable would be cycle control procedures perfected so that artificial inseminations could be made without the necessity of heat checking. Cycle control procedures could also allow scheduling of events to meet individual producer needs. For example, such procedures could allow for scheduling calving periods, shortening calving periods and marketing of more uniform calves.

Ideal cycle control procedures must control ovarian activity when administered at all stages of the estrous cycle, be easily administered, be consistently effective, not impair fertility and not interfere with future reproductive potential. Although progress has been made in developing cycle control procedures for beef cattle, most encouter problems in one or more of the foregoing areas.

Previous work (1972 Nebraska Beef Cattle Report, E.C. 72–218) indicates that a progestogen ear implant impregnated with a synthetic progesterone-like hormone (G. D. Searle and Co., Chicago, IL) offers considerable promise as a cycle control agent. This work and subsequent studies with the implant indicate that areas needing some improvement are precision of cycle control and resulting fertility. Some relatively new materials called prostaglandins(PG) may be of value in cycle control procedures since they appear to bring about changes in the ovary that cause cattle to come into estrus and ovulate.

The present study was conducted to gain additional information on the value of the progestogen implant in cycle control and to determine if the utilization of PG treatment in addition to the implant might have beneficial influences upon cycle control and fertility.

Table 1. Estrous activity of cows during the first 17 days subsequent to Progestogen implant removal.

Group	No. cows	No. showing estrus	Avg. days to estrus	No. showing estrus at interval[a]: 1	2	3	4	5	6	7	8
1. Control	31	20	7.8	3	3	2	1	5	2	2	2
2. Implant only	31	26	3.3	20	2	0	0	3	0	0	1
3. Implant + PG(I)[b]	31	25	2.6	16	6	2	0	1	0	0	0
4. Implant + PG(R)[b]	31	26	2.1	19	7	0	0	0	0	0	0
5. Implant + PG(B)[b]	31	27	3.2	17	6	0	1	3	0	0	0

[a]Consecutive, 2-day, post-treatment intervals except for interval 8 which includes 3 days

[b]PG (Prostaglandin) injected at the time of implant insertion (I), implant removal (R) and at breeding (B) in groups 3, 4 and 5, respectively.

Table 2. Breeding and calving results for cows treated with Progestogen implants and Prostaglandin injections.

Group[a]	No. cows	No. bred AI[a]	No. conceived AI	AI conception rate, %	Overall conception rate[b], %	Avg. days from implant removal to calving
1. Control	31	20	12	60	87	308.6
2. Implant only	31	26	18	69	97	300.6
3. Implant + PG(I)	31	25	10	40	87	301.5
4. Implant + PG(R)	31	26	11	42	97	303.0
5. Implant + PG(B)	31	27	15	56	87	302.2

[a]Cows showing estrus the first 17 days after implant removal were artificially inseminated.
[b]AI + natural.

Study Design

Progestogen-impregnated ear implants (G. D. Searle and Co., Chicago, IL) were used alone and in combination with prostaglandin ($PGF_{2\alpha}$-Tham salt, The Upjohn Co., Kalamazoo, MI) to study effectiveness for estrous cycle control in spring calving beef cows.

A total of 155 Hereford and Hereford-Angus cows were assigned with respect to breed, age and calving date to five equal sized groups. Treatments were: (1) control, (2) progestogen implant only, (3) implant plus PG at implantation, (4) implant plus PG at implant removal and (5) implant plus PG at insemination.

The progestogen implants weighed 120–125 mg and contained 6 mg of a synthetic progestogen (Searle SC21009) incorporated in a plastic-like material (Hydron). All implants were placed under the skin on the outer side of the ear for eight days. Implants were removed through an incision made directly over the implant. PG was injected subcutaneously in distilled water at the rate of 30 mg/injection.

Epididymectomized bulls were used for twice daily estrous checks before, during and following the treatment period. Cows standing for mounting by bulls or other cows were considered to be in estrus. Cows showing estrus during a 17-day period immediately following implant removal were artificially inseminated.

An experienced technician made all inseminations utilizing extended semen (Midwest Breeders Cooperative, Shawano, WI) from a Hereford bull for Hereford cows and from a Charolais bull for Hereford-Angus cows. Cows first detected in estrus at morning checks were inseminated during the evening of the same day. Cows first detected in estrus during the afternoon were inseminated the following morning. Heat detectors (KaMaR, Inc., Steamboat Springs, CO) were used on the rump of cows during the actual A.I. period to facilitate detection of estrus.

Following the A.I. period cows were exposed to intact Angus bulls for an additional 42 days. The calving dates together with color markings of the calves were used to establish the breeding dates at which conception occurred.

Cattle were maintained on alfalfa-bromegrass pasture during the spring and early summer months and again during the autumn months. Native type pastures were grazed during the remaining summer and winter months. Hay was provided during the winter as needed.

Study Findings

The progestogen implants remained in position without any loss and inhibited estrous behavior during the eight days that they were in place. Estrus occurred on an average of 3.3 days following the time of implant removal in the implant alone group as compared to 7.8 days for the controls (Table 1). PG treatment at the time of both implant insertion (group 3) and removal (group 4) appeared to shorten this interval. All treatments resulted in estrous synchronization as revealed by the data pertaining to distribution of estrous periods among consecutive post-treatment intervals. Post-treatment interval data indicate that PG treatment at the time of implant removal (group 4) might have improved synchronization over other treated groups.

The conception rate from A.I. for the implant only treatment (group 2) was as good or better than for the control group (Table 2). PG treatment at insemination (group 5) had little, if any, effect on the A.I. conception rate whereas such treatment at implant insertion (group 3) or removal (group 4) had a detrimental effect. Any detrimental effect of treatments on conception was only temporary as conception rates for the total breeding period (A.I. + natural) were as good for the four treated groups as for the control group.

Days from implant removal to calving tended to be fewer for all treatments (groups 2–5 vs. group 1, Table 2). Age and breed of cow did not appear to influence the interval from implant removal to calving. Days postpartum was, on the other hand, negatively associated with the interval to calving. Postpartum intervals to initiation of the A.I. period (implant removal date) ranged from 38 to 102 days, and the negative relationship is undoubtedly explained by needed time for postpartum recovery of reproductive structures.

Summary

Cows implanted with progestogen showed estrus at 2–4 days subsequent to implant removal. Prostaglandin injections in cows on the progestogen implant were helpful in improving the precision of cycle control, but appeared to temporarily depress fertility. Treatments had only a slight effect on shortening the interval from implant removal to calving. Cow age and breed had no effect on this interval to calving whereas the length of the postpartum interval to treatment had a negative effect.

Additional studies to learn more about how these materials are acting will be necessary to overcome problems encountered in this study.

[1]Gary D. Stauffer is graduate assistant. Earl F. Ellington is Professor, Beef Physiology.

Preservatives For Ensiling

Vernon Krause
D. C. Clanton[1]

Forage preservation by ensiling is used by many livestock producers in Nebraska. Success when ensiling forage, however, depends upon management practices. It is important to reduce losses in the field and in the silo. Harvesting forage at higher moisture content generally reduces field losses, but can cause additional losses in the silo. Reducing losses in the silo involves fine chopping in the field, a firm pack, quick fill, and immediate silo covering or closing.

Concern over nutrient losses in the silo has encouraged development of silage preservatives and additives. Several products have been tested. Results have been quite variable. Preservatives are reported to reduce seepage, fermentation losses and possibly reduce spoilage on top of the silo.

Feeding trials with large numbers of animals are needed to effectively measure differences in feeding quality of preserved forage. Two silage preservatives were tested, one with corn silage at the North Platte Station, and one with alfalfa at the Northeast Station.

At North Platte, corn green chop was divided (every other load) and stored in two small trench silos. The silos had about 200 ton capacity and had dirt walls with asphalt bottoms. Forage going into one of the silos was treated with IM-PRUV-AL preservative, a combination of chemical ingredients prepared to aid the fermentation of green chop at ensiling. Silos were not covered following filling. Silage was fed during the winter following harvest to three replications of growing calves.

Table 1. Performance of calves fed corn silage treated with IM-PRUV-AL and silo losses (North Platte Station).

	Control	IM-PRUV-AL treated
Daily gain, lb (kg)[a]	1.87 (.85)	1.87 (.85)
Feed consumption, lb (kg) (as fed)		
silage	31.1 (14.1)	31.6 (14.4)
supplement	1.0 (.45)	1.0 (.45)
Dry matter consumption, lb	12.1 (5.50)	11.9 (5.41)
Dry matter/lb gain, lb	6.48	6.40
Silo dry matter loss, %	31.8	30.9

[a]37 calves on control; 35 on treated. Avg. initial weight 468 lb (213 kg).

IM-PRUV-AL did not measurably increase preservation of corn silage over the untreated silage (Table 1). There were no significant differences between IM-PRUV-AL treated silage and the control silage in silo dry matter preservation, feed intake and performance of calves on test.

At the Northeast Sation, alfalfa at 30% dry matter was ensiled in two bunker silos. Alfalfa in one bunker was treated at filling with "Silo-Best", an enzyme microbial additive.

Steers were fed control or "Silo-Best" treated silage with either 0, 2.5 or 5.0 pounds of whole shelled corn. Gains and feed efficiency of cattle increased as corn was added to the ration (Table 2).

Steers fed "Silo-Best" treated alfalfa silage gained .27 pounds (.12 kg) more per day than steers fed untreated alfalfa silage. Steers fed "Silo-Best" silage also required .94 pounds (.43 kg) less dry matter per pound of gain than steers fed untreated silage.

Table 2. Performance of calves fed direct cut alfalfa silage treated with "Silo-Best" and silo losses (Northeast Station).

	Control			"Silo-Best" treated		
Corn/head/day, lb (kg)[a]	0.0	2.5 (1.14)	5.0 (2.27)	0.0	2.5 (1.14)	5.0 (2.27)
Avg. daily gain, lb (kg)	2.01 (.91)	2.54 (1.15)	2.84 (1.29)	2.38 (1.08)	2.76 (1.25)	3.06 (1.39)
Dry matter consumption, lb (kg)	17.23 (7.83)	18.94 (8.61)	19.25 (8.75)	17.22 (7.83)	17.93 (8.15)	19.02 (8.65)
Dry matter/gain	8.58	7.46	6.77	7.26	6.50	6.21
Silo dry matter loss, %			13.38			13.35

[a]20 steers per treatment; initial weight 559 lb. (254 kg).

Visual differences in spoilage over the top of the polyethylene-covered bunkers were negligible, and dry matter loss from the silos was the same. Feeding values of the silages were different, indicating that alfalfa silage harvested at 70% moisture contained more nutrients per unit of dry matter when treated with "Silo-Best." Specific nutrients preserved are yet to be determined but responses in cattle gain and feed efficiency when corn was added to the silages would suggest corn was able to partially compensate for differences in nutrients between the silages (Table 3).

Specific ingredients or combinations of ingredients in "Silo-Best" which caused the differences in cattle performance are uncertain, but results suggest that direct cut alfalfa silage preservation can be enhanced by certain additives.

In theory, preservatives have a place in the ensiling process. However, not all preservatives produce the desired effect. Future research may more clearly define actions of certain preservatives and explain differences in products and effectiveness in preservation.

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Table 3. Increased performance of steers fed "Silo-Best" preserved alfalfa.

	"Silo-Best" minus control		
Corn/head/day, lb (kg)	0.0	2.5 (1.14)	5.0 (2.27)
Avg. daily gain, lb (kg)	.37 (.17)	.22 (.1)	.22 (.1)
Dry matter/lb gain	1.32 (.6)	.96 (.44)	.56 (.25)

Additions for Corn Silage

Non-Protein Nitrogen

Paul Q. Guyer
Vernon Krause
Walter Tolman[1]

Nutrient additions of urea and mineral to corn silage at the time green chop is ensiled have produced gains similar to untreated silage with the same nutrients added at feeding time. More recent results from Michigan have indicated that Pro-Sil, a liquid additive containing ammonia and minerals, may be more effective in reducing cost of gain than the urea-mineral combinations.

Pro-Sil has been studied in four trials at the Northeast Station. In the first trial in 1972, control rations consisted of corn silage and either soybean meal or urea-alfalfa nitrogen supplements formulated to provide rations containing 12% protein, .45% calcium and .35% phosphorus (dry basis) and 20,000 I.U. of vitamin A per head daily. Pro-Sil was added to the treated silage at the rate of about 45 pounds per ton (20.4 kg/MT) green chop containing 35% dry matter. This produced a silage containing about 13% protein, .35% calcium and .35% phosphorus (dry basis) plus trace minerals and vitamins.

Steers fed soybean meal had the fastest and most efficient rate of gain, while those fed Pro-Sil in this test had the slowest and least efficient rate of gain (Table 1). Feeding .1 pound (.04 kg) of ground limestone per head daily in addition to the Pro-Sil treated silage appeared to increase both rate and efficiency of gain. The decided improvement in both rate and efficiency of gain by the addition of extra limestone indicated that the calcium content of the Pro-Sil treated silage was low for this type of ration. More recent formulations of Pro-Sil have increased levels of calcium.

Pro-Sil treated, mineral treated and regular silages were studied when fed to yearling steers in 1973 (Table 2). Mineral treatment consisted of additions of limestone and dicalcium phosphate to raise the calcium and phosphorus content of the silage to about .8 and .3%, dry basis, respectively. Control rations were formulated to contain 11.5% protein, .45%calcium and .3% phosphorus (dry basis) and 20,000 I.U. of vitamin A per head per day. Pro-Sil was added to the treated silage at the rate of about 45 pounds per ton (20.4 kg/MT) to provide silage containing about 13% protein, .4% calcium and .3% phosphorus. Vitamin A was added at feeding time. Supplements for the control and mineral treated silages included soybean meal and urea base supplements and for the mineral treated silage a third supplement of a 20% solution of aqueous ammonia was included.

Rate of gain was essentially the same for all types of silages and all supplements fed. Cattle fed the mineral and Pro-Sil treated silages however, appeared to have considerably more efficient gains than those fed the control silage. Cattle fed the aqueous ammonia added at feeding time made a relatively quick adjustment to the ammonia smell as well as making comparable rate and efficiency of gain to the other rations fed.

Two trials were conducted with Pro-Sil treated corn silage in 1975. In the first trial, heavy yearling steers were fed Pro-Sil treated or control silage supplemented with

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Table 1. Pro-Sil treated vs control corn silage with supplement added at feeding for light yearling steers, 1972.[a]

	Control silage		Pro-Sil silage	
	Soybean supplement	⅔ urea-N + ⅓ dehy-N	Treated only	Treated plus limestone[b]
Daily gain, lb	1.57 (.71)	1.49 (.68)	1.41 (.64)	1.53 (.69)
Feed consumption, lb[c]	15.2 (6.91)	15.3 (6.95)	14.8 (6.73)	14.9 (6.77)
Feed/gain	9.68	10.26	10.50	9.71

[a]20 steers per treatment weighing 575 lb (261 kg) fed 83 days — kilograms in parentheses.
[b]0.1 lb (.045 kg)/head/day at feeding.
[c]Dry basis.

Table 2. Mineral and Pro-Sil treated vs regular corn silage, 1973.[a]

	Control		Mineral treated			Pro-Sil treated
	Soybean meal	Urea	Soybean meal	Urea	Aqueous ammonia	
Daily gain, lb	1.89 (.86)	1.93 (.88)	2.01 (.91)	1.86 (.85)	1.95 (.88)	1.96 (.89)
Feed consumption, lb[b]	18.2 (8.27)	18.5 (8.41)	16.7 (7.61)	16.9 (7.67)	16.8 (7.62)	17.1 (7.77)
Feed/gain	9.63	9.59	9.00	9.00	8.60	8.72

[a]32 steers per treatment weighing 650 lb (295 kg) fed 74 days—Kilograms in parentheses.
[b]Dry basis.

Table 3. Pro-Sil treated vs regular corn silage, 1975.[a]

	Control silage		
	Soybean supplement	Urea base supplement	Pro-Sil treated
Daily gain, lb (kg)	2.13 (.97)	2.01 (.91)	2.28 (1.04)
Feed consumption, lb (kg)[b]	19.22 (8.73)	20.32 (9.24)	19.91 (9.05)
Feed/gain	9.02	10.11	8.73

[a]19 steers per treatment weighing 650 lb (294 kg) fed 84 days — kilograms in parentheses.
[b]Dry basis.

Table 4. Pro-Sil treated vs regular corn silage for light yearling steers, 1975.[a]

	Control silage		
	Soybean supplement	Urea base supplement	Pro-Sil treated
Daily gain, lb (kg)	2.29 (1.04)	2.25 (1.02)	2.21 (1.00)
Feed consumption, lb (kg)	14.25 (6.48)	14.53 (6.60)	13.51 (6.14)
Feed/gain	6.22	6.46	6.12

[a]18 steers per treatment weighing 525 lb (238 kg) fed 98 days — kilograms in parentheses.

Non-Protein Nitrogen

(continued from page 31)

either soybean meal or urea. The control rations were formulated to contain 11.5% protein, .4% calcium and .3% phosphorus (dry basis), trace minerals and vitamins.

Steers fed Pro-Sil made the fastest and most efficient gains, while steers fed the control silage with the urea supplement had the slowest gains and poorest feed conversions (Table 3).

In the second trial, using the same silages, but lighter weight yearling steers, gains were essentially the same for both silages and for both the soybean meal and urea based supplements (Table 4). However, steers fed Pro-Sil appeared to be slightly more efficient in feed utilization.

Pro-Sil treated (new formulation or original formulation plus limestone) silage fed to light weight yearling steers produced gains comparable to control or mineral treated silages supplemented with soybean meal, urea or aqueous ammonia nitrogen. These data indicate a slight improvement in efficiency of gain for the Pro-Sil treated silage compared to the control silage. Mineral treated silage also appears to be utilized more efficiently than control silage.

From the standpoint of rate of gain, these data agree with earlier data indicating little difference in performance from adding non-protein nitrogen at the time of ensiling vs adding it at feeding time.

The efficiency data were somewhat favorable to Pro-Sil or mineral additives at ensiling time. This could be more apparent than real. Pro-Sil (ammonia and mineral) and mineral additions prolong and increase silage fermentation. This results in the production of more organic acids.

During fermentation, sizeable dry matter losses (up to 15–20%) occur with minimal energy losses (1–5%). Also, drying methods may drive off some of the organic acids making the silage appear to have less dry matter than it really has. Thus the reduction in dry matter required for gain in these tests may not be as great as it appears. More detailed studies will be needed before the full significance of efficiency of gain data is understood.

Other factors that may have a bearing on the use of Pro-Sil include:

1. Cost of nutrients (including interest) compared to cost of a similar product at feeding time.
2. Delay in harvest and/or additional labor required for application.
3. Irritation caused by ammonia during harvest.
4. Some nutrient loss of the additive during fermentation.

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Housed Feeding of Growing Calves

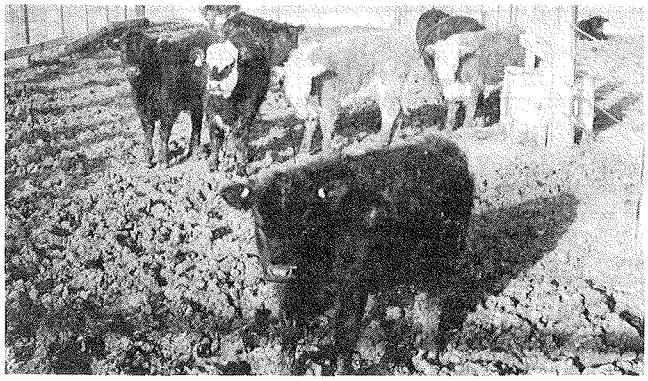
Terry Klopfenstein
John Waller
Cecelia Dorn
Lyle Petersen[1]

Housed confinement facilities are used mainly for finishing cattle fed high concentrate rations. However, calves fed roughage rations may be affected more by adverse weather and lot conditions than older cattle. Performance of growing calves fed in housed confinement facilities is an important factor to consider before investing in such facilities.

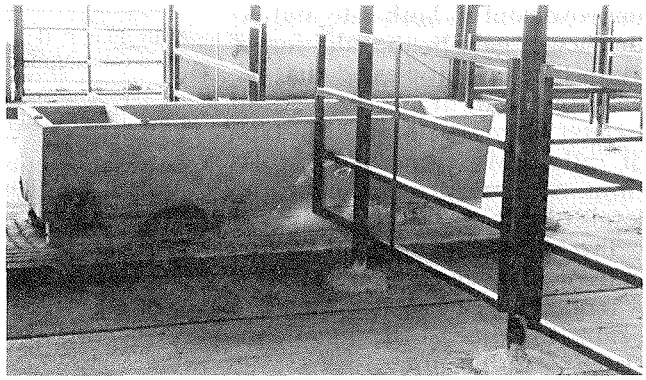
Six growth trials were conducted at the University of Nebraska Field Laboratory at Mead during all seasons. Rations fed during these trials were composed of corn silage, corn stalks and husklage, or sodium hydroxide treated corn stalks, husklage or corn cobs. Different sources of supplemental protein also were fed. Supplemental nitrogen was provided by a range of sources from all urea to all soybean meal. All six trials included Angus, Hereford and crossbred calves.

Calves were fed in unsheltered pens or in a half-slatted floor confinement building in experiment I. The dirt pens had fenceline feed bunks oriented in a northeast-southwest position. An eight foot (2.4 m) slab of concrete formed an apron behind the feed bunks. Each pen had a mound of average to poor quality, composed of dirt and some manure.

The half-slatted floor confinement building had a single pitched roof and was open to the south. Feed bunks were located on the south side, which was open. Pens were 30 x 16 feet (9.1 x 4.87 m) each with a 16-foot (4.87 m) con-



Unsheltered dirt lots.



Flush flume confinement barn.

Table 1. Slatted floor confinement vs outside pens for growing calves—experiment I.[a]

	Confinement half-slatted floor	Unsheltered dirt pens
No. calves	95	95
Space/calf, sq. ft.	20 (1.8 m²)	400 (36 m²)
Bunk space/calf[b], in.	6 (15 cm)	24 (60 cm)
Daily gain, lb	1.60 (.73 kg)	1.76 (.80 kg)
Feed/gain[c]	10.48	9.53

[a]January 21 - May 8, 1975.
[b]All calves fed twice daily.
[c]Dry matter basis.

crete slatted area in the middle of the 30-foot (9.1 m) length and solid concrete 7 foot (2.1 m) aprons sloping 6.25 percent at both front and back.

Average daily gain was slightly greater and less feed was required per pound of gain for calves fed in unsheltered dirt lots compared to those fed in confinement (Table 1).

Unsheltered pens, the same type as in experiment I and a double flume-type confinement building were compared in experiment II. To evaluate the effects of animal density on performance of housed confinement calves, two groups (11 and 15 head per group) were allotted to equal size pens. This provided 20 or 15 square feet (1.8 or 1.3 m²) of pen space per head.

The confinement building had a double pitched roof and was oriented in an east-west position. The north side was enclosed and contained a 14-foot (4.2 m) feed alley and the feed bunks. Pens were 18 x 12.5 feet (5.5 x 3.8 m) with two flumes within the 18-foot (5.5 m) length. The concrete floor sloped 4.2 percent from the feed bunk for 4.5 feet (1.4 m) to the first two inch (5 cm) flume opening. The next 4.5 foot (1.4 m) section sloped upward at 6.25 percent and the next 4.5 foot section (1.1 m) section sloped downward, 6.25 percent to the second flume opening. The fourth 4.5 foot (1.4 m) section sloped upward 6.25 percent to the rear of the pen (see photo). The flumes were flushed with water and the manure flowed into a holding pond.

Calves in pens with 15 square feet (1.3 m²) per head had a lower gain and efficiency compared to those with 20 square feet (1.8 m²) per head. Performance in the pens with 20 square feet (1.8 m²) per head was slightly greater than those fed in unsheltered dirt pens (Table 2).

In experiments III through VI growth was compared in the double flume confinement building and unsheltered dirt pens. The unsheltered pens for these trials had a 20-foot (6 m) concrete apron behind the feed bunks and no mound. The animals in these experiments were fed once daily rather than twice as in experiments I and II.

Calves fed outside and in confinement had similar performance. Two experiments were conducted in the winter, two in the summer and one in the spring. There was one positive and one negative response to the confinement barn in each winter and summer. The spring experiment showed equal performance in confinement and outside. Temperatures tended to be normal during these experiments with periods of very cold weather in the winters and very hot weather in the summers. Precipitation was below normal during the entire period, and mud in the dirt lots was minimal.

Calves fed on slatted-floors were quite clean while those in the double flume confinement barn carried some manure. At the conclusion of experiment V, five calves from the confinement barn and five comparable calves from the dirt lots were slaughtered. Dressing percent and hide weights averaged 54.1 percent and 62.3 pounds (28.3 kg), respectively for confinement cattle; and 54.0 percent and 61.7 pounds (28.0 kg) for outside cattle. This indicates that manure or mud on the animals were similar.

Results of six tests do not encourage feeding growing calves in housed confinement because of the greater investment in facilities. It is possible that increased pen space, bunk space or total pen size (for ease of cattle movement) in confinement would increase calf performance. However, the facility cost per animal would also increase with increased pen space and bunk space. Waste handling, refeeding of waste and relative land and building costs are factors which may influence the practicality in the future of feeding calves in confinement.

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[1]Terry Klopfenstein is Professor, Ruminant Nutrition. John Waller is graduate assistant. Cecelia Dorn is graduate assistant. Lyle Petersen is graduate assistant.

Table 2. Solid floor confinement vs dirt lots for growing calves—experiment II.[a]

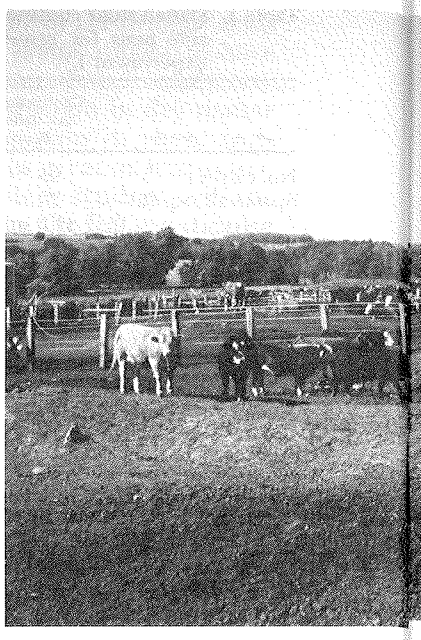
	Confinement double flume		Unsheltered dirt pens	
No. calves	22	30	48	
Space/calf, sq. ft.	20 (1.8 m²)	15 (1.3 m²)	400 (36 m²)	
Bunk space/calf, in.[b]	11 (28 cm)	8 (20 cm)	24 (60 cm)	
Daily gain, lb	1.76 (.80 kg)	1.56 (.71 kg)	1.72 (.78 kg)	
Feed/gain[c]	8.47	9.50	9.80	

[a]January 29–May 8, 1975. [b]All calves fed twice daily. [c]Dry matter basis.

Table 3. Summary of calf performance in solid floor confinement and dirt lots.[a]

	Double flume confinement barn					Outside dirt lots				
Experiment No.	III	IV	V	VI	Mean	III	IV	V	VI	Mean
No. calves	95	88	192	118	493 (total)	63	88	96	80	327 (total)
Space/calf, sq. ft.	19	20	19	19	19.3	400	430	400	300	383
(m²)	(1.7)	(1.8)	(1.7)	(1.7)	(1.7)	(36)	(38.7)	(36)	(27)	(34.4)
Bunk space/calf[b], in.	10	11	10	10	10.3	18	20	18	14	17.5
(cm)	(25)	(26)	(25)	(25)	(25.8)	(45)	(50)	(45)	(35)	(44)
Daily gain, lb	1.77	.99	1.47	1.70	1.48	1.73	1.14	1.40	1.89	1.54
(kg)	(.81)	(.45)	(.67)	(.77)	(.67)	(.79)	(.52)	(.64)	(.86)	(.70)
Feed/gain[c]	8.07	12.3	11.0	10.9	10.6	9.38	10.9	10.8	9.5	10.1

[a]Experiment III 550 lb (250 kg) steers fed May 22 - September 11, 1975; Experiment IV 520 lb (236 kg) steers fed November 6, 1975 - February 26, 1976; Experiment V 531 lb (241 kg) steers fed February 26 - June 21, 1976. Experiment VI 536 lb (243 kg) steers fed June 24 - October 21, 1976.
[b]All calves fed once per day.
[c]Dry matter basis.



Cattle finished on slatted floor providing 20 square feet per head contrasted to cattle fed in unpaved open lots at Mead facility.

Housed and Unhoused Confinement Facilities for

Stanley D. Farlin
C. B. Gilbertson
Greg Schindler[1]

Different types of facilities for finishing cattle were compared in eight trials.

Housed confinement evaluated included (1) a shed roofed barn 32 feet wide (9.75 m), open to the south with 50 percent slatted floor providing 20 square feet (1.8 square meters) per head and (2) a gable roof with an opening along the ridge, inside driveway on north side open on south providing approximately 22 square feet (2.0 square meters) on a concrete floor sloping to a slot floor with a flush-flume cleaning system.

Unhoused confinement included (1) pens with slatted floors without a roof providing 20 square feet (1.8 square meters) per animal and (2) concrete aprons providing 20 square feet (1.8 square meters) per animal with a slope of three or nine percent to a gutter.

Conventional lots were unpaved other than a 10 foot (3.04 m) apron parallel to the feed bunk. The smaller conventional unpaved lots were not mounded and provided approximately 200 square feet (18.4 square meters) per animal, whereas the larger unpaved lots were mounded and provided about 400 square feet (36.8 square meters) per animal.

Since season and climatic conditions are important factors in evaluating confinement facilities, trial results are presented individually with dates indicated. All trials were conducted at Mead, Nebraska, an area with an average annual precipitation of 28 inches (.71 meter).

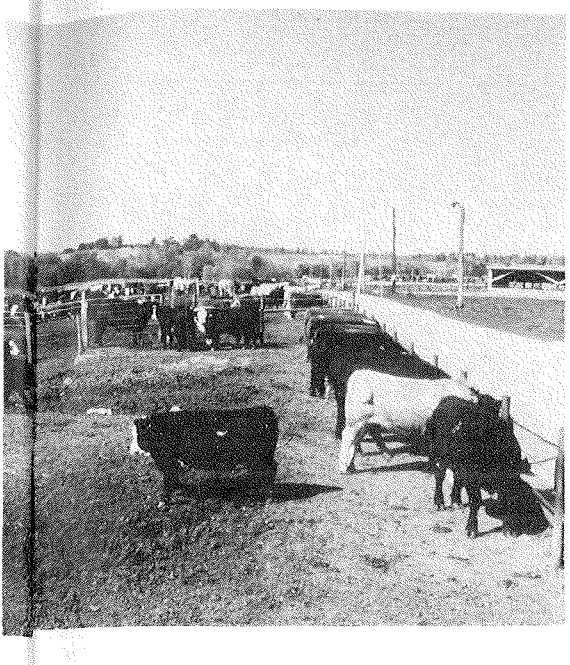
Rations fed in all trials were composed of 10 percent roughage, usually hay, and 90 percent concentrate consisting of corn and supplement. Within each trial the rations were the same across facilities. Yearling cattle of similar size and breed were used when comparing facilities.

Rate of gain reported reflects any differences in carcass weights due to type of facility by calculating an adjusted final weight. This adjustment was made by dividing carcass weight by 62 percent to get the adjusted final weight. Dressing percent for cattle in housed and unhoused confinement facilities was similar and was consistently

Table 1. Housed and unhoused confinement facilities vs conventional lots during winter and spring.[a,b]

	Large conventional outside lots	Small conventional outside lots	Housed slatted floor	Unhoused slatted floor	Unhoused concrete floor	
					3% slope	9% slope
No. pens	4	2	4	2	1	1
No. cattle	80	20	96	20	10	10
Initial wt., lb	572	585	592	586	620	594
	(260)	(266)	(269)	(266)	(282)	(270)
Adj. avg. daily gain[c], lb	2.62	2.52	2.42	2.59	2.30	2.55
	(1.19)	(1.14)	(1.10)	(1.18)	(1.05)	(1.16)
Avg. daily feed (DM), lb	19.6	17.7	18.4	17.6	17.7	19.3
	(8.9)	(8.0)	(8.4)	(8.0)	(8.0)	(8.8)
Feed/gain	7.48	7.02	7.60	6.80	7.70	7.57
Carcass wt., lb	616	614	609	622	614	623
	(280)	(279)	(277)	(283)	(279)	(283)
Dressing percent	58.85	59.16	59.95	60.08	60.99	59.91

[a]Numbers in parenthesis expressed in kilograms.
[b]Trial conducted from January 15, 1974 to June 25, 1974.
[c]Final weight adjusted to a dressing percent of 62 based on carcass weight.



r Finishing Beef

greater than for cattle fed in conventional lots.

Tables 1–4 show results of trials comparing unhoused confinement with conventional lots and housed confinement over a two year period. Table 5 summarizes rate of gain and feed efficiency for four comparisons.

Tables 6–8 contain comparisons of conventional lots with housed slatted floor facilities over nearly two years. A summary is presented in Table 9. Table 10 includes observations made for 84 days on cattle fed in conventional outside lots and in a facility with a concrete floor flush-flume system.

Results

Rate of gain and feed efficiency were nearly the same for large conventional outside lots and the housed slatted floor facility for three trials (Tables 9) involving 1,209 cattle. In two additional trials (Tables 1 & 2) rate of gain was slightly better in large conventional lots, however, feed efficiency was nearly equal. Cattle in the unhoused slatted floor facility in two trials had slightly higher gains than cattle on housed slatted floors and were nearly equal to

(continued on next page)

Table 2. Housed and unhoused confinement facilities vs conventional lots during summer and fall.[a,b]

	Large conventional outside lots	Small conventional outside lots	Housed slatted floor	Unhoused slatted floor	Unhoused concrete floor 3% slope	Unhoused concrete floor 9% slope
No. pens	1	2	1	2	1	1
No. steers	24	20	22	20	10	10
Initial wt., lb	678 (308)	659 (300)	661 (300)	670 (305)	658 (299)	651 (296)
Adj. avg. daily gain[c], lb	2.85 (1.30)	2.30 (1.05)	2.59 (1.18)	2.67 (1.21)	2.55 (1.16)	2.44 (1.11)
Avg. daily feed (DM), lb	19.6 (8.9)	17.0 (7.7)	17.4 (7.9)	17.0 (7.7)	17.0 (7.7)	17.0 (7.7)
Feed/gain	6.89	7.41	6.70	6.43	6.67	6.97
Carcass wt., lb	690 (314)	661 (300)	656 (298)	635 (289)	650 (295)	635 (289)
Dressing percent	58.74	58.52	60.73	59.16	59.16	58.83
USDA carcass grade[d]	12.14	11.85	11.60	11.65	11.50	12.20

[a]Numbers in parenthesis expressed in kilograms.
[b]Trial conducted from July 2, 1974 to December 3, 1974.
[c]Final weight adjusted to dressing percent of 62 based on carcass weight.
[d]11 = high good, 12 = low choice.

Table 3. Housed, unhoused and conventional lots for summer and fall.[a,b]

	Small conventional outside lot	Housed concrete floor flush-flume	Unhoused slatted floor	Unhoused concrete floor 3% slope	Unhoused concrete floor 9% slope
No. pens	2	2	2	1	1
No. steers	20	24	20	10	10
Initial wt., lb	674 (306)	668 (304)	677 (308)	675 (307)	648 (295)
Adj. avg. daily gain[c], lb	2.77 (1.26)	2.83 (1.29)	2.87 (1.30)	2.54 (1.15)	2.52 (1.15)
Avg. daily feed (DM), lb	20.7 (9.4)	21.1 (9.6)	20.7 (9.4)	20.7 (9.4)	22.1 (10.0)
Feed/gain	7.47	7.46	7.21	8.15	8.77
Carcass wt., lb	650 (295)	651 (296)	660 (300)	631 (287)	613 (279)
Dressing percent	57.80	59.50	59.60	60.30	59.50
Abscessed livers, %	20.0	20.8	25.0	50.0	10.0

[a]Numbers in parenthesis expressed in kilograms.
[b]Trial conducted from July 8, 1975 to November 20, 1975.
[c]Final weight adjusted to a dressing percent of 62 based on carcass weight.

Table 4. Conventional outside lots vs unhoused confinement facilities during winter and spring.[a,b]

	Small conventional outside lots	Unhoused slatted floor	Unhoused concrete floor 3% slope	Unhoused concrete floor 9% slope
No. pens	2	2	1	1
No. steers	20	20	10	10
Initial wt., lb	684 (311)	673 (306)	705 (320)	686 (312)
Adj. avg. daily gain[c], lb	1.92 (.87)	2.05 (.93)	1.86 (.85)	1.92 (.87)
Avg. daily feed (DM), lb	21.3 (9.7)	21.3 (9.7)	21.3 (9.7)	21.3 (9.7)
Feed/gain	11.09	10.39	11.45	11.09
Carcass wt., lb	625 (284)	632 (287)	632 (287)	626 (285)
Dressing percent	60.50	62.30	61.40	61.90

[a]Numbers in parenthesis expressed in kilograms.
[b]Trial conducted from November 11, 1975 to April 28, 1976.
[c]Final weight adjusted to dressing percent of 62 based on carcass weight.

Confinement Facilities...

(continued from page 35)

gain for cattle in large conventional lots.

Cattle in the unhoused slatted floor facility had more efficient gains than cattle fed in the housed slatted floor facility and large conventional outside lots, respectively.

Gains for cattle on unhoused concrete floors (3 and 9 percent slopes) gained about 8 percent slower than cattle on unhoused slatted floors and required about 10 percent more feed per unit of gain (Table 5). There was no appreciable difference in rate and efficiency of gain between floor slopes of three and nine percent in the unhoused concrete floor facility.

Cattle in the small conventional outside lots did not gain as rapidly or efficiently as those in the large conventional outside lots (Tables 1 & 2).

There appears to be little if any advantage with a housed concrete floor flush-flume system over large conventional outside lots (Tables 3 & 10).

These results, obtained over a period of two years, indicate that housed confinement facilities do not offer any appreciable advantage in rate and efficiency of gain for finishing cattle over conventional outside lots. They also indicate that cattle in unhoused slatted floor facilities will gain as rapidly as cattle in housed confinement or outside lots and may be more efficient.

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[1]Stanley D. Farlin is Associate Professor, Beef Nutrition. C. B. Gilbertson is Assistant Professor, Livestock Waste Management. Greg Schindler is research technician.

Table 6. Conventional outside lots vs housed slatted floor facility during winter and spring.[a,b]

	Large conventional outside lots	Housed slatted floor
No. pens	6	6
No. cattle	265	267
Initial wt., lb	583 (265)	587 (267)
Adj. avg. daily gain[c], lb	2.47 (1.12)	2.40 (1.09)
Avg. daily feed (DM), lb	19.5 (8.9)	18.7 (8.5)
Feed/gain	7.89	7.79
Carcass wt., lb	608 (276)	604 (275)
Dressing percent	58.92	59.85
USDA carcass grade[d]	12.12	11.85
Yield grade	3.1	3.0
Abscessed livers, %	17.7	16.8

[a]Numbers in parenthesis expressed in kilograms.
[b]Trial conducted from January 15, 1974 to June 25, 1974.
[c]Final weight adjusted to dressing percent of 62 based on carcass weight.
[d]11 = high good, 12 = low choice.

Table 7. Conventional lots vs housed slatted floor facility for summer and fall.[a,b]

	Large conventional outside lots	Housed slatted floor
No. pens	8	8
No. steers	191	186
Initial wt., lb	667 (303)	662 (301)
Adj. avg. daily gain[c], lb	2.80 (1.27)	2.72 (1.24)
Avg. daily feed (DM), lb	19.3 (8.8)	18.3 (8.3)
Feed/gain	6.91	6.75
Carcass wt., lb	679 (309)	669 (304)
Dressing percent	57.53	60.12
USDA carcass grade[d]	11.81	11.78

[a]Numbers in parenthesis expressed in kilograms.
[b]Trial conducted from July 2, 1974 to December 3, 1974.
[c]Final weight, adjusted to dressing percent of 62 based on carcass weight.
[d]11 = high good, 12 = low choice.

Table 8. Conventional outside lots vs housed slatted floor during spring and summer.[a,b]

	Large conventional outside lots	Housed slatted floor
No. pens	4	8
No. steers	108	192
Initial wt., lb	726 (330)	721 (328)
Adj. avg. daily gain[c], lb	2.35 (1.07)	2.35 (1.07)
Avg. daily feed (DM), lb	21.4 (9.7)	21.4 (9.7)
Feed/gain	9.11	9.10
Carcass wt., lb	603 (274)	600 (273)
Dressing percent	58.63	59.28
USDA carcass grade[d]	12.79	12.58
Yield grade[e]	3.4	3.3
Abscessed livers, %	11.1	10.4

[a]Numbers in parenthesis expressed in kilograms.
[b]Trial conducted from April 17, 1975 to July 31, 1975.
[c]Final weight adjusted to dressing percent of 62 based on carcass weight.
[d]11 = high good, 12 = low choice.
[e]1 is most desirable, 5 is least desirable.

Table 9. Summary: Conventional lots and housed slatted floor facilities.[a,b]

	Large conventional outside lots	Housed slatted floor
No. trials	3	3
No. animals	564	645
Adj. avg. daily gain[c], lb	2.54 (1.15)	2.48 (1.13)
Feed/gain	7.97	7.88
Dressing percent	58.36	59.75

[a]Numbers in parenthesis expressed in kilograms.
[b]Trials conducted during 1974–1975.
[c]Final weight adjusted to constant dressing percent for each trial based on carcass weight.

Table 10. Conventional lots vs housed flush-flume system for winter.[a,b]

	Large conventional outside lots	Housed concrete floor flush-flume
No. pens	2	2
No. steers	68	71
Initial wt., lb	847 (385)	828 (376)
Avg. daily gain, lb	2.81 (1.28)	2.88 (1.31)
Avg. daily feed (DM), lb	24.0 (10.9)	23.3 (10.6)
Feed/gain	8.55	8.12

[a]Numbers in parenthesis expressed in kilograms.
[b]Observations made from November 26, 1975 to February 18, 1976 when half of cattle in another trial moved into confinement facility.

Table 5. Summary: Unhoused facilities and conventional lots for finishing cattle.[a,b]

	Small conventional outside lots	Unhoused slatted floor	Unhoused concrete floor 3% slope	Unhoused concrete floor 9% slope
No. trials	4	4	4	4
No. animals	80	80	40	40
Avg. daily gain,[c] lb	2.38 (1.08)	2.55 (1.16)	2.31 (1.05)	2.36 (1.07)
Feed/gain	8.36	7.71	8.49	8.60
Dressing percent	59.00	60.29	60.46	60.04

[a]Numbers in parenthesis expressed in kilograms.
[b]Trials conducted during 1974–1976.
[c]Final weight adjusted to equal dressing percent based on carcass weight.